# Gravitation Correlated with Light

by **Rudolf Kiesslinger**

In memory of
my mother,
*Margarete Kiesslinger*
She helped me grow into the
many worlds in which
we live.



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## If you *expect* a new theory about gravitation or relativity … then this book may not be understandable.

The theory of this book is simple. Not even a new hypothesis has been postulated. Sometimes it looks that we are accustomed that a theory *had to be* "abstract" (in the sense of being difficult to understand). In contrast, the logic in this book *is* less abstract than any alternative "standard theory".
There was no need for any new hypothesis.

For instance: If you are convinced that the *intrinsic structure* of a mass changes when we accelerate its velocity, then you will get in conflict with the theory of relativity presented in this book. Of course, according to **Special Relativity Theory**, the mass increases when its velocity increases (relative to an observer at rest). Hence the statement, that acceleration would not indicate a change of its *intrinsic* structure, seemed to be paradox. However precisely this I will explain to you by the following arguments, though it looks to be in contradictition even to all textbooks.

Whilst standing in a railway station you may see a train in full speed going through. At the moment when the train is passing you see it in its full size, but with increasing distance its size decreases until – if there would be no end of the rail – you see the train shrinking into the vanishing point – relative to you in the station. However via your handy a passenger in the train will ascertain that neither he nor the train had shrunken.

If the train would collide with a standing train then this would be a catastrophe. If however the other train has exactly the same velocity as the first, then both the trains may just touch without any energy transfer, in spite of the fact that the kinetic energy of your train is the same as in the previous case. Of course, relative to a train having the same velocity there exists no kinetic energy. With other words: Relative to the moving train the kinetic energy is zero, relative to a standing train it is not zero.

This means: energy is a *relative* quantity, not an absolute one. A body represents at the same time any energy because its energy depends on the *relative* velocity to the observer.

General conclusions:
A collpasing universe with its habitants will not shrink into a point (in the same sense as a departing train and its passengers do not shrink). The universe is just shrinking when approaching the future – in the view of an observer at rest in the present. The future appears like a vanishing point in the perspective of the present.

Up to this stage Klassic Physics and **S**pecial **R**elativity **T**heory (**SRT**) represent essential the same. However **SRT** makes a lot of additional statements, and for this I will surprise you with the the following statement: The classical theory transforms into the Relativity Theory just by combining it with energy conservation. This means: There is no need for a new formulation above the classical formulation in order to get the relativistic dynamics of movements. The already existing formulation is sufficient. What we have to do is only to insert the parameters of **SRT** into Newtons dynamics. That means: we remain within the equations of the graviational law as it is:

**Gravitational force = $M_1 \times M_2$ divided by $R^2$.**

Marginal note: When the train is disappearing into the vanishing point we silently have assumed that we see the train where it is. In fact however we see it in a shorter distance due to the time the light needs for covering the distance to us. Due to this time we have inserted into the formula a smaller distance to the train, und this we have to account in the calculation. Moreover: Due to **S**pez.**R**el.**T**heory (**SRT**) the velocity of the light is the same regardless of the observers movement.

We accept: 1. the energy due to movement is a relative quantity, 2. according to the **SRT** each energy **E** has a corresponding mass $\mathbf{E/c^2}$ and 3. the mass changes due to its movement. However this change does not effect the intrinsic struture of the mass, it effects "how the mass is seen", this means: *relative* to an observer at rest.

By the so called **Lorentz Transformation** the variable parameters in the formula can be calculated**.**

Of course, all paramenters must refer to one and the same reference system.

If we insert relativistic paramters into Newton's dynamics of movement, then we get – to the surprise for many physicists – exactly the actual *relativistic* movements observed, without any additional assumption.

Of course, introducing relativistic parameters into the law of Newton changes this law in its foundation, however *the formulas remain uneffected*. Only the inserted parameters change**:** The masses are no longer constants, distances and time intervals are transformed relativistically. However these parameters do not change relative to itself, they are changing only in the view of a moving observer. Just one paramter is left unchanged: the velocity of light. It is the same in each reference system.

Though we can state that *distances*, *time intervals* and *masses* are changing relativistically, they remain unchanged relative to *itself*. Changing means "in the view of an observer at rest". With other words: The **SRT** does not describe a change of these parameters relativ to there own – this means: not in its inner structure – it discribes their change in the view of others. Compare this with the train, which (with its passengers) do not shrink itself. However we should bear in mind that no observer can know more than that what can be observed. What a mass is "in itself" remains unknown and ridiculous as before: The universe cannot be explained and not be proved.

The distinction between classical and relativistic physics is not a new set of formulas. In the contrary, the formulas are the same, however the classical defined parameters (*mass*, *distances* and *time*) inserted into the formulas are replaced by their relativistic expression. For instance, the masses, which are constants in classical physics, must be inserted by their intrinsic energy $mc^2$, defined in Spec.Rel.Theory. A mass expressed by the formula $mc^2$ changes when accelerated. By the same law its equivalent energy changes by the energy inserted (or extracted) if a force acts on it along a distance.
If this is observed then the classical theory transformes into the relativity theory. Of course, this requires mathematical routine which may be difficult to learn.

None of the many abstract "standard" theories are needed, especially none of the many not imaginable cosmological hypotheses invented for solving some *special* theorems, but producing a lot of new problems.

If however in the classical equations of dynamics and graviation all parameters are replaced by their relativistic definition according to **SRT**, then, it turns out, many important problems become solved without the need of additional hypotheses or "theorems". This is the subject of the following study.

Some of the most renowned problems to be solved or disproved in this book are the following:

- *Expansion of the universe* (or its acceleration) does not exist (it has *not* been observed).
  The red shift of *fossil* galaxies is not a result of their expansion, it is a *measurable* effect of gravitation."Expansion" and "Big Bang" are wrong interpretations;
- The "Strange Acceleration of Pioneer 10 and 11 is explained;
- "Why is the sky in the night dark? This has a simple explanation;
- "Dark Matter" and "Dark Energy" are explained;
- Black Holes cannot exist;
- Advance of the perihelion of Mercury explained.

The so called "Standard" Theories have been invented for solving these problems just by hypotheses.

The explanations presented in this book do not require any of these hypotheses.

Of course, in order to understand the following Energy Conserving Law of Gravitation the reader may skip some of the detailed explanations if he is mainly interested in the main arguments. Many details shown here are only explained in order to keep apart immaterial critics.

The introduction presented herewith should only prepare the reader for the unexpected simplicity of the theory of gravitation in contrast to the "standard" cosmologies, where the "world" is often "explained" by almost metaphysical assummtions, for instance by some "space geometries".

The reader will not find any of these far-fetched ideas.

*Rudolf Kiesslinger*

# Abstract

All physical principles must be traced back to their roots where relativistic physics, especially gravitation, is fundamentally correlated with the qualities of light. This opens a new window to reality. All measurable discoveries of Einstein are verified, without any new hypothesis or theory – especially without the assumption of a hypothetical source-free field.

The only requirement is application of Special Relativity to *all* empirical facts and to Newton's Law of Gravitation. This means:

*If* **Classical Gravitation** is *adapted* to **Energy Conservation** and **Special Relativity** (**Lorentz Invariance**), *then*

1. this explains without an energy-supplying field (where energy had to be created without any source):
   **a)** *relativistic* orbits of planets,
   **b)** *relativistic* bending of light near large masses,
   **c)** *Gravitational* Doppler Shift.
2. *Additionally*, it reveals new discoveries, which could *not* be explained by General Relativity:
   **d)** events occurring within the Schwarzschild Radius,
   **e)** red shift of fossil light (is *not* caused by expansion of the universe),
   **f)** gravitation is the inverse of the Second Law of Thermodynamics,
   **g)** Calculation (!) of the Hubble Constant.

*All* results are derived from empirical evidence using elementary differential calculus.

# Kurzfassung

Die Ursprünge physikalischer Prinzipien müssen wir in ihren Wurzeln suchen. Es sind die Eigenschaften des Lichts, worauf sich relativistische Physik und mit ihr Gravitation gründet. Das öffnet ein neues Fenster zur Realität. *Ohne* neue Theorien oder Hypothesen, vor allem ohne das Postulat des quellenfreien Feldes, werden Einsteins *messbare* Folgerungen bestätigt,— allein durch *konsequente* Anwendung der Speziellen Relativitätstheorie auf *alle* empirischen Fakten. *Adaptiert* (!) man nämlich das **Klassische Gravitationsgesetz** an **Energie-Erhaltung** und **Spezielle Relativität** (**Lorentz-Invarianz**) dann zeigt sich Erstaunliches:

1. Es erklärt, was bisher nur erklärbar schien mit Energie-Entstehung im Feld ohne Quelle, insbesondere:
   **a)** *Relativistische* Planetenbahnen
   **b)** *Relativistische* Lichtbeugung an Massen,
   **c)** *Gravitations-Dopplereffekt*, führt darüber hinaus
2. zu neuen Erkenntnissen, die bisher durch Allgemeine Relativität nicht erklärbar waren, u.a.
   **d)** was innerhalb des Schwarschild-Radius geschieht,
   **e)** Rotverschiebung fossilen Lichts (die *nicht* Folge einer Expansion des Universums ist),
   **f)** Gravitation ist die Umkehrung des Zweiten Hauptsatzes der Thermodynamik,
   **g)** Berechnung (!) der Hubble-Konstanten.

*Alles* wird mit elementarer Differentialrechnung aus empirisch bekannten Fakten abgeleitet.


## Inviting the Reader for Cooperation

In the last years many astronomers have been confronted with a rising opposition against even the faintest critic on the Big-Bang-Hypothese, and this in spite of the protest of many outstanding scientists. I can quote only some for all: Halton C. Arp, Hermann Bondi, Margaret und Geofrey Burbidge, Al Cameron, William Fowler, Thomas Gold, Fred Hoyle, Jayant Narlikar and many others. Critical letters to the editors where not printed, and in the rare cases where there was a response, the answer was an evasive phrase in place of arguments. Even commercial advertisements have not been accepted when in its text a critical paper is mentioned. What is the advantage for the editors when the reader remains uninformed? Up to now I cannot realize why an editor should be frightened if a science is based on a rational discourse.

Because this paper is also afflicted by the boycott of the editors, I invite the reader to seize any chance for making known the arguments presented in this book for explaining some observations which could not be appreciated before. These arguments need to be discussed, the more, since it seems that they cannot be found in any other publication – due to the editor's boycott.

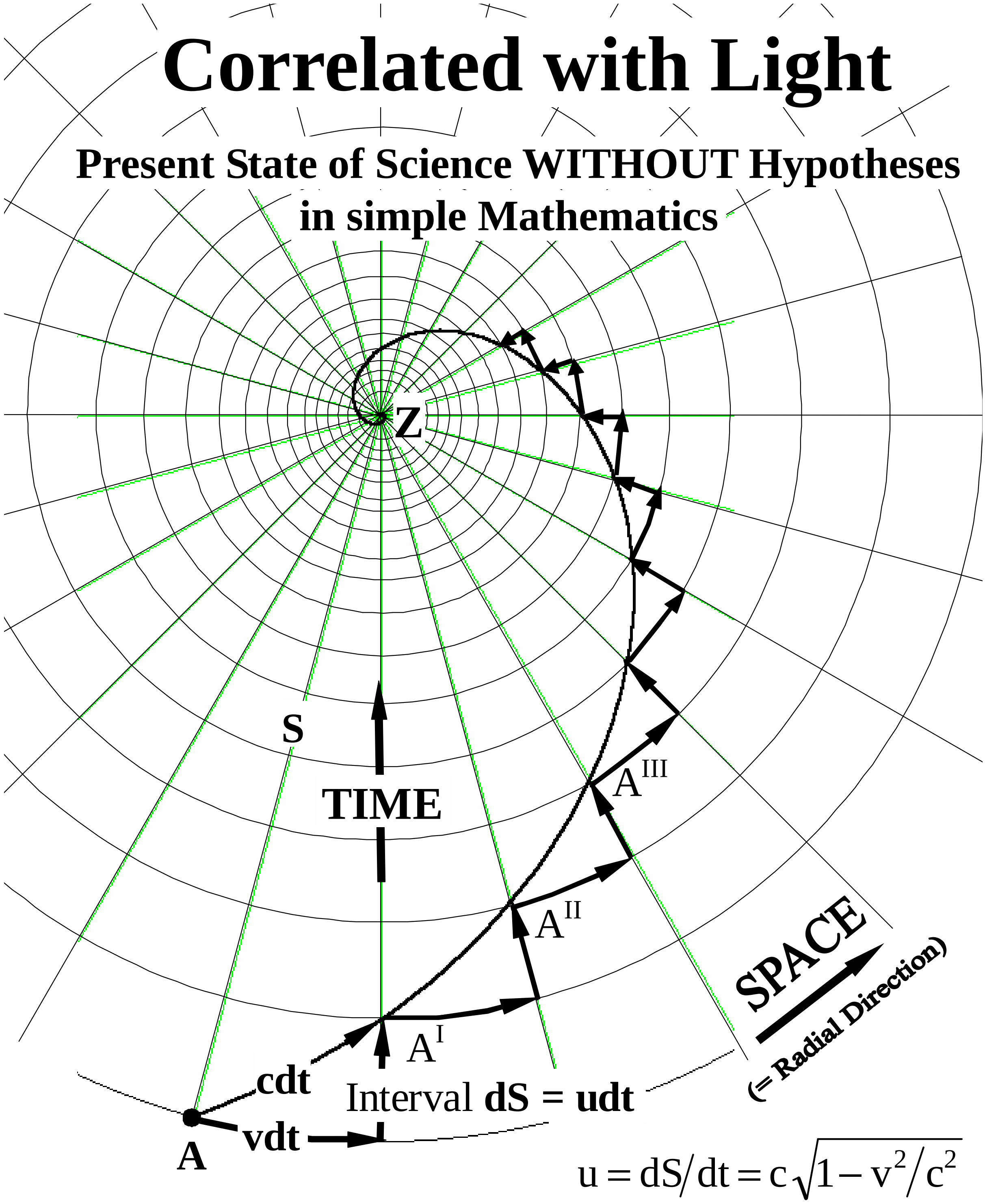
Some scientific findings in this book are presented here for the first time, although they are not new. They are an implicite (concealed) consequence of two established fundamental theories of Physics: the **Special Relativy Theory** and the **Principle of Energy Conservation**. You find on page 106 evidence, that the universe does not expand and neither **Big Bang** nor **Black Holes** are possible. Hubble's measurements of red shift of distant galaxies are explained very simple by these two established theories without any further hypotheses. Of course, if Big Bang and Black Holes have reached the status of a religious key experience then rational theories and measurements have no chance.

*Rudolf Kiesslinger*

# Gravitation

# Correlated with Light

## Present State of Science WITHOUT Hypotheses
## in simple Mathematics




## Derived from Special Theory of Relativity

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For revelation of a substantial error in the Energy-Conserving Gravitational Law a reward of € 25, 000 have been offered. In spite the fair conditions nowbody have delivered any consistent critique.

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# Address to the Critic of this Book

The criticism to this book is old. The author is criticized because he dares to shaken the fundations of the impressiv edifice of modern cosmology, especially Big Bang. He questions even Black Holes. Does he not see that a lot of these objects in the sky have been identified by its mass? Editors of astronomical journals are flooded with theories "of this kind", mostly from authors who proclaim a new interpretation of cosmology.

The criticism is correct in so far as indeed this book offers a new approach to cosmology not found anywhere else. Wrong is the person adressed and wrong are date and meaning of the criticized facts. The facts have been published more than a century ago, 1896, that is before the author of this book was born and even before Einstein had published his famous theory. Hence the critic has not, as he may believe, an easy task with a "misunderstood author", he has to defend his critique against one of the most ingenious co-architects of modern physics, **Ludwig Boltzmann**, attacked by him as rude as Ernst Mach and others did in the past.

This can be understood if it is realized that this book is the result of a formula published as long ago as 1896 by Boltzmann. The formula can be found in Feynman's lectures and in other text books about theoretical physics. It is one of the basic formulas in the kinetic theory of gases. It expresses Boltzmanns visionary idea that all forces responsible for molecular binding are proportional to the molecular *energy*. This is the very prinziple which, a few years later, Einstein has identified as Special Relativity. Of course, at that time this could not be understood in all its consequences. Shortly before, with Maxwell's equations, the relativity principle was introduced in physics by electrodynamics. The crucial feature of Boltzmann's visionary idea is the identity of mass and energy, that means the binding forces within a molecule are proportional to the energy of the molecule (instead to gravitational forces which are defined by their weight). Boltzmann realized that this identity is true *for all central forces*, gravitation included. Consequently, the masses in Newton's gravitational law are by no means constants, they are manifestations of their intrinsic (inner) energy. Of course, this remains true also when Boltzmann expressed the inner energy by the temperature.

Not before recent times some physists begin to realize, though reluctantly, that the intrinsic (the inner) energy, $mc^2$, of a mass decreases precisely by that amount as it acquires kinetic fall energy. This fundamental principle of physics is exemplary explained in text books for the binding energy of an atomic nucleus in a chemical compound. You can find it, for instance, by (1) **Marcus Chown** in his recommendable essay "The Magic Furnace", 1999, Page 81-85, and by (2) **Harald Lesch** in a television serie BR "Alpha-Centauri" 2008, 4, 13. Both autors accept the mass as being the source of the gravitational fall energy, but without considering the disastrous effects of that relativistic principle upon their own "standard theories". (Consequently Big Bang and Black Holes keep on to be the omnipresent spectre in Lesch's TV-serie.) The correct answer needs a visionary like **Ludwig Boltzmann**, who, 1896, a decade prior to Einstein, had calculated that the mass decreases by the mass-equivalent of the energy of free fall (see insert on **Page 83**).

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# Some Formulas Resulting from Energy Conservation

**R = distance of masses to center of gravity [cm], M = central mass [g], a = G(M+m)/c$^2$ or GM/c$^2$ [cm]**
**G = gravitation constant = 6.67·10$^{-8}$ [cm$^3$g$^{-1}$s$^{-2}$], ρ = mean density of the universe [g cm$^{-3}$]**

| | |
|---|---|
| Freier Fall aus Unendlich:<br>*Free Fall from R = ∞* | $\mathbf{v = c\cdot\sqrt{1-e^{-2a/R}}}$, (no Black Holes; only when R= 0 goes v = c)<br>$\cong c\sqrt{2a/R} = \sqrt{2GM/R}$ when R >>a (as in classiscal physics) |
| Gravitationsbeschleunigung:<br>*Gravitational Acceleration* | $\mathbf{b = -\frac{GM}{R^2}\cdot e^{-2a/R}}$, (**Boltzmann's Law**. In classiscal physics is $e^{-2a/R} \cong 1$) |
| Radius des Universums:<br>*Radius of the Universe* | $\mathbf{R_{universe} = \sqrt{\frac{3c^2}{8G\pi\rho}} = \frac{2GM}{c^2}}$ (Definition) (M = mass of the universe [g]) |
| Lichtablenkung durch M:<br>*Light Bending by a Mass,* M | $\mathbf{2\varphi_{(R=\infty)} = -\frac{4GM}{c^2R_o}}$. (R$_o$ = Distance of light ray to the mass, M) |
| Distanz vs. Rotverschiebung z:<br>*Distance* R *versus Red Shift,* z | $\mathbf{R = 5.67\cdot 10^{13}\sqrt{\frac{\ln(1+z)}{\rho}}}$ **[cm].** |
| Hubble-Konstante v$_H$ :<br>*Hubble Constant* v$_H$<br>(v$_H$ defined for R = R$_H$) | $\mathbf{v_H = c\sqrt{1-e^{-8\pi G\rho R^2/3c^2}} \underset{8G\rho R^2<<c^2}{\cong} 2R_H\sqrt{\frac{2}{3}G\pi\rho}} = \frac{R_H}{R_{universe}}c$<br>$R = R_H = 3.1\cdot10^6$ lightyears = **$10^6$ Parsec** = 3.1 10$^{24}$ cm.<br>When ρ = 4 H-atoms/m$^3$, v$_H$ = 60 km/s Mpc. |
| Radius von Quasaren:<br>*Radius of Quasars* | $\mathbf{R = \frac{GM}{c^2\ln(1+z_{rel})}}$. (M = mass of the quasar)<br>(z$_{rel}$ = relative red shift to the associated galaxy) |
| Differentialgleichung der relativistischen Planetenbahnen:<br>*Differential Equation for Relativistic Orbits* | $\mathbf{m\ddot{R} - mR\dot{\varphi}^2 = -\frac{GMm}{R^2} - 3\frac{GMmF^2}{c^2R^4}}$<br>(with Kepler's Law of Equal Areas, $\mathbf{R^2\dot{\varphi} = F}$ = constant) |
| Verlangsamung der Zeit<br>*Time Dilatation* | $\mathbf{t = t_o e^{-a/R}}$ Course of time at the distance, R, of a mass, M. |
| Gravitation am Ort ferner Galaxien *at Distanz R from us* | $\mathbf{b = \frac{GM}{R^2}e^{-a/R} = GAR\rho\, e^{-\frac{G}{c^2}AR^2\rho}}$ (relativ zu uns – *relativ to us*)<br>(das heißt: aus der Sicht von uns – *seen from us)* |

**The theories approach exact gravitation with each additional term**, shown by using time dilatation:

$$t^2 = t_o^2 e^{-2a/R} = t_o^2\left[1 - \frac{2a}{R} + \frac{1}{2}\left(\frac{2a}{R}\right)^2 - \frac{1}{3!}\left(\frac{2a}{R}\right)^3 + - ...\right]$$ .= square of the interval. For comparison:

1$^{st}$ approx'n: ↳**Newton's axiom** - - - - - - contains only the constant 1$^{st}$ term, i.e. t = t$_o$. Time and mass are absolute and independent of gravitation.

2$^{nd}$ approx'n: ↳**Einstein's hypothesis** – terms after the 2$^{nd}$ are neglected (Black Hole when R = 2a). Time decreases too much, mass decreases too little).

3. Exact measurement: **Energy-Conserving Gravitation** – includes all terms (no *Black Hole*) (gravitation alters mass and time by the same factor).

Einstein introduced $\mathbf{t^2 = t_o^2(1-2a/R)}$, this t is a hypothetical „Interval“ which can not be deduced from a theory. In contrast in this book is $t = t_o e^{-a/R}$, not hypothetical but a consequence of energy conservation.

# 1. Did You Know … ?

The question refers to the following two <u>measurements</u>, often quoted, but their implication are mostly ignored:

1. **Red shift of the light of remote galaxies** (at the time of emission, but being unchanged when measured today).
2. Measurement of the **Gravitational Doppler Shift**, i.e the decrease of the frequency of light when "climbing up" a gravitational field (by a factor predicted by Einstein).

The following explanations are based on known physical theories without any new hypothesis. New is only the <u>combination</u> of some *accepted* principles which are scattered through various branches of physics, but up to now not sufficiently investigated with respect of their mutual interaction. <u>Without additional assumptions</u> this text refers exclusively to facts which can be found in common textbooks and which are confirmed by measurements.

## 1.1 <u>Explanation of Red Shift of Remote Galaxies</u>

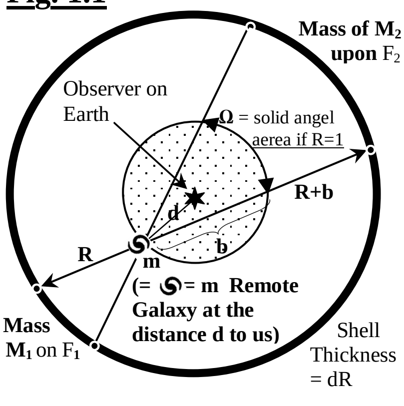
An experiment with clocks published in 1971 by J. C. Hafele and R. Keating [Science 177, 166 (1972)] attracted world-wide attention. For the first time, it was confirmed empirically that a clock slows down when its distance to the gravitational center decreases. Up from 1989 the accuracy of the measurment has been questioned, but at this time its result was already confirmed in an other way – then with extreme accuracy, for instance by the Global Positioning System (GPS). The slowing of time does not depend on the kind of clock if measured with atomic clocks. Atoms are clocks because each atomic resonant frequency is an ideal time standard for synchronizing clocks representing the relativistic definition of time.

**The stronger the gravitational field, the slower the course of time**. *This* is the cause of the red shift for the light from distant galaxies, not expansion of the universe (and not the weak field of the earth and/or the emitting galaxy; both have almost no influence and can be neglected). Proof:

First, it must be emphasized that <u>no</u> new hypotheses and <u>no</u> other physical laws are assumed than those which are known and accepted by *all* physicists and astronomers (including Einstein). These premises are:

1. The gravitation of a spherical, symmetrical mass remains the same when its entire mass is assumed to be concentrated in its center. The proof can be found in any textbook.
2. <u>Inside</u> a homogeneous spherical mass, the gravitation decreases linearly and reaches zero when the distance to the center reaches zero (see the proof in the legend of the drawing below).
3. <u>Fundamental Principle of Cosmology</u>. "*The universe is homogeneous and isotropic*"; this means: All points in the universe are equivalent, no point has a higher priority than any other.
   At any given location, each point is the center of the universe, peripherical points do not exist.
4. <u>Fundamental Principle of Relativity</u>. *In different reference systems, the course of time is different, hence the reading of clocks differs.* To be precise: The course of time *within* a given reference system is the same everywhere, but it differs (measurably) between *different* reference systems (**A**) if their <u>relative velocities differ</u>, *or* (**B**) if the <u>gravitational fields differ</u>. **The stronger the field, the slower time passes**. Result: The closer to center of the field, the greater the red shift of the atomic spectra.
5. Highly precise time measurements based on an atomic resonant frequency.
6. Gravitational force $\mathbf{K = \frac{GMm}{R^2}}$. M and m are the masses in a two-body system. (G is a constant, R = distance between the two bodies)

**<u>Fig. 1.1</u>**




**<u>Assertion of Item 2</u>:** The gravitation of the "shell" masses (shell is *outside* the dashed volume) upon a mass, **m**, at its perimeter is zero.

<u>Proof</u>: (see also **P. 106)** The effects of opposite masses $M_1$, $M_2$ of the "shell" upon **m** cancel mutually. This can be understood if we consider the forces of each layer of the shell upon a mass, **m**, on the surface:

**(a)** The masses at opposite areas of a layer (relative to **m**) **<u>in</u>**crease by $\mathbf{R^2}$, that is, by the <u>square of their individual distances</u>, $\mathbf{R_1}$ and $\mathbf{R_2}$, but

**(b)** their gravitational force upon **m** **<u>de</u>**creases by the square of the *reciprocal* distance, $\mathbf{1/R^2}$, hence, opposite forces cancel mutually.

That means: **the mass outside the sphere exert no gravitation on** its surface.

This argumentation was first used by Cavendish and Priestley in 1771 for proof of the law of electrostatic attraction. Because a charge within a hollow sphere is not attracted by an evenly distributed charge upon the shell, they concluded, the electrostatic attraction must be proportional to $1/R^2$.

Using classical theory, it has been proved that the gravitational force of a spherical mass acts as though the mass were concentrated at its center. If a mass, **M**, approaches the sphere from outside, then the gravitation upon it increases until the surface is reached. After penetrating the surface, the distance of **M** to the center ($\mathbf{R_{inside}}$) is less than the radius, **R**, and the mass will be attracted only by the mass of the inner sphere (the dashed sphere between it and the center), which has the smaller radius $\mathbf{R_{inside}}$. The gravitational forces of the shell (this is the mass between $\mathbf{R_{inside}}$ and **R**) cancel mutually.

*For instance, if the sphere where hollow, then no gravitational force would exist within. Outside the shell, the gravitational force is the same as if the mass of the shell were concentrated in its center.*

Next let us assume the **entire universe** is that sphere. According to a general principle of cosmology no point in the universe has a higher-priority position relative to the others (item 3. above), hence an observer at any point considers *his* location to be the center of the universe. This is often explained in analogy of the earth's spherical surface, where each country can rightfully claim to be the “Middle Empire”.

Next, imagine a large sphere with us in the center. Of course, it is *within* the universe and it is *smaller* than the universe. We call its radius $\mathbf{R_{inside}}$, this is the distance to a remote galaxy, **M**. This gigantic sphere (dashed circle, **Fig. 1.1**) embraces millions of galaxies. Their combined gravitational acceleration (**b**) upon **M** is the same as if all these galaxies were concentrated in its center, where we are. All objects *outside* this sphere belong to the shell, hence they do not exert any gravitational force on the galaxy which is at its surface (moreover, **b** decreases to zero when **R** goes to ∞, as will be proved along with **Equ.3.56 – P. 37**).

If we know the average density of the universe, then we obtain the total mass of that gigantic cosmic sphere by multiplying its volume by the mean density of the universe. With the formula given above (Item 6) we obtain the gravitational force, **K**, of that mass upon the observed galaxy (or the strength of the gravitational field) at the location of the galaxy relative to our point of view.

"Relative to our view" means: the field strength is a *relative* quantity. For some readers this seems to be difficult to understand: It depends on location and velocity of the observer. For instance: For an observer floating in free fall, the field strength is always zero. Another observer, at rest at a distance greater than our distance, attributes to the same galaxy a greater field strength because: the gravitation decreases by the square of the reciprocal distance ($\mathbf{1/R^2}$), but the gravitational mass of that sphere increases by $\mathbf{R^3}$, hence the gravitation is stronger at a greater distance from the center.

**This is the simple explanation of the red shift of a remote galaxy observed by E. P. Hubble, (which is not receding), as explained above in Item 4(B). (See Pages 100–106).**

**Note: If remote galaxies where receding (as many believe), the frequency would have an additional Doppler red shift due to the receding velocity. This would contradict all measurements known to date.**
Please note that the light does not become red-shifted whilst *traveling* along its trajectory, it *has already been emitted* with that red shift (due to the greater gravitation at the time of emission – as stated above). This however is true only relative to our point of view. At the site of its source it is not red-shifted because there, it is compared with the time calibration of the local frequency meter having the *same* red shift. Why is this not self-contradictory? The explanation is simple. The light we receive was emitted a long time ago when the universe was larger and each measuring unit for length – including the wavelength of light – was correspondingly larger. Conversely, the same would be true for light emitted in our milky way millions of years ago if it where observed today in a remote galaxy.
Therefore, the main argument for the Big Bang collapses. It shows just the contrary: The red shift disproves Big Bang and expansion of space, empirically and theoretically. This conclusion rests solely on observation and on accepted theories without any additional assumption or hypothesis. The proof is confirmed by many recent observations not explainable by an expansion of the universe. Such observations with large telescopes where presented by Halton C. Arp, Fred Hoyle and others more than 20 years ago, but to date, all measurements not compatible with the Big-Bang hypothesis have been ignored (or suppressed).
H. C. Arp has done ground-breaking work with these observations.

In the next chapter we will see that a light ray, once it has been emitted, can not change its frequency afterwards, especially it cannot be effected by a gravitational field. Its frequency is determined only by the mass of the emitting atom. An instance is the red shift of the light emitted by an extremely concentrated Quasar.

The increase of gravitation with distance is not surprising because it is easily verified. Due to mutual gravitation, all galaxies of the universe would collapse. The greater the distance relative to an observer, the faster is the *relative* velocity of collapse. For another observer at a greater distance from M, the relative velocity *and* its cause – the acceleration of free fall – would be greater. However the acceleration is nothing else than what we define as “gravitation”. Hence, it is not a contradiction that – in the view of an observer at a greater distance – the gravitation is greater. If we do not *assume* a Big Bang, then we must accept the collapse of the universe. But don't be afraid, there is no danger. It would result in a crash only if the Theory of Relativity weren't true. As explained in the following chapters, the relativistic effects upon length and time prevent the collapse from ending in a crash. In fact, if Black Holes could exist, the universe itself would be a Black Hole. This can be demonstrated by inserting the mass of the universe into the equation of the radius of a Black Hole. The result is the radius of the universe, and we are living *within* that radius!

Now let us consider the second famous measurement. It is based on the same physical principle.

## 1.2 The Gravitational Doppler Effect

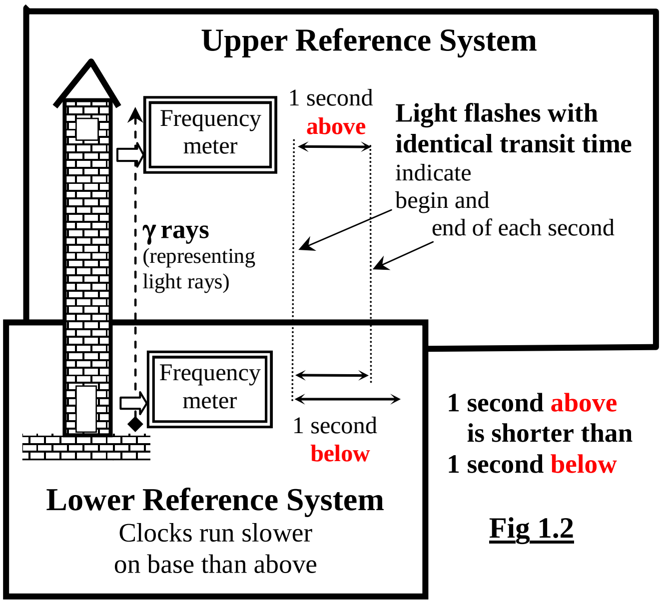



**Fig 1.2**

By using the Mössbauer Effect, Pound, Rebka and Snider verified a frequency change by the gravitational field (1960). For an ascending light ray (represented by a gamma ray), the frequency meter at the top showed a lower reading than a frequency meter at the base – by the factor **$1/(1+\Delta\varphi/c^2)$.** This confirms precisely Einstein's prediction. **$\Delta\varphi$** is the increase of the potential energy when raising a *unit* of mass from the lower to the higher point.

**$\Delta\varphi/c^2$** is the mass equivalent of **$\Delta\varphi$**.

If, conversely, we consider a descendin*g* photon (which is only kinetic energy), then, according to the *common* (wrong) explanation, the photon acquires additional kinetic energy from the *field* analogous to a falling stone. Now we will prove that the explanation with field energy is incorrect. The correct statement must be:

**The energy of photons (the frequency) is not affected by the gravitational field** (see next Page)**.**

A light ray can escape even the strongest field *without loss of energy*. This means:

**Once more, the mere possibility of Black Holes is refuted.**

Such a statement puts the advocates of Black Holes and Big Bang on the warpath, however it is easily verified by another discovery of Einstein in the following way:

According to Einstein, the course of time is at the base slower by the factor $1/(1+\Delta\varphi/c^2)$ than it is at top. This has been measured (Hafele & Keating 1971, than with increasing accuracy by the University of Maryland 1976, and others): one second lasts longer at the base by the factor $1+\Delta\varphi/c^2$ compared with one second at the top.

If (and only if) the frequency does not change, the instrument at the base will count as much more oscillations per second as the second at the base is longer. Exactly this has been measured. This means: When the instrument is shifted from one location to the other, then its reading does not indicate a frequency change of the light (or γ-ray), but it shows that the instrument's clock follows the course of time at the new location. The "higher frequency" *measured* at the base confirms that the clock at the base follows the slowed course of time at the base. A frequent error in the argumentation lies in the comparison of two measurements made in different reference systems. Comparing measurements does not make sense if each reading refers to a different reference system. "Frequency" is a relative quantity which differs when the reference system is changed. It differs because the course of time changes.

At this stage of argumentation, the advocates of Big Bang and Black Holes stop the discussion. They insist that the two frequency meters (its clocks) are in the *same* reference system because "due to physical principles, it is impossible to distinguish between the two systems". They argue that the different locations of the two frequency meters present different *parameters* of the space-time geometry within the *same* reference system, and that these parameters define the gravitational field. However this argumentation is incorrect.

John A.Wheeler, a major advocate of the theory of Black Holes* (*"Gravitation und Raumzeit", Spectr. Verlag 1989), Page 174)* synchronized the clocks by indicating begin and end of each second by light flashes initiated by the upper frequency meter. (In another text, Wheeler mentioned the change of mass in a gravitational field, however this was not taken into account in the theory about Black Holes.)

A reference system is *defined* by synchronized stationary clocks at *all* locations. If the second of the lower frequency meter is calibrated by the light flashes from the upper frequency meter, then one will measure the *same* frequency for gamma rays at both locations. (The transit time and the frequency of the light flashes is immaterial because they cover the same height (distance), whether they are transmitted at the start or the end of each second.)

The slower course of time at the base shows that a **falling mass** decreases by exactly the same factor as the passing of time slows down. This is a consequence of Einstein's definition of distance by the transit time of light covering it. Therefore the precise timing of the atomic clock is proportional to its mass.

If you favor a more theoretical explanation then you can proceed in the following way:

**Because a mass m defines gravitation, any change of the field strength is proportional to the mass.**
**A mass is proportional to $E = mc^2$ (Special Rel.Theory) and, in accord to Quantum Physics, $E = h\nu$**
(**h** is the Planck Constant, $\nu$ is the number of oscillations per second)**.**
**The theory states: these oscillations are correlated with any mass and can cause external effects if the mass or parts of it, for instance its atoms, get in resonance.**
**Each cycle of the oscillation has the same minute energy h ($= E/\nu$)** (h = Planck Constant)**.**
**For *any* mass we can write: $E = mc^2 = h\nu$, with a corresponding resonance frequency $\nu = mc^2/h$.**
**So the number of oscillations per second defines both:**
**the *energy* $mc^2$ of the mass m (m is the cause of the field) and the *duration* of the second. Conclusion:**
**The length of the second and the mass are proportional (because they change by the same factor).**

Upper and lower reference system can easily be distinguished. Lack of care with frames of reference is common in texts about relativity and has led to many ritualized fallacies, for instance, Big Bang.

The *measured* frequency for the light ray becomes less if we (with the instrument) ascend the tower. This is not an effect of the rising light ray: *the frequency is already less* at the base due to the lower mass of the emitting atoms near the gravitational center. The length of a second on top is greater than it is at the base.

However the advocates of Big Bang and Black Holes claim that I still don't understand their argumentation. They argue that the lower frequency meter cannot be calibrated with the second of the upper one because it is not allowed to measure the incoming light using a re-calibrated instrument. True can only be what has been measured by the lower frequency meter, that is, **the higher frequency** according to their theory, however that would confirm that the field is the source of additional energy when light "falls".

But such argumentation turns even worse for the advocates of Big Bang and Black Holes. Nobody can object to calibrate the upper frequency meter by a well-defined number of oscillations of, let us say, caesium atoms inside the instrument. Now let us assume a *solitary* pulse emitted from the upper instrument having exactly the number of oscillations which defines one second by the frequency of the caesium atom. In advance, an *identical* frequency meter has been moved from the upper position to the lower one, together with its caesium atoms. Then, independent of the gravitational field, that instrument can measure nothing other than that single pulse having exactly the *same* number of oscillations as above. Within the same second, it will count exactly the same number of oscillations as above, which are evenly distributed in the one-second interval due to the identical definition of that interval. Hence the advocates of Big Bang and Black Holes have the following problem:

How will they explain that *actually,* a *higher* frequency has been measured – as they themselves insist? At best they could postulate that only the first oscillation of that pulse propagates at the velocity of light and the following ones move faster than light, because only then could the last oscillation arrive before the one-second interval is over, and in the remaining interval, additional oscillations could be inserted.

There exists only one other explanation for the higher frequency measured, the explanation by Gravitation with Energy Conservation, shown in the next section.

But first a comment: Einstein considered his General Theory of Relativity as a compelling consequence of just two cosmological principles, **Homogeneity** and **Isotropy** of the universe ("the mean mass density is the same at each location and in all directions". Now the zealous Big-Bang advocates have used these principles as an argument against energy conservation in the law of gravitation, however they did not realize that these principles are *also* compatible with energy conservation. Einstein's conclusion was possible only due to a hidden third hypothesis, stating that the "field" would be the source of the gravitational energy. This has been considered as "self-evident" instead recognizing it as a hypothesis. If however the source is not the "field", but the falling mass is, as proved in Ch.1.1 + 1.2 by measurements, then this principles lead to the same conclusion: *gravitational energy is conserved*.

## 1.3 Gravitation with Energy Conservation

Newton was aware of the conflict between energy conservation and gravitation. When pondering about the problem of how to adapt the Law of Gravitation to energy conservation, he recommended further research. However that was not feasible prior to Einstein's discovery of the equivalence of mass and energy in 1905. It is difficult to understand why Newton's advice has not been tried for almost a century after Einstein's discovery (except by E. A. Milne, who unfortunately used the incorrect hypothesis of an expanding universe).

In order to rule out any prejudice right from the start, I not will rely on a *theory* but on generally accepted *measurements*. Readers not familiar with the differential calculus may skip the following derivation and may just trust my calculations. The following two facts in Einstein's theory are considered as accepted:

**When approaching a central mass,**
**(1) the force of gravitation increases, and**
**(2) inversely the course of time is retarded.**
**This means: The stronger the field, the slower a clock will run.**

The rate of a clock is (and can only be) calibrated by comparing it with an atomic resonant frequency.
On the other hand the **resonant frequencies of an atom are precisely proportional to its mass**.

Hence *atoms are clocks*. Whenever the atomic resonance frequency decreases, then its mass must also decrease by the same factor and vice versa, though (as will be explained later) *relativistically*, that is, in the view of an observer remaining at rest (relative to the measuring devices).

This is the result of the clock experiment (Hafele and Keating i.a.). It proves that a falling mass, **m**, decreases by the factor $\mathbf{f(R) = 1–\Delta\varphi/c^2} < 1$, where $\mathbf{\Delta\varphi}$ is the decrease of the Potential (= energy per unit of mass!). Because the kinetic energy increases by the same $\mathbf{\Delta\varphi}$, it follows that the source of the potential energy is the falling mass, **not the gravitational field** of the central mass. At $R = \infty$ is the energy of the original mass $mc^2$, at $R < \infty$ is the mass decreased by a factor $\mathbf{f(R) < 1}$, hence the remaining mass is smaller: $\mathbf{mf(R) < m}$.

For simplification, let us assume a two-body system, and:
m falls to the center of gravity, where the observer is at rest. **f(R)** is to be found.

*The relativistic distance,* **R**, *of the mass to the center of gravity is defined by the transit time of light.*

**(1.1)** The **total potential energy** = $\mathbf{[M+m]c^2}$. The **remaining potential energy** at the distance R is

**(1.2)** $\mathbf{E_{pot} = [M+m\cdot f(R)]c^2}$ where $0 < \mathbf{f(R)} < 1$. Because $\mathbf{E_{kin} = \left|\int_\infty^R K dR\right|}$ and $E_{pot} = (M+m)c^2 – E_{kin}$,

The derivative with respect to distance **R** is the **"Energy converted from $E_{pot}$ to $E_{kin}$ per unit of R"**:

**(1.3)** $\mathbf{|K| = \left|\frac{dE_{pot}}{dR}\right| = mc^2 f'(R).}$ The factor **K** of energy conversion is called "**Gravitational Force**".

If the mass is defined by its gravitational *function* in Newton's Law of Gravitation, then it has the value **mf(R)**. Thus, the mass is not a constant. This is typical for a relativistic quantity, especially for mass (whose dependency on velocity is generally accepted). It may come as a surprise that masses at rest and distances have never been introduced as *relativistic* quantities in the Law of Gravitation. This we shall do now:

**(1.4)** $\mathbf{K = G\frac{M\cdot mf(R)}{R^2}}$ **and** $\mathbf{E_{pot} = (M+m)c^2 - \int_\infty^R KdR,}$ **hence** $\mathbf{|K| = \left|\frac{dE_{pot}}{dR}\right|.}$ **Equ.(1.4) = Equ.(1.3),** because the energy for dropping Equ.(1.4), is supplied by the intrinsic energy Equ.(1.3), of the **dropping mass** m (not the "space" or "field").

$$\mathbf{G\frac{Mmf(R)}{R^2} = mc^2 f'(R),}\quad \textbf{in other arrangement}\quad \mathbf{\frac{f'}{f} = \frac{GM}{c^2}\frac{1}{R^2}.}$$

The left side is the derivative of lnf(R), integration of the right side yields $-\frac{G}{c^2}\cdot\frac{M}{R} + \text{const.}$

Integration from $\infty$ to R: $\mathbf{\ln f = -\frac{G}{c^2}\frac{M}{R}}$. Inserting this into the exponent of the base, **e**, we obtain:

## The Energy Conservation Law of Gravitation = Boltzmann's Law:

**(1.5)** $\mathbf{f(R) = e^{-a/R}}$ (Boltzmann) where $\mathbf{a = \frac{G}{c^2} M}$, $\mathbf{f(R) = e^{-a/R}}$ [$f(0) = 0 < f(R) < f(\infty) = 1$]

inserted into Equ.(1.2) + (1.4): (Please notice the framed **footnote*** below)

**(1.6)** $\mathbf{E_{pot} = (M+m\, e^{-a/R})c^2}$,

**(1.7)** $\mathbf{t = t_\infty / e^{-a/R}}$ = time interval at $R < \infty$
$\mathbf{t_\infty}$ is the same interval at $R = \infty$

and with the condition $E_{kin} = (M+m)c^2 - E_{pot}$:

**(1.8)** $\mathbf{E_{kin} = mc^2(1 - e^{-a/R_o})}$ and

**(1.9)** $\mathbf{K = G \frac{Mm}{R^2} \cdot e^{-a/R_o}}$ **Boltzmann's Law**

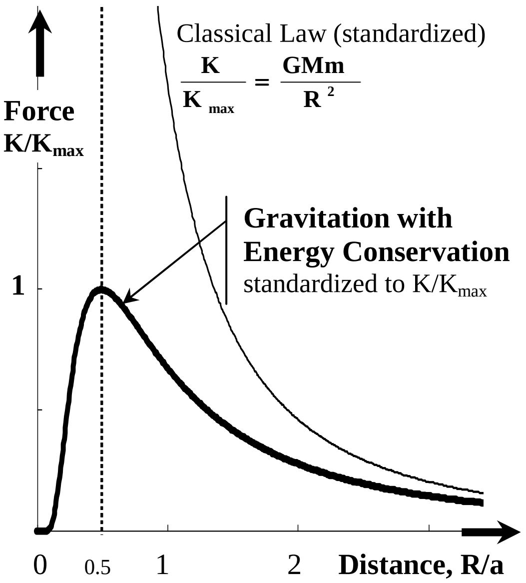
Since the time proceeds more slowly by $1/e^{-a/R}$, the mass decreases by the factor $e^{-a/R}$ according to the clock experiment of Chapter 1.1.

## Symmetry of the Masses M and m

In Chapt. **3.3**, **Page 23**, it will be proved that R must be defined as the distance to the common center of gravity, hence R is different for the masses M and m. That means that M, the central mass, also decreases by the factor $e^{-a/R}$, but here, $\mathbf{a = Gm/c^2}$ instead of $\mathbf{GM/c^2}$. If, however, we substitute the entire distance between M and m for R, then $\mathbf{a = G(M+m)/c^2}$. Thus, the formula is symmetrical with respect to each mass.

## 1.4 Graph of the Gravitational Force

The reader may experience the same surprise I had if he too, step by step, realizes that this adaptation converts the Classical Law into the General Theory of Relativity, **without using the hypothesis of field energy outside a mass (as an effect of the curvature of space)**. It turns out that there is no need for defining the empty space (or the vacuum) as additional source of energy as assumed by Newton and Einstein.




The diagram shows the gravitational force at extremely small distances, possible only if the masses are compressed to less then the so-called **Schwarzschild Radius**, 2a. (For the mass of the sun, is a = 1484 meters; of the earth 4.5 mm). For greater distances, the two curves approach asymptotically until they cannot be distinguished. That explains why classical and relativistic orbits are almost identical.

Even if the distance of two masses would decrease to the Schwarzschild Radius or less, the result would not be a Black Hole because the masses turn into kinetic energy which has no gravitation in the direction it moves, as shown in the diagram at left. Upon such a collapse, the *central* mass, M, decreases. Due to the impact, a part of the mass – with its kinetic energy – may be reflected out of the center along the axes; the other part is transformed into radiation (**Gamma Burst** and other frequencies). A considerable part of the collapsing mass may escape into space.

**Fig. 1.3 Gravitational Force** (additional details on **Page 21**. See also the plot on **Page 83**.)
(Each curve standardized to $K/K_{max}$).

The difference between the Classical Law and the Energy-Conservation Law of Gravitation precisely reflects the transformation of Potential Energy into Kinetic Energy relative to an observer at rest. This is shown even more impressively in the formulas of the next chapter.

*) $\mathbf{m = m_0 e^{-a/R_o}}$ is called **Boltzmann's Law** because in the 19th century it was found by Ludwig Boltzmann (within his theory of heat). By expressing the masses by their energy he proved that it is true for all conservative forces in the universe, hence it must also be true for gravitation. See **explanation on Page 83**)

## 1.5 "The Small Difference" between Classical and Einstein's Theory

When Einstein established his famous "Field Equation", he adopted from the Classical Potential Theory the *postulate* that the gravitational energy *emerges* from "space". From that he concluded: If the distance to the gravity center increases from R to infinite, then any *time interval* decreases from $t_o$ to t according to

**(1.10)** $\mathbf{t^2 = t_o^2\left(1 - 2GM/c^2R\right) = t_o^2\left(1 - 2a/R\right)}$ **postulated by Einstein** (see **Page 16**, explained on **Page 98**)

This formula is not evident, nevertheless it is added to the *postulate* that the gravitational energy has no source. Obviously Einstein realized that it is not derivable from any other assumption. A different assumption would result in a different formula. However Einstein's vision *leading to that formula* has turned out to be an ingenious stroke because its outcome has been confirmed by measurements which are very convincing. For about eight decades up to now, it seems that no one has dared to doubt its results.

However, the time interval (1.10) cannot be postulated at all because, according to Energy-Conserving Gravitation, it *is* already defined – by a formula other than that proposed by Einstein:
**Equ.(1.7), Page 6,** shows that mass and time change by the same factor, $\mathbf{e^{-a/R}}$. Clocks can be synchronized with any spectral frequency representing the transition between defined energy levels of the atom. The transition of <u>energy</u> is identical with an equivalent change of <u>mass</u>. Due to its mass, each atom is a clock synchronized with the course of time. If, at the distance, R, from the mass, M, a time interval is $t_o$, then, at infinite distance, that interval was less, that is $\mathbf{t = t_o e^{-a/R}}$.

In order to make this comparable with the squared interval derived with Einstein's postulate, we have to square the formula, $\mathbf{t^2 = t_o^2\, e^{-2a/R}}$ , then expand it in a series. Underneath, we write the corresponding terms of **(1)** Newton's axiom of absolute time, **(2)** Einstein's interval, and **(3)** the measurement:

**<u>Equ. 1.11</u>**

$$\mathbf{t^2 = t_o^2 e^{-2a/R} = t_o^2\left[1 - \frac{2a}{R} + \frac{1}{2}\left(\frac{2a}{R}\right)^2 - \frac{1}{3!}\left(\frac{2a}{R}\right)^3 + - ...\right]}$$ = squared interval. The result compared with:

1. Approx.: ↑**<u>Newton's Axiom</u>** - - - contains only the constant 1st term (time and mass are absolute and independent of gravitation).

2. Approx.: ↑**<u>Einstein's Hypothesis</u>** - all terms after the 2nd one are neglected (Black Hole at R=2a). Time runs too slowly, mass decreases too little.

↑

3. Confirmed by measurement: **<u>Gravitation with Energy Conservation</u>** with all terms (no Black Hole). Mass and time are altered by gravitation with the same factor.

The differences between these three theories will be clear at a glance. It can be seen why the first two approach the correct result if the neglected terms are inserted successively:

**1. <u>Newton's absolute time</u>** results when all terms except the constant first one are neglected.
Newton's time is absolute, $t = t_o$, because it is independent of the distance to the center of gravity.

**2. <u>Einstein's hypothetical interval</u>** results if the negative second term, –2a/R, is included. It is a very small correction because that term is extremely small for $R >> 2a = 2GM/c^2$. When the mass of the sun is M, then $2a = 2GM/c^2 \cong 3$ km, the distance to the earth is 150 million km; hence, the orbits in Einstein's General Relativity Theory and in Newton's Theory are almost identical and already highly accurate. The scarcely measurable deviation from Newton's Law was a brilliant confirmation of the interval postulated by Einstein. A proper postulate could hardly be imagined even by Einstein, or seemed to be somewhat metaphysical because it would never be measurable within the irregular disturbances caused by other planets.

However, substantial deviations appear near the so-called Schwarzschild Radius $\mathbf{R = R_S = 2a}$. For that radius, Einstein's formula results in $\mathbf{t = t_o(1–2a/2a) = 0}$. This corresponds to a standstill of time at $\mathbf{R_S}$ **(> 0)**, and with **t = 0** the formula $\mathbf{t = t_o}\sqrt{1 - v^2/c^2}$ **= 0** is true only for **v = c** = velocity of light. So in Einstein's theory, the distance $\mathbf{R_S}$ defines the surface of a Black Hole where "not even light can escape".

3. However **with energy conservation**, the terms of higher power are not neglected. Here, each time interval obeys the formula $\mathbf{t = t_o e^{-a/R} > 0}$ for *all* $\mathbf{R > 0}$. This means: $\mathbf{t = 0}$ and $\mathbf{v = c}$ is true *only* if $\mathbf{R = 0}$ so **the mere possibility of the existence of a Black Hole is disproved**.

Another consequence of neglecting the terms of higher power is a distortion of the geometry of space. If time intervals become zero at $\mathbf{R_S > 0}$, then the corresponding length must decrease by the same factor because, for light, the quotient of length and time must be the constant velocity of light.

The common theory has been deduced in a very different way where the existence of terms of higher power remained concealed. These terms are concealed in the formalism of the starting condition, e. g. **Equ.(5.4)** of the Special Theory. In prevalent interpretation, a mass can be accelerated to a higher velocity only by an energy input, dE, from outside by applying a momentum d**P** (explained on **Pages 68-69**).

## Conclusions

The wealth of unexpected results of Gravitation with Energy Conservation makes it impossible to present a general view within a reasonable time. In order not to confuse the reader by a lot of accumulated results, I have first selected some evident and convincing findings. Later, starting at Chapter (3), the mathematical conclusion reveal a general view. Step by step it may become clear why the definition of mass by Equ.(1.5) to Equ.(1.9) is in accordance with all observations and also with all *observable* statements of the General Theory of Relativistic Gravitation. According to measurements, the hypothesis of a source-free field is replaced by the principle of energy conservation. The effect upon the formulas for $\mathbf{R >> a}$ is very small, just by the factor $\mathbf{e^{-a/R} \cong 1}$ when compared with Einstein's General Theory. The deviations are great and dominant only when **R** drops to near the small distance **2a**. For distances considerably greater then 2a, the resulting formulas can be considered identical to those of the theory of Einstein or the classical theory. The factor $\mathbf{e^{-a/R}}$ does not change by differentiation.

## 1.6 Relativistic Orbits of Celestial Bodies, Light Deflection by Large Masses

The majority of physicists became convinced of Einstein's General Relativity Theory of Gravitation by two arguments. First, the advance of the perihelion in the orbit of the planet Mercury could be explained using the postulate of the squared time interval quoted above:

**Equ.(1.10)** $$t^2 = t_o^2\left(1 - 2GM/c^2R\right) = t^2\left(1 - 2a/R\right)$$ (G = gravitational constant)

When compared with some competing theories, the breakthrough in favor of Einstein's theory was the prediction of another effect not resulting from any other theory, that is, the deflection of light on the edge of large masses. Near the sun, Einstein predicted an angle twice as large as calculated using the classical theory, and this was verified in a measurement by A. Eddington during an eclipse.

If we repeat the calculation using Energy-Conservation Gravitation, then we obtain the same results Einstein did for two effects: the advance of the perihelion and the deflection of light, however each with much simpler calculation. Moreover, by including energy conservation, we find an additional result which would be difficult to obtain using Einstein's theory: that is, calculation of the shape of the gravitational field of kinetic energy. According to Special Relativity, mass and energy are equivalent. Any mass, **m**, is energy expressed by the formula $\mathbf{E = mc^2}$, and any energy is mass, $\mathbf{m = E/c^2}$. (If we define our units in a way that the velocity of light, $\mathbf{c = 1}$, then we can write $\mathbf{E = m}$, as often preferred by Einstein.)

If the energy is the intrinsic substance of a body, then the *shape* of the gravitational field can be calculated simply as the sum of its parts. However, if we are dealing with free energy – e.g. kinetic energy – then the question of the shape of its field is not so simple.

First, we have to realize the following: If a mass is defined by inertia, then – according to Special Relativity – a body simultaneously has two different inertial "masses": a "longitudinal" and a "transverse inertial mass", depending on whether it is accelerated in the direction of its movement or transverse to it. The one has a three-fold difference to the "mass at rest". Each one must have a gravitational field (like any mass); hence, for one and the same body, two different gravitational fields must exist. How can this be explained? If an explanation exists, then it must be hidden so perfectly that most physicists are not aware of it, as can easily be checked by an inquiry.

**The meanting of „Longitudinale" und „Transversale" mass is explained on page 110.**

However, when energy conservation is included, then Gravitation distinguishes itself from Einstein's gravitation in just one respect: It is free from the extremely complicated distortion of space near the singularity at the Schwarzschild Radius, where the velocity of a falling body would reach the velocity of light. However, this singularity and with it, the associated distortion of space, disappears when energy conservation is taken into account. This simplifies the sophisticated mathematical description drastically even for large distances. The correlated mechanism of the theory, which up to now has been hidden in unintelligible explanations with abstract quantities, becomes transparent at once for the physicist. He need not rely on a formal logic which is extremely difficult to control or even imagine.

When energy conservation is combined with special relativity, then "mass" cannot be defined by inertia as in classical theory, because both its intrinsic quantities are already defined: **mass** by energy, and **energy** by gravitation. Of course, the order of the definition can be changed, however two different definitions cannot be used for one and the same quantity, for instance for mass.

Using energy conservation, the gravitational field of kinetic energy can be calculated. It has two different values: it is zero in the direction it moves, but precisely that part of gravitation which is missing in this direction is added in the orthogonal direction where it has twice the value. Moreover: If the body acquires its kinetic energy through acceleration by using external energy, then the gravitation of that *inserted* energy must be added in both directions (due to its spherical symmetry). If, however, the body has been accelerated at the expense of its own mass, then the external energy inserted is zero, hence there is nothing to be added.

These results are new for physicists. (See the derivation in Chapters **3.4 + 3.5**, Pages **24–27**).

Now, two remarkable consequences of the dependence of gravitation on direction should be mentioned:

**1. The advance of the perihelion** of planetary orbits. **2. Two-fold light deflection** near large masses.

For light, this is self-evident because light consists only of kinetic energy, whose gravitation transverse to its direction of travel is twice as much as that of an equivalent mass. (In classical theory, the field of the kinetic energy would have a spherical shape.)

## 1.7 The Finite Radius of the Universe

When calculating the force of gravitation upon a remote galaxy as shown in the Chapter 1.1. (**Explanation of Red Shift of Remote Galaxies)**, the result as seen from the earth may be a surprise.

According to the Classical Law of Gravitation, gravitation grows without limit as the distance increases. Not so with Energy-Conservation Gravitation as calculated using **Equ.(1.9)**. Initially, this equation also shows an almost linear increase in gravitation when the distance increases; however, at very large distances, the rate of growth decreases until – at several billion lightyears – it reaches a **maximum**. After that, it drops asymptotically to zero [see calculation in Chapter **3.10**, P. **36**ff, **Equ. (3.56)**, and also the **plot on P. 84**].

It makes sense to define the distance to the maximum as "**Radius of the Universe"** because it would be difficult to find another *general* definition for *all* the various celestial bodies. Most celestial bodies are gaseous without a discrete surface. In order to define a proper "surface", let us observe a falling body. When the distance decreases, the gravitation increases and reaches a maximum at a distance, **R**, and then the gravitation declines, reaching zero at the center. The distance $R_0$ where the gravitation reaches its maximum, can be defined as "Radius". The same definition can be used for the radius of the limitless universe.

Using that definition, we find the radius $R_0$ of the universe depends only on the square root of its reciprocal mean mass density, $\rho$, according to the following equation (see **P. 38**):

**(3.58)** $$\mathbf{R_0 = c\sqrt{\frac{3}{8G\pi\rho}}}$$ (c = velocity of light, G = gravitational constant).

If we calculate the mean **density $\rho$ of the universe** using the assumed mass of all *visible* celestial objects, then we get for $\rho$ about one hydrogen atom per cubic meter. However, with additional dark matter, we must assume a density substantially greater. If it is four times greater, then, using Equ.(1.9), we obtain **16 billion lightyears** for the **radius of the universe**.

That is about the same as has been assumed using the common hypotheses of an expanding universe.

## 1.8 Cosmological Consequences: Gravitation is the Inverse of the Law of Entropy

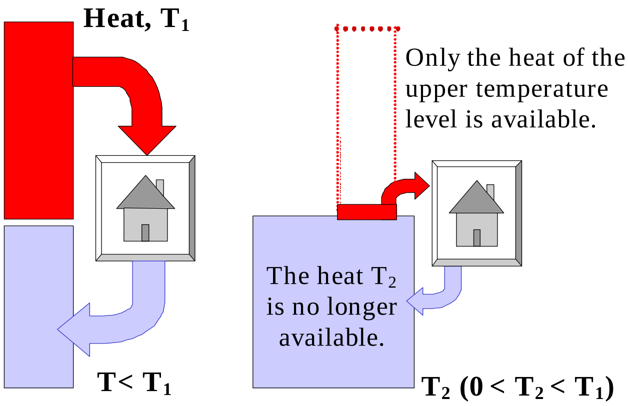



**Fig. 1.4**

The theory of heat is subject to the

**$2^{nd}$ Law of Thermodynamics.**

It states: From the total heat, **Q**, of a closed system, only the fraction **E** between the temperatures $T_1$ and $T_2$ can be extracted and used, for instance as mechanical energy, but not the heat between the lowest possible level, $T_2$ and $T = 0$. This means: The maximal energy extractable from **Q** is the fraction

$$\textbf{(1.12)}\quad E = Q\,\frac{T_1 - T_2}{T_1}\quad \text{(Carnot's efficiency).}$$

From this, a cosmological conclusion has been drawn by W. F. H. Nernst (and Lord Kelvin): If in the far future all stars cool down to the **lowest temperature level** $T_2$, then the universe will die the "heat death" because no further temperature gradient exists: $T_1 - T_2 = 0$. Then energy is no longer available, the prerequisite for life no longer exists.

**Fig.1.4** shows that all the energy consumed by living beings ultimately reaches the lowest temperature level, $T_2$, from which it cannot be extracted. After the universe has reached that state, no life is possible forever. Of course, there have been doubts (by Nernst's friend S. Arrhenius and others) as to whether such a consequence of the $2^{nd}$ Law of Thermodynamics would also apply to cosmic processes, and at all times.

Now suddenly, with Energy-Conservation Gravitation, such doubts are confirmed. This law is the cosmic process which reverses, in the long run, the $2^{nd}$ Law of Thermodynamics. This is a consequence of a fundamental physical principle stating that the qualities "energy", "mass" and "gravitation" cannot be separated. If one of these qualities exists, then each of the others must also exist, with its correlated quantities. These quantities determine the dynamics of that system. Regardless of the kind of energy, each energy has an equivalent mass, with its correlated gravitation. Heating a body increases both its mass and its gravitation, proportional to the heat. **If that body acquires kinetic energy by gravitation, then this is at the expense of its total mass, including that part of it which is heat, and that heat may be at the lowest temperature level, where it is not extractable by a thermodynamic process.** This means:

**Falling is the inverse function of the Second Law of Thermodynamics**.

This changes our view of the world fundamentally. Now, without conflicting with the principles of physics, the following new interpretation of the known observations is possible and conceivable:

Within galactic systems, new stars and planets are formed by gravitational aggregation of matter dispersed in clouds throughout space. In some planetary systems, conditions may become advantageous for living organisms. For millions of years, the stars have been radiating their energy whilst approaching the galactic center in large spirals. Statistically, part of their momentum continually returns into the galactic periphery, hence the masses must ultimately fall into that center. That may be accompanied by more-or-less violent explosions where most of the collapsing masses are radiated or ejected in the form of particles, similar to a large fountain. The path with the fewest obstacles for such ejection is the galactic axis of rotation, the other directions may be blocked by centrifugal forces, collapsing masses and magnetic fields.

Each ejected mass can again become raw material for new stars and we can conclude:

**The center of the galaxis is a recycling machine for stars!**

That is a concievable process, however at least two questions remain: Does any mechanism or physical principle exist which can transform radiation back into a bodily mass? Is Cosmic Background Radiation (particles included) perhaps a remnant of the past?

It may be worthwhile to ponder about this.

# 2 The Assumptions of Physics

Without mentioning it, we have assumed classical and relativistic principles, for instance: energy conservation, the classical axioms of Newton, also the absolute constancy of the velocity of light with its relativistic implications. However, not providing precise definitions does not imply ignorance or unawareness. Rather, it expresses the insight that definitions without a simultaneous understanding of the meaning of words may turn out to be tiring. The author does not see any sense to answer questions before the reader has an idea – correct or not – of the objects about which we are speaking and to which we can refer a question or definition. Is our physical concept of the world the outcome of a linear piling-up of knowledge in our brain, or rather a continuous creative process, including retrospection, where we compare yesterday's experience and ideas with today's questions, giving our mind the chance to grow progressively through mental reflection?

What are the assumptions (consciously or unconsciously) which determine our thinking about physics? We cannot even reflect on this without making some assumptions, regardless of whether they are right or wrong. It sounds paradoxical, but mathematics and modern physics have been characterized as being “exact” only after they were defined by UNPROVABLE assumptions called AXIOMS or PRINCIPLES. These sciences are defined by axiomatic assumptions which can **not** be proved.

Being in the midst of the discussion about relativistic physics, I see that obviously there is much confusion even among physicists. Often we are confronted with the criticism that Einstein could not have checked whether the velocity of light would always be constant “in all” reference systems; consequently his theory should be considered as hypothetical, not verifiable, in fact possibly disproved.

Anyone who argues this way reveals a fundamental misunderstanding of physics because the constancy of the velocity of light *is not the result of a measurement*, it is an axiom. In principle, this axiom could have been established even before the velocity of light was measurable. All physical axioms (principles) have one characteristic in common: they can NOT be PROVED. This means that they cannot offer what these critics are asking for, because axioms are “Not-Disproved-Assumptions”, and “not disproved” does not mean “proved”. One instance is the Principle of Energy Conservation. Nobody can prove it. The only argument for accepting it is the fact that no observation exists which disproves it. If a principle is disproved in one case, then it is disproved in general and must be discarded.

Moreover, a given principle cannot be cancelled or restricted by another principle. There is no order of precedence, no stronger or weaker principles exist. Either a principle is true, then it is always true (although the truth cannot be proved), or it is not true.

In order to understand the argumentation contained herein – with all its relativistic aspects – one must realize the fundamental difference between the axioms of Classical Physics and the Relativistic Principles. Of course, this also applies to the consequences.

The argumentation in this essay presents nothing new, except the consequence from measurements showing that the course of time and – correlated with time – the mass, decrease when approaching the center of gravitation. When reaching the center, the falling velocity reaches the velocity of light; then however, the course of time has decreased to zero and the mass has transformed into radiation.

The greater the initial mass, m, the greater is its rate of decrease until the mass reaches zero. Black Holes cannot appear, there is no “Event Horizon” at a distance $R > 0$, as is often assumed; only when $R = 0$ is $v = c$, but there, the mass has vanished (this means the gravitational mass in the direction toward the center).

One unexplained domain remains, i.e. when the *definitions* for length and mass are not applicable. A distance between masses is defined by the transit time of light, hence a distance cannot be measured with a precision greater than the wavelength of the photons which are used as reference. The shorter the wavelength, the higher the energy of the photons *extracted* from the very mass whose distance is to be measured. If nothing is left over from the mass, then the distance remains undefined, and this has been observed in some experiments. For instance, with the tunnel effect: there, it appears as though the velocity of light would be higher than c. Here, the Relativity Theory is correlated to Quantum Physics.

# 2.1 Relativistic and Classical Principles

## What are the Fundamental Units of Physics?

With Einstein's publication of the Special Relativity Theory in 1905 and – a few years later – the General Theory of Relativity, a new understanding of the nature was initiated, unique in the history of natural science. This goes back not only to Einstein. Signs for its coming can be traced back several decades before Einstein, especially to some fundamental mathematical discoveries about multidimensional geometry, and, at the turn to the 20th century, to never-before-imagined theories about space and time by H. A. Lorentz, H. Poincaré and others, also by Ludwig Boltzmann.

This change in thinking was advanced by Albert Einstein to such an extreme, that in some cases even he himself remained inconsistent when he tried to follow the paths he had opened partly intuitively, partly by mathematical reasoning. The method of reasoning demonstrated by Copernicus, Galileo, Newton and others was so convincing that the mere idea of proceding beyond these pioneers often provoked passionate opposition, perhaps *because* the new logic did not contradict the old one but surpassed it on a higher level, and that was often considered next to impossible. Unfortunately, customary thinking prevents even consideration of a logic which might surpass the customary logic applied successfully so often in the past.

The first fundamental breakthrough occurred when it was realized that a physical object, e.g. a body, cannot be recognized as a "thing in itself", not even by observation. We never see an "object in itself ", for instance we do not *see* a person. What we see, whether physical objects or living beings, are *images* which emerge in our brain. We can neither enter the mental world of a living being, nor even look into it, hence we cannot experience the other life as it is "in itself". We perceive it only through analogy using our own mental experience. Analogy, however, cannot tell us more than that which we have experienced in our own mental imagination. If we are born color-blind, then we cannot know the colors an other creature sees. What we see or perhaps measure is only an *effect*, but certainly not the mental experience of colors of the other individual.

This is true also for the physical world. A body can react to an object only insofar as the object effects that body. In the observer's view, an object "exists" merely in the form of an experienced effect, not by anything this "object" may experience itself by its own mind's eye (being "real" only in this object). What the other existence may be "in itself", even its existence, does not matter in physics if it has no effect in the "observer". For an observer, no reality exists other than the images emerging in his own "imagination", of course including the effects registered by instruments, which too, can indicate nothing other than effects.

*There is nothing more objective than the subjective*.

Exactly that is the message of the Theory of Relativity. This theory shows us for the first time, that we cannot become aware of any reality of the physical world other than through its effects upon us, the observer. We cannot say an object *possesses* a certain length or mass, we can only state the length or mass which a particular observer attributes to that object. His observation depends, for instance, on its velocity relative to the observer and may be considered as self-evident. It may also depend on the gravitational field (which, in turn, depends on the relative velocity to the observer). If, for instance, we are on the surface of the earth from where we observe a space vehicle following an elliptical orbit around the earth, then we reason that there must be an attractive force which causes the vehicle to divert from a straight path to a curved orbit. Astronauts inside the vehicle see the same situation quite differently. Their vehicle is an "inertial system". Inside the (small) vehicle they see any movement relative to that vehicle, hence the gravitation is zero. If they had neither windows nor a memory of their launch, then they could not know anything about the field and about their orbital movement relative to the earth, which they do not see. The astronauts float within the vehicle, and if they move, then only relative to the vehicle. This can be experienced in a diving airplane.

Length and mass change with the location and the velocity of the observer. Not being absolute quantities, they cannot characterize an object. Because these quantities are relative, we already get into trouble if we just try to define them. For instance, it has been defined: the unit of mass by 1 $cm^3$ water at 4°C; the unit of length by the International Prototype Meter in Paris. If these standards are not constants, then we cannot use them for reliable measurements. A physical theory makes sense only if we have absolute standards for length and mass, as well as for time. Obviously, the entire logic of physics breaks down if it is not possible to base the standards on a foundation which remain unaffected by observation.

In the meantime this problem has been realized, but not before physicists were confronted by a strange observation which, at first, could not been explained. It is the observation that the velocity of light is always the same, regardless of the observer's movement relative to the source or the sensor of the light.

The most radical conclusion from that observation was drawn by Einstein. He realized that in conventional physics, *all* fundamental quantities are "relative", and as such, inappropriate for the defininiton of fundamental quantities. For thousands of years, these quantities have been the base for all definitions and measurements, with more or less precision. Now Einstein turned these definitions upside down by replacing them by new definitions. Instead of expressing the velocity of light to be the quotient of two measured quantities – distance and transit time of light for covering that distance – he reversed the definition. This means: He *degraded* to relative entities the very quantities which had been considered absolute and invariable – time and length – by *defining* each of them by light! While for Newton the absolute invariable entities in the world had been space and time, now Einstein declared: the only absolute entity is light! This means:

Neither space nor time, but light must be used as base for the fundamental units, independent of the observer and appropriate for defining all other units. Is this possible? It is possible and simple. We need only a light ray in vacuum emitted by an atom of a defined element. Any spectral frequency can be used as calibration unit: For length: the wavelength, for time: the period. In order to minimize adaptation problems with the units hitherto used, we can multiply each calibration unit by a suitable constant scale factor.

**(2.1)** Then the ratio would be: $\dfrac{\textbf{Wavelength } \boldsymbol{\lambda}}{\textbf{Period } \boldsymbol{\tau}} = \mathbf{c}$, the *absolute constant* **velocity of light**.

If the definition by light is established for both units – for length by $\lambda$, for time by $\tau$ – then all events are governed by Special Relativity. Of course, this theory was accepted because its consistency with all known observations and experiments had been confirmed. From that time, any report of a velocity greater than that of light could be explained as a not-understood theory, and would just indicate an erroneous measurement by using classical procedures instead of using those defined by light. It is true that some measurements seemed to indicate a velocity greater than that of light (to this I will refer later). At the moment, I wish to trace Einstein's chain of reasoning when he constructed his General Theory of Gravitation.

As most of the great discoverers did, he also deduced his findings not from new postulates, but rather, he had at first an idea of the outcome, and afterwards – by pondering on it – he constructed appropriate postulates, but this he didn't disclose when he presented the flawlessly formulated result.

The most important postulate was the constancy of the velocity of light. Step by step, he realized its far-reaching consequences. So he recognized that length and time are relative quantities, but not only that. Mass also turned out to be relative, while hitherto, mass had been the embodiment of immutability. *All* fundamental physical quantities revealed themselves to be dependent on the relative velocity of the object to the observer. Even more exciting: Mass and energy have been recognized as being identical, unthinkable in Newton's time. This means: The weight of a clock spring increases when wound up, although far too less to be measurable. However the mass of an elementary particle increases many times when accelerated to high velocities, and this can be measured with high precision.

So, Classical Physics had to be replaced by the "**Special Relativity Theory**", which, without exception, has subsequently been confirmed by innumerable observations and applications. But one phenomenon remained to be explained: Gravitation.

For this, Einstein had an idea: Is gravitation a quality of the geometry of space?

The absolute constancy of the velocity of light, c, determines all fundamental units of physics by a light ray having a certain resonant frequency, $\nu$, of an arbitrarily selected atom. In principle, we can use its wavelength, $\lambda$, to define the **unit of length** $= \lambda = 1$; or its period, $\tau$, to define the **unit of time** $= \tau = 1$. We can also define the **unit of mass** with a light quantum, $\mathbf{E = h\nu}$, by defining $\mathbf{m = E/c^2 = 1}$. Next, we can choose a scale factor for each of this quantities in such a way that our definition becomes best adapted to the cgs system when the velocity of light, **c**, is = $\mathbf{3{\cdot}10^{10}}$ **cm/s** = constant.

## 2.2 The Equations of the Special Relativity Theory

The Special Relativity Theory cannot be understood, not even superficially, if we have not realized that the fundamental physical quantities (length, time, mass) are NOT qualities of the physical objects themselves. Rather, they are qualities of the *images* in the "imagination" of the observer. The images are not the real objects, but illusionary impressions. A physicist can identify as "natural laws" only the rules by which these images are correlated. The laws depend on the observer's condition (location, velocity, time, gravitational field), as well, of course, on the condition indicated on instruments by which our senses are augmented.

**Expressed precisely: If we say an object "has" a certain mass or length at a defined time, then we do not mean a quality of the observed object itself. What we mean is: parameters which are – in the observer's *imagination* – characteristic for the momentary behavior of the object. We do not know anything about the qualities of an *object as such* (unless we look into our own mind, since only I myself can "see my life from within"). What is an "observer"?**

An "observer" must not be a living organism. *Each* physical object is an observer because it "observes" the others by the effects on itself, and only by those effects, not by anything correlated with a reality the other object may be for its own.

It is assumed that the following equations of **Special Relativity** are known; their verification can be found in textbooks. The equations express the dependence on velocity. That dependence has been deduced from the absolute constancy of the velocity of light. However, a special theorem remains to be investigated: It is the dependence on the gravitational field. The equations are true when gravitation is absent.

**(2.2)**

1. **Mass increases** from $m_o$ to m by $\Delta m$: $\mathbf{m} = \dfrac{\mathbf{m_0}}{\sqrt{1 - v^2/c^2}}$; $\mathbf{\Delta m = m - m_o}$
2. **Time dilatation** (Increase of a time interval): $\mathbf{T} = \dfrac{\mathbf{T_0}}{\sqrt{1 - v^2/c^2}}$;
3. **Addition of velocities:** $\mathbf{v} = \dfrac{v_1 + v_2}{1 + v_1 v_2/c^2}$;
4. **Length contraction:** $\mathbf{L = L_0 \sqrt{1 - v^2/c^2}}$;
5. **Doppler effect:** $\lambda = \lambda_o \sqrt{\dfrac{1 - v/c}{1 + v/c}}$.

These equations represent the so-called "Lorentz Transformation".

Together with **E = mc²**; it is the base and prerequisite for all the subsequent derivations.

**"Lorentz Invariance"** means: These equations are true anywhere in the universe, this means at any location and at each time. In other words: **At each location, the universe is similar to itself.**

**Equivalence of mass and energy, $E = mc^2$** (or: $m = E/c^2$), implies that the *increase* in mass by acceleration, that is, $\Delta m = m - m_o$, must be the mass-equivalent of the kinetic energy, $\Delta m = E_{kin}/c^2$. This is evident because it is produced by accelerating a mass, $m_o$, to the velocity v. Speeding up the mass, $m_o$, to a velocity, v, means simply *transporting a mass (energy)*, $\Delta m = E_{kin}/c^2$, *from outside*, into the intrinsic mass, $m_o$.

The increase of mass when v increases will be proved on the following page. The derivations of the other equations can be found in textbooks and are not quoted here. For lack of space, I will only recommend the following textbooks from the many which can be recommended:

1. Hermann Bondi**: "Relativity and Common Sense – a New Approach to Einstein"** (120 pages).
For didactic reasons, Bondi explains the theory not with the relativistic root (as usual) but with the **k-factor**. For readers of his book, I quote the correlation of the k-factor with v, but please note: Bondi writes "v" for "v/c"; that means that v is expressed as a fraction of the velocity of light:

$$\sqrt{1 - v^2} = \frac{2k}{k^2 + 1}, \qquad v = \frac{k^2 - 1}{k^2 + 1}, \qquad k^2 = \frac{1 + v}{1 - v}$$

2. Max Born: „**Die Relativitätstheorie Einsteins**" (324 pages).
ISBN 3-540-04540-6, Springer-Verlag Berlin Heidelberg NewYork Tokyo 1984

## 2.3 Relativistic Increase of Mass due to Velocity

**Assumptions**: **1.** Equivalence of mass and energy, $\mathbf{E = mc^2}$,
**2.** The absolute constant velocity of light, **c**, and
**3.** The axioms of Newton, applied on the mass $\mathbf{m = m(v)}$.

**Prerequisite:** Energy, $dE = K ds$, inserted from outside by applying the force, K, along the path ds

**[A]** $\mathbf{E = \int K\, ds}$. (K = force)

According to Newton's definition, the force for changing the momentum, mv, when time changes is:

**[B]** $\mathbf{K = d(mv)/dt} = (dm/dt)\, v + m\, dv/dt$.

**[C]** $\mathbf{E = mc^2}$ These three equations can be found in textbooks. To be proved is the

**Assertion:** $\mathbf{m = \dfrac{m_o}{\sqrt{1 - v^2/c^2}}}$ where $m_o$ = mass at rest (i.e. when v = 0)

[For $v^2 << c^2$ we obtain the known approximation $E = m_o c^2 + m_o v^2/2$].

**Proof:** Derivation of equation **[A]**:

**[D]** $K = dE/ds = (dE/dt)/(ds/dt) = (dE/dt)/v$. Equalized with K of **[B] right**:

$(dE/dt)/v = (dm/dt)\, v + m\, dv/dt$, in other arrangement $dE/dt = (dm/dt)\, v^2 + m\, v\, dv/dt$.

The right side of the last equation extended by $c^2/c^2$ :

$dE/dt = (dm/dt)\, c^2\, v^2/c^2 + (m\, c^2\, v/c^2)\, dv/dt$. Into the right side of this equation, we insert

**Equ.[C]** $E = m\, c^2$ and its derivative $dE/dt = (dm/dt)\, c^2$.

We obtain: $dE/dt = (dE/dt)\, v^2/c^2 + (E\, v/c^2)\, dv/dt$; arranged differently:

**[E]** $(dE/dt)\,(1-v^2/c^2) = (E\, v/c^2)\, dv/dt$.

By using the abbreviation: $\mathbf{A = (1-v^2/c^2)}$ and its derivative $dA/dt = -(2v/c^2)\, dv/dt$, we obtain:

$(dE/dt)\, A = -(½)\, E\, dA/dt$. Multiplied by dt: $dE\, A = -(½)\, E\, dA$, or

$dE/E = -(½)\, dA/A$. Integrated with the boundary values: when $v = 0$, then $E = E_0$, and $m = m_o$:

**(2.3)** $$\mathbf{E / E_0 = \frac{1}{\sqrt{1 - v^2/c^2}}}, \text{ hence } \mathbf{m / m_0 = \frac{1}{\sqrt{1 - v^2/c^2}}}$$ as has been asserted. ($m_0$ = mass at rest)

## 2.4 Unit of Mass Defined by Light

By introducing Poisson's equation, Einstein could explain on planetary orbits two observations: the advance of the perihelion, and the deflection of light near the sun (by an angle twice that of classical physics). For Einstein and generations of physicists, this was assumed as proof that the General Theory of Gravitation is a consequence of Poisson's Equation. However it is a grave error. Essential for these two effects is not Poisson's Equation, but rather the work of an unnoticed stow away passenger imported with the equation, i.e. the constancy of the velocity of light. This can be realized if we discard Poisson's Equation, and with it, its precondition: a source-free field which would supply a falling mass with kinetic energy (it would contain relativistic masses). Then the constancy of the velocity of light leads to all measurable relativistic results, however with much simpler mathematics without reference to the tensor algorithm (see Chap. **1.1**, **1.2** and **1.3**).

If Einstein had applied the principle of relativity to the falling masses as well, then, of course, he would have recognized that no singularity exists in the gravitational field (where the curvature of space is extremly distorted, the energy unlimited). Then he would have defined mass as a relativistical changing quantity as he had done with the other two essential physical quantities, length (space) and time.

## 2.5 Einstein's Hypothetical Space

When Einstein tried to answer to the mystery of gravitation he had an idea: Can gravitation be understood as a quality of space? We do not know Einstein's chain of reasoning when he tried to prove his speculation, and how often he was caught in dead-ends. However, if we consider his postulated axioms in retrospect, then – with high reliability – we can trace the reasoning he followed.

In his book "**Grundzüge der Relativitätstheorie**", Einstein postulates an "**Energy Tensor of Matter**" having the *hypothetical* quality that its divergence disappears. Because the reader will most likely agree that his postulate is scarcely understandable, I will neither try to explain it nor use it. I shall content myself with the remark that Einstein adopted this tensor from classical physics. With this tensor, he introduced a classical assumption as condition for his General Theory of Gravitation, hence the theory stands or falls on that assumption. This can be seen in the specification for that tensor, postulated by Einstein without justification or explanation with the following words (my translation):

"1. It [the tensor] should not contain higher than the 2nd differential quotients of $g_{\mu\nu}$.
2. It should be linear in those differential quotients.
3. Its divergence should disappear identically."

I do not assume that anybody will understand these axioms. The reader should not be annoyed that I quote it without explanation (this I will justify later). To each of these axioms we may ask: Why? Einstein did not clear explain any of them, he added just the following brief comment:

"The first of these conditions are of course extracted from the equation of POISSON".

Without trying to explain these axioms or to express it by the tensor algorithm, I add only the following remarks, which can be read in relevant textbooks. There we find the known classical equation for the mutual attractive gravitational force, K, of two masses (if m<<M):

**(2.4)** $$\mathbf{K = \frac{GMm}{R^2}}.$$ (Newton's law). G = gravitational constant, R = distance between the masses)

The equation is true for spherical, symmetrical masses, M and m. Each mass can be thought to be concentrated in its center (for mathematical proof see textbooks). If the masses are neither spherical nor symmetrical but are distributed within a volume according to a density function, then we obtain the force upon a mass by integrating the attractive forces of all the mass elements, dM. In this case, Newton's law remains true, it has to be integrated over all the mass elements, dM (and dm). To accomplish this, Poisson – a mathematician – transformed Newton's Law into a differential equation.

With Poisson's equation, Einstein introduced a non-relativistic assumption, as he himself emphasized. Then he formulated the theory using the three axioms quoted above. When replacing Newton's Law by Poisson's equation, he certainly obtained a more general formulation, but the fact remains that the formula is a classical one, hence his theory is already at the onset founded on classical conditions.

Additional to these conditions, Einstein introduced the axiom of the absolute constancy of the velocity of light. This he did by *postulating* the "Interval". From these combined conditions, he deduced relativistic measuring units for length and time. Thus, the constant velocity of light was combined with the classical equation of Poisson, this means combined with the generalized form of Newton's Law of Gravitation. Hence his General Theory is true under the precondition of that law. The main condition of Newton's Law states that the kinetic energy in a falling mass is *created* in a "source-free field". Hence, as in Classical Physics, in Einstein's theory that energy "emerges" from space (the "field") without having a source, and this was emphasized by Einstein himself.

From these classical preconditions and the constant velocity of light Einstein concluded, without calculation, the following formulas for the change of the time interval. (However **B** would be true only if $GM/c^2 << R$):

**(A)** $\underline{\mathbf{t^2 = t_o^2\left(1 - 2GM/c^2R\right)}}$, or, if $2GM/c^2R<<1$, **(B)** $\underline{\mathbf{t \cong t_o(1 - GM/c^2R)}}$ or $\underline{\mathbf{t_o \cong t(1 + GM/c^2R)}}$

(t is a time interval at infinite distance, $t_o$ is that interval when reaching the distance R.)

Einstein's correct conclusion in his own words (my translation): "The more ponderable masses exist in its environment, the slower a clock will run." (By "environment", Einstein apparently means that all ponderable masses act from the same direction relative to the clock, hence the clock is assumed *not to be inside* the mass, M).

Because Einstein uses unusual symbols (shown on **Page 98**) for the equations (B), I have translated his formulas from his notation into the usual language of physics.

Instead of using the three axioms quoted above (and speculating on how Einstein's formulas could be deduced from them), the reader may appreciate when I now demonstrate a far simpler way for obtaining the formulas (B) directly from the classical formulas. In formulas (B) we can easily recognize some inconsistencies with respect to energy conservation and Special Relativity.

We start with a mass falling from infinity to a distance, **R**, to the center of **M**. According to classical theory, at the distance **R** it reaches the velocity $\mathbf{v = \sqrt{2GM/R}}$. From this we obtain its kinetic energy, $\mathbf{E_{kin}= mv^2/2= GMm/R}$. In Classical Physics, especially in Poisson's equation, the kinetic energy is supplied by the field (*not* by the mass). The mass retains its initial value at $\mathbf{R} = \infty$, where, according to Special Relativity, the internal energy of the falling mass is $\mathbf{mc^2}$, hence: $\mathbf{E_{kin}/mc^2 = GM/c^2R}$. In classical theory, the hypothetical field energy is not known. Known is only the *change* in the potential energy of the field. When falling from an infinite distance, the change is $\mathbf{E_{pot} = -GMm/R}$, as in the formula above; the potential energy *decreases* by the amount of the emerging kinetic energy. If however $\mathbf{mc^2}$, rather than the field, supplies the initial potential energy, then $\mathbf{mc^2}$ decreases to $\mathbf{mc^2-GMm/R}$. Hence, that would be the remaining potential energy after free fall:

$\mathbf{mc^2 - E_{pot} = mc^2 - \frac{GMm}{R} = mc^2\left(1 - \frac{GM}{c^2R}\right)}$. As before, $\mathbf{\frac{E_{pot}}{mc^2} = \frac{GM}{c^2R}}$, this is the ratio of the kinetic energy to the entire initial energy, $mc^2$. Now we can understand Einstein's formula (B). It shows that time and potential energy decrease by the same factor (the ratio of $E_{pot}$ to the energy, $mc^2$, of the falling mass).

So we have obtained directly, what Einstein had deduced from the assumption on which Poisson's equation is based. We, too, obtained formula (B), but note: we did not use the tensor algorithm. Like Einstein we obtained it from the classical formulas. Obviously, if Einstein had not used the classical formulas, then he would have obtained neither formula (B) nor its approximation. We have revealed even more, namely: $\mathbf{mc^2}$ is the source of the kinetic energy, but Poisson's assumption of an energy-supplying field is incompatible with this. From here on, Einstein's argumentation is inconsistent because he continues his calculation as if his assumptions had been relativistic. Under relativistic assumptions, however, the masses cannot be constants, they must be relativistic quantities – whether in Newton's or in Poisson's formulation. Moreover, Special Relativity demands energy conservation, whereas in classical theory, the energy of the falling mass is "created" in empty space: the "field". We deceive ourselves if we believe that the principle of energy conservation would be rescued simply by calling the empty space "field". It is true that "the sum of potential and kinetic energy is constant", but constancy as such does not produce energy from nothing. Of course, Einstein was aware of this problem. He "solved" it by casually specifying a new axiom without identifying it as such. This he did without any reasonable justification, simply by the following remark:

"It must be considered that besides the energy density of matter, an energy density of the gravitational field must also exist; hence, without any question, there cannot be a separate principle of conservation of energy (or of momentum) *for matter alone*." (My translation, Einstein's italics).

This is the origin of the problem which he couldn't solve when trying to disprove the existence of Black Holes. Of course, he realized that Black Holes would not disappear even if he avoided point masses with infinite densities by using Poisson's Equation. However, if he had made relativistic assumptions with energy conservation, then he would have obtained the factor $\mathbf{e^{-a/R}}$ instead of the parenthetical expressions in Equ.(B). This is pointed out in Chapter 1.3.

Einstein gives no hint how a postulated hypothetical field energy could be measured. Field energy makes the theory self-contradictory. On the one hand, the mass of an object in free fall will not decrease, because the equations are defined under the assumption that the source of energy is not the falling mass but the field,. On the other hand, these very formulas lead to the consequence that time runs slower, the stronger the field is (in his words: "...the more ponderable masses are in its environment"). However, the oscillation of atoms (by which the time standard is defined) is proportional to the atomic mass, hence, the mass must decrease at the same rate as the rate of time, in contradiction to the assumption. This contradiction cannot be resolved. If, according to Einstein, the falling mass does not decrease, then its gravitation too will not decrease; on the contrary, it would increase if the kinetic energy also exerts gravitation – as commonly (erroneously) is assumed. Another contradiction arises at the so-called Schwarzschild Radius. There, the mass reaches the velocity of light, which – by the way – means infinite energy!

This is the definition of a Black Hole. Its contradictions could be eliminated only if we define an extra axiom for each inconsistency. In such a sophisticated mathematical algorithms, it would be a hopeless task to trace and remove all contradictions which may be hidden therein.

However, the inconsistencies in Einstein's theory can be eliminated far more simply by the very ideas Einstein himself introduced into physics. This must be emphasized in order to give the credit to Einstein and to prevent incorrect interpretation of what I try to make clear. He arrived at his epoch-making conclusions certainly not by applying the axioms quoted above, because most likely he didn't start with these axioms. Rather, his motive was the brilliant (though misleading) intuition that gravitation might be a quality of the four-dimensional curvature of space. This implies that he started not from a physical point of view, but from the mathematical idea of curved space. The idea fascinated him from the time of his college days. His confidence in being on the right track was reinforced because the idea was successful and consistent with all known measurements. Obviously, he was convinced that sooner or later its contradictions would be overcome. This train of thought even led to the idea of a "Weltformel" (a formal explanation of the world). No other scientist had understood better the principle of relativity in its *full* consequence. This is an epoch-making achievement even on its own.

Many hypotheses for a relativistic theory of gravitation have been constructed by very competent mathematicians, more or less tentatively, but they had an essential problem with the geometry of curved space in the vicinity of Black Holes: There remained some inscrutable white areas where no universal mathematical solution could be found. Hence, it was neither surprising nor should we be troubled that not all problems were solved. However, compared with all conceivable theories, Newton's theory had the obvious advantage of coming closest to the ideal for describing gravitation as simply as possible. When even Newtons's theory, the simplest of all, is so complicated – in the vicinity of the singularity (infinite energy) – then it should not be a surprise that any other theory would be all the more intricate, nevertheless solvable someday.

For his General Theory, Einstein referred to the highly developed Potential Theory of curved space. Nobody expected that a potential function could be found which had not already been thoroughly analyzed and explored by ingenious mathematicians. Whatever Einstein might have wished for (with respect to multidimensional curved space) a reservoir of ideas was already known with a lot of theoretical variations – or was something missing? Yes, something had been left out. The most important parts of the Potential Theory had been created by thinkers who where more mathematicians than physicists, however they lived at a time when some of the fundamental principles of physics had not been discovered or not yet realized in their universality. One instance is the Principle of Energy Conservation. Obviously, for each central forces which could be imaged there was always a theory in store, but as long as the Principle of Energy Conservation – especially the equivalence of energy and mass – had not been thought, not even the greatest genius could incorporate the equivalence of mass and energy into any Potential Theory.

Einstein relied on the Classical Potential Theory. If he had preferred the other option – if he had Newton's Law *adapted* to the Principle of Mass-Energy Equivalence – then he would not have overlooked the fact that Newton's (or Poisson's) original law is *not* the assumed simplest theory possible. The cause, why the Relativistic Potential Theory sometimes leads to unresolvable problems, is the singularity in that domain where the force of gravitation becomes infinite and the free fall reaches the velocity of light. There, the curvature of space becomes self-contradictory. If however Newton's Law is *adapted* to the Principle of Energy Conservation, then we obtain a result which nobody had expected, in spite of its simplicity. Then the necessity of doing the impossible – adapting physical principles to a singularity – vanishes. The singularity leads to such an extreme curvature of space that some principles of physics degenerate to self-contradictions.

Why did Einstein not insert relativistic masses in Newton's Law? The simple explanation may be: It was his idea of explaining gravitation by an extra curvature of space. Exactly that would necessitate a curvature of space which is responsible for the singularity!

## 2.6 Black Holes Observed?

Since a few years infra-red radiation can be used for observing the center of the Milky Way and other galaxies. *Visible* light radiated from that center cannot penetrate the dust clouds in front, however infra-red light can. In the infra-red view we see in some galacies stars orbiting round their centers on very narrow elliptical paths. In spite of the observed extreme high velosities these stars do not escape their orbits, hence they must be held gravitationally in its orbit by very large masses in the center. The mass can be calculated from the measured orbital data with the result that in some galaxies many million sun masses must be within the small distance of their orbit to the center. If the calculated escape velocity is greater than that of light then "not even light can escape from it". Such a mass concentration is called "Black Hole". This is the conclusion in almost all textbooks. However this conclusion cannot be correct because of the following facts.

1) Contrary to this interpretation, the escape (or falling) velocity in a field is *always* less than the velocity of light, regardless of how large the mass concentration may be. This is shown by the measurements of Hafele & Keating and followers. [refer to **Equ.(3.6)** in Chap. **3.2**].

2) Additionally, the kinetic falling energy arise *at the cost* of the intrinsic energy ($mc^2$) of the falling mass. That means the mass – and its correlated gravitation – becomes reduced while falling and reaches zero at the center. The part of the mass which has been transformed into kinetic energy **has ceased to exert gravitation in the direction it moves.**

3) Light is kinetic energy and therefore can not exert gravitation *in the direction it propagates* (however, it *does* - even twice - in the transverse direction, shown in Chap.3.4). This may be better understood if we visualize a ray of light (photons) approaching us. In order to exert gravitation upon us, a photon would have to do so continually before it would be absorbed when reaching us. This means the gravitation of the photon would have to move faster than the photon itself – with a velocity greater than that of light. Such a velocity is not possible according to the Theory of Relativity (see the "Addition Theorem for Velocities" in the **Note, Page 79**). According to the same theorem, the photon could not act in the opposite (backward) direction – that is, back to the source of the light – because no velocity can be subtracted from the velocity of light.

The many enthusiastic reports about the "discovery of Black Holes" show in fact nothing other than the observation of high velocities within a very small region near a galactic center. Though this is evidence for an extremely concentrated mass in the center, it is not evidence for a Black Hole, because any theory that such a mass concentration were a Black Hole is easily refuted. It is not true that Black Holes have been seen – they are invisible by definition. Their circumference and their radius ("Event Horizon" and "Schwarzschild Radius") are contradictions in themselves, because these dimensions shrink to zero when the velocity of light is reached. The "better" knowledge about Big Bang and Black Holes, claimed by some authors against thoughtful researchers with other opinions, will enter the history of science as a period of daydreams, because it is based on the incorrect assumption that light is subject to gravitation in the direction it propagates (this would contradict the measurements, shown in **Chapt.1.1** and **1.2** – see note on **Page 79**).

In order to rescue Black Holes and the Big Bang, scientific journals and congresses would have to eliminate all counter-arguments from all archives and even from the minds of all people who dared constructive criticism. They had to combine this with an everlasting boycott of all such critical thinkers. This is the well-known strategy of religious fanaticism. The immaterial and material damage to science through such a censorship would be immense.

Let me quote one of the most prominent scientists of the present, Geoffrey Burbidge:

"*Commonly, new ideas in a scientific branch are advanced by young scientists who oppose some established concepts. Not so with present-day cosmologists: The younger ones are even more intolerant than their elders to ideas diverging from the holy Big Bang. The worst aspect is that authors of textbooks in astronomy no longer present the cosmology as 'work in progress' but as if the correct theory had already been found. ... Anyone who has been in this field long enough knows very well that 'peer review' and the examination of articles has been developed into a kind of censorship. It is especially difficult to obtain financial support for telescope observation time if the proposed project does not follow a certain party line. For instance, Halton C. Arp ... was refused the use of the Mount Wilson and Mount Palomar telescopes because he continually discovered facts which contradicted standard theory. Occasionally, unorthodox papers have been withheld or excluded from being published for years. The same applies to appointments for academic positions. ...*".

(Re-translated from "Immer Ärger mit dem Urknall", rororo 1993).

# 3. Mathematical Confirmation

## 3.1 The Function $e^{-a/R}$ and the Law of Gravitation

The graph of the function $e^{-a/R}$ (**Page 83**) will be helpful for understanding the Relativistic Law of Gravitation. The qualities of the law, derived with its relativistic features in the next chapters, are determined by this function, and with it, the cosmological consequences. Its value is a function of two natural constants:

| For the system | R [in cm] | $e^{-a/R}$ |
|---|---|---|
| Mercury – Sun (mass of Mercury $=3.3\cdot10^{26}$g) | max. $0.703\cdot10^{13}$<br>min. $0.464\cdot10^{13}$ | $1-2.1\cdot10^{-8}$<br>$1-3.2\cdot10^{-8}$ |
| Earth – Sun (mass of Earth $= 6\cdot10^{27}$g) | max. $1.526\cdot10^{13}$<br>min. $1.466\cdot10^{13}$ | $1-0.97\cdot10^{-8}$<br>$1-1.01\cdot10^{-8}$ |
| Jupiter – Sun (mass of Jupiter $= 1.9\cdot10^{30}$g) | max. $8.15\cdot10^{13}$<br>min. $7.4\cdot10^{13}$ | $1-1.8\cdot10^{-9}$<br>$1-2.0\cdot10^{-9}$ |

**1.** Gravitational const., $G = 6.6726\cdot10^{-8}\text{cm}^3/\text{gs}^2$
**2.** Velocity of light, $c = 2.9979\cdot10^{10}$ cm/s
$c^2 = 8.987\cdot10^{20}\ \text{cm}^2/\text{s}^2$.

with Equ.(5): $\mathbf{a = \frac{G}{c^2}M}$

$\mathbf{e^{-a/R} = 1- a/R + a^2/2R^2 - a^3/6R^3 +...-...}$

$M_{Sun} = 2\cdot10^{33}$g ($\cong$ 333,000 earth masses):

For planets, $e^{-a/R}$ is extremely near 1 and deviations from the Classical Law are scarcely detectable.

**<u>The Graph of the Attractive Force</u>** $\mathbf{K = \frac{GMm}{R^2} e^{-a/R}}$ Equ.(1.9)

Essential is the *variable* factor $\mathbf{y = \frac{e^{-a/R}}{R^2} = x^2\cdot e^{-ax}}$ (The substitution R = 1/x inverts the R axis without changing the extreme values at their locations: If $x = \infty$ then $y = 0$, $R = 0$. If $x = 0$ then $y = 0$, $R = \infty$).

For the extremes: $y' = x(2-ax)\cdot e^{-ax} = 0$. Each of the three factors represents an extreme:

| a) <u>Minimum</u> at $e^{-ax} = 0$ | b) <u>Maximum</u> at $2-ax = 0$ | c) <u>Minimum</u> at $x = 0$ |
|---|---|---|
| $x = \infty$, $R = 0$<br>$K = 0$, $E_{pot} = Mc^2$.<br>$(= \lim_{R\to0} K)$ Equ.(1.6)<br>Limit as per l'Hospital's rule for R=0 can only be calculated using R = 1/x.<br>$E_{kin} = mc^2$; this means: the energy is kinetic. | $x = 2/a$ $R = a/2$<br>$K_{max} = \frac{4GMm}{a^2e^2} = \frac{4c^4m}{GMe^2}$ Equ.(1.9)<br>$E_{pot} = (M+m/e^2)\cdot c^2$ Equ.(1.6)<br>$E_{kin} = mc^2\cdot\underbrace{(1-1/e^2)}_{0.8647}$ | $x = 0$ $R = \infty$<br>$K = 0$ Equ.(1.9)<br>$E_{kin} = 0$<br>$E_{pot} = (M+m)c^2$ Equ.(1.6), this means the energy is potential energy = bodily mass. |

For $R \to \infty$, $e^{-a/R} = 1$. Then, the total mass is potential energy according to Equ.(1.6).
A mass at such a remote distance is called **<u>Prime Mass</u>** or **<u>Initial Mass</u>**.

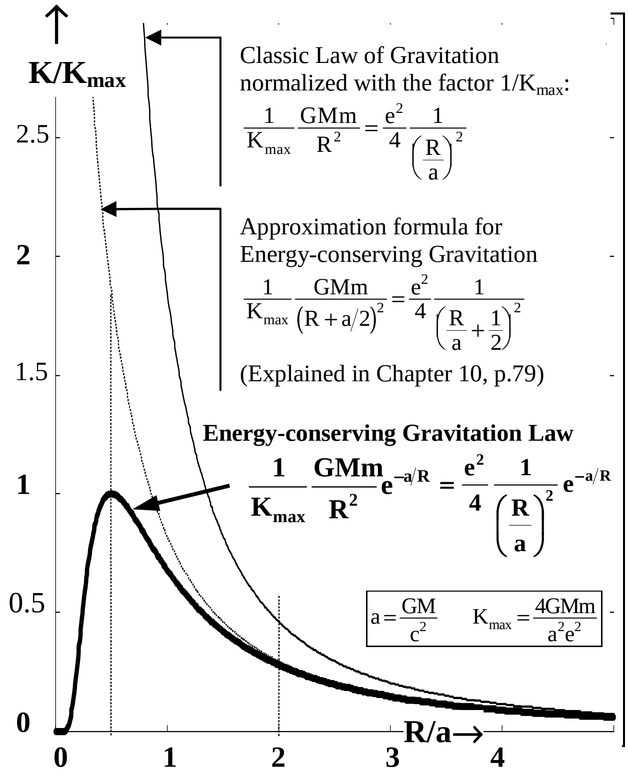
In the *classical* law is $E_{pot} = \int_R^\infty \frac{GMm}{R^2}dR = -\frac{GMm}{R} < 0$, $E_{pot} < 0$, whereas Equ.(1.6) states that $E_{pot} > 0$:

$$E_{pot} = (M+m\,e^{-a/R})c^2 = [M+m\,(1-a/R+a^2/2R^2-+\cdots)]\,c^2 \cong Mc^2+mc^2-\frac{amc^2}{R} = (M+m)c^2-\frac{GMm}{R} > 0.$$

The mass can be defined by Equ. (1.5) – (1.9). This means that the classical theory of gravitation becomes generalized when it is adapted to the *Principle of Energy Conservation*. This replaces the mass definition used in experimental physics. In the classical theory, the constant part, that is $(M+m)c^2$, has been omitted because its effect on motion disappears in the formula when differentiating the constants. So we can state:

If the mass decreases by the factor $\mathbf{e^{-a/R}}$ then the spectral (natural) frequencies of its atoms must also decrease, and with it the duration of a periode of a light wave – each by the same factor. If at $R = \infty$ a time interval has been $\mathbf{t_\infty}$, then at a deccreased $R < \infty$ this interval must also be decreased to less than $\mathbf{t_\infty}$. This means: the less the distance to the gravitational center, M, the slower is the course of time.

In many cases the difference between $e^{-a/R}$ and 1 is small and negligible. If, however $R \cong a$, then all speculations about events in the vicinity of the singularities, called Black Hole, are left to become vanished, because the gravitative mass disappeares by the factor $e^{-a/R}$. This means: The generalized "**<u>Energy-conserving Relativity Theory</u>**" must be distinguished from the "**<u>Source-free Relativity Theory</u>**" of Einstein.




**Energy-conserving Law of Gravitation**
normalized to $K/K_{max}$ with Newton's classic law

**<u>Fig. 3.1</u>: Force of Gravitation**
(See also the diagrams on **Page 83**)

Einstein used the classical law of gravitation as reference when defining the setup for his theory. I did the same with just one difference: I *adapted* to the identity $E = mc^2$ the classical law of energy conservation. The reader may feel the same surprise I had when he too, step by step, realizes <u>that this adaptation converts the classical law into the General Theory of Relativity</u>, however <u>*without* the hypothesis of field energies outside a mass</u> (postulated as effect of curvature of space).

The measuement proves that the vacuum cannot be defined as an additional source of energy.

The diagram shows the graph of the force function when normalized its value to 1 at the maximum. This means: the force function (Equ.1.9) has been divided by $K_{max}$ (from column b on previous page):

$$\mathbf{P} = \frac{\mathbf{K}}{\mathbf{K_{max}}} = \frac{GMm \cdot e^{-a/R}}{R^2} : \frac{4GMm}{a^2 \cdot e^2} = \frac{\mathbf{1}}{\mathbf{4}}\left(\frac{\mathbf{a}}{\mathbf{R}}\right)^2 \mathbf{e}^{2-\frac{\mathbf{a}}{\mathbf{R}}}.$$

The equation shows that the force function depends only on R/a, that is: R measured with **a**, the unity of length. Considering a system of two bodies then its behavior is determined by the amount of "**a**".

Note the extremely small distance to the center of gravitation. R = a would be a distance of 4.5mm to the center of the earth, or 1484 meters to the center of the sun. Such short distances would be possible only if the two bodies were compressed to less than those distances.

With Equ.(1.5) and with the masses in the table the reader can easily calculate some values for 'a'.

An examination of the influence of 'a' may prevent the widespread assumption that 'a' would always be small ($e^{-a/R} \cong 1$). As will be shown in Chap. 3.10, for the universe the length a is half of its radius, R!

In all derivations in this essay, the limited velocity of gravitational signals (= c) has been neglected. Earth and sun localize their gravitation to the points where they had been about eight minutes (or 20 arc seconds) earlier. This effect may neutralize mutually. A similar time shift is true for a statistical distribution of stars.

**All the results presented here – verified by the Clock Experiment – reflect the fact that a falling body acquires kinetic energy not from the field, but from its own mass. Though this is an empirical result and was predicted by Einstein, it contradicts the basic condition of the General Theory of Relativity. Its consequences, still ignored to this day, are deduced and explained in this essay.** That means:

1. *All* mathematical theorems of General Relativity which are deduced from the incorrect assumption of a field energy are not granted to be true. Their truth may be like that of "The Emperor's New Clothes" in Andersen's tale.
2. **Big Bang and Black Holes have turned out to be impossible, whereas all other relativistic effects remain almost unaffected or have been confirmed, at least by extremely good approximation.**
3. Textbooks and a countless number of scientific papers must be corrected, the present proliferation of hypotheses is blown away in favor of a much simpler physical theory, just by inserting Energy Conservation and Special Relativity to Classical Gravitation, <u>*without*</u> any new theories.
   **Why this has never been tried before may be an almost unbelievable mystery.**

## 3.2 Acceleration and Velocity as Function of Distance, R

## Law of Inertia

According to **Equ.(2.2/1)** of Special Relativity, a mass, $m_o$, increases to $\mathbf{m = \frac{m_o}{\sqrt{1-v^2/c^2}}}$ when it is accelerated by applying a force to it. If, however, the mass, $m_o$, becomes accelerated by its own intrinsic energy, $mc^2$, then the energy must decrease to $\mathbf{mc^2\sqrt{1-v^2/c^2}}$ and with it, the mass, because the total energy cannot change. The difference between this and $mc^2$ is the kinetic energy :

$E_{kin} = mc^2 - E_{pot} = mc^2 - mc^2\sqrt{1-v^2/c^2}$ . According to Equ.(1.8), $E_{kin} = mc^2(1-e^{-a/R})$. Equating:

**(3.1)** $\mathbf{E_{kin} = mc^2(1-\sqrt{1-v^2/c^2}\,) = mc^2(1-e^{-a/R})}$. This means $E_{kin}$ is a function

1. of the distance, R, which the mass has reached when it has descended from ∞ to R,
2. of the velocity at that distance. Differentiation on both sides with respect to time, t,

( left $\frac{d}{dv}\frac{dv}{dt}$ = right $\frac{d}{dR}\frac{dR}{dt}$ ), [and with $a = \frac{GM}{c^2}$ ] results in:

$$\frac{m}{\sqrt{1-v^2/c^2}}\cdot b = -\frac{mc^2}{R^2}\cdot a\cdot e^{-a/R} = -\frac{GMm}{R^2}\cdot e^{a/R} = -K \qquad \text{[K according to Equ.(1.9)]}$$

Therein is $b = \frac{dv}{dt}$ = acceleration, and $v = \frac{dR}{dt}$ = velocity of free fall. We can write

**(3.2)** $$\underline{\mathbf{b\cdot\frac{m}{\sqrt{1-v^2/c^2}} = -G\cdot\frac{Mm}{R^2}\cdot e^{-a/R} = -K.}}$$

**Law of Inertia**. It establishes the **Conservation of Momentum**, because $b = 0$ if $K = 0$, hence $v$ = constant.

This law has not been postulated, not even indirectly, it is a consequence of the Energy-Conserving Gravitational Law.

The left side is mass times acceleration (note: the mass is the relativistically *increased* mass), the right side is the cause of the acceleration, the gravitational force, with the relativistically *decreased* mass, $me^{-a/R}$.

The equation has been derived under the condition that force and acceleration are directed toward the center. There are good reasons for the assumption that *all* forces including electromagnetic ones are central forces (**Page 50-52**), but the electromagnetic force is stronger by a factor of about $(10^{21})^2$. For central forces, this is easily proved. From Equ.(3.2) we obtain for the acceleration, b:

**(3.3)** $$b = -GM\frac{\sqrt{1-v^2/c^2}}{R^2}\cdot e^{-a/R},$$ 'b' is directed toward the center.

The negative sign is the condition for balancing the central force. b = 0 implies R = 0 *or* R = ∞.

This differs from the prediction of the widely accepted Source-free Relativity Theory, where in case of a sufficiently concentrated central mass, a Black Hole should appear according to the following argument: Near the so-called Schwarzschild horizon, the velocity of free fall approaches the velocity of light and the acceleration of free fall becomes infinite even for photons. That is the conclusion in the conventional Source-free Theory, whatever one may understand under it. In contrast to that prediction, the Energy-conserving Gravitation Law does *not* lead to the singularity of Black Holes. From Equ.(3.1) we obtain

**(3.4)** $\mathbf{\sqrt{1-v^2/c^2} = e^{-a/R}}$ . This inserted for the root in Equ.(3.3):

**(3.5)** $$\underline{\mathbf{b = -\frac{GM}{R^2}\cdot e^{-2a/R}}}$$ = **acceleration, b, of a mass, m, expressed as function of R**.

For $e^{-2a/R} = 1$ we get $b = GM/R^2$ in accordance with the Classic Law.

For R = 0 is b = 0. In contrast to both, source-free relativity *and* classical law, the gravitation has disappeared. Hence, **there is no Black Hole** and nothing can prevent the energy from escaping by radiation. All results have been derived without the assumption of curved space. From Equ.(3.4) we get:

**(3.6)** $\mathbf{v = c.\sqrt{1-e^{-2a/R}}}$ = velocity of free fall **as function of R**. v = c *only* when R = 0.

This, too, indicates the impossibility of Black Holes. If a mass reaches the center, then it must be transformed into radiation and can escape (radiation can escape in any case because gravitation is not sensed in the direction in which light propagates). This does not preclude that – due to other physical effects – mass can be

transformed into radiation at a far greater distance. An example is a meteor's impact on the surface of the earth and its kinetic energy is transformed into heat. Eventually, heat will be radiated. (→P.49, Ch. 3.15).
When R >> 2a, then the function $e^{-2a/R} \cong 1 - 2a/R$, hence with $a = GM/c^2$, the velocity (Equ. 3.6) is

$$v \cong c.\sqrt{\frac{2GM}{c^2R}} = \sqrt{2GM/R}$$ in accordance with v expressed by classical law.

It should not be forgotten that all these results are based on the Clock Experiment. These results are not only a conceivable but a *compelling* alternative to Relativity as it has hitherto been understood.
Some conclusions from Equ.(3.5) and (3.6) are of cosmological interest and will be discussed later.

## 3.3 Symmetry of Masses to the Center of Gravity

What first catches the eye of experts is the asymmetry of the Energy-Conserving Law of Gravity

$\mathbf{K_1 = G\frac{M \cdot me^{-a/R}}{R^2}}$. Due to the factor $e^{-a/R}$, it looks as if "m" had a higher priority for gravitation than "M".
*However for an observer on the other mass, this formula obviously appears to be identical:*

$\mathbf{K_2 = G\frac{m \cdot Me^{-a/R}}{R^2}}$. Though $K_1$ and $K_2$ have the same form, they are not equal – because their constants 'a' are different in the exponents for $K_1$ and $K_2$: $a_1 = GM/c^2$ and $a_2 = Gm/c^2 \neq a$. This destroys the equilibrium of the forces. The principle **actio = reactio** requires that $K_1 = K_2$. Moreover, the observers would measure different values for the same relative velocity, namely

for m $v_1 = c\sqrt{1-e^{-2a_1/R}}$, and for M $v_2 = c\sqrt{1-e^{-2a_2/R}}$ [for v, see **Equ.(3.6), Page 22**].

The conditions $K_1 = K_2$ and $v_1 = v_2$ will be met only if the distances of the two masses were different for each mass. This seem to be paradoxical because we would have to assume

for $K_1 = K_2$ $v_1 = c\sqrt{1-e^{-2a_1/R_1}} = v_2 = c\sqrt{1-e^{-2a_2/R_2}}$. This can be true only if

$\frac{a_1}{R_1} = \frac{a_2}{R_2}$. However, $a_1 = \frac{GM}{c^2}$ and $a_2 = \frac{Gm}{c^2}$. The exponents will be equal if $a_1/R_1 = a_2/R_2$,

$\frac{GM}{c^2R_1} = \frac{Gm}{c^2R_2}$ Hence, $\mathbf{mR_1 = MR_2}$. This formula, however, reveals the solution of the paradox, because it is the **condition for the common center of gravity, S**. The condition is defined as:

**(3.7)** $\mathbf{M}\bullet\xrightarrow[v_2]{}\cdots R_2 \cdots o_S \cdots R_1 \cdots \xleftarrow[v_1]{}\bullet\,\mathbf{m}$ and $\mathbf{R = R_1 + R_2}$, $\mathbf{MR_2 = mR_1}$.

This means: the "distance", R (in the exponent a/R), must be understood not as the distance between M and m, but as individual distances to their common center of gravity. Then, not only $v_1 = v_2$ but also the forces and the acceleration will be in equilibrium and the principle of symmetry **– actio = reactio** – is met. Of course, this has to be proven mathematically. In order to do that, we proceed as before:
From **(3.7)** we obtain $R_1 = \frac{RM}{M+m}$, and $R_2 = \frac{Rm}{M+m}$. Analogous to Equ.**(1.2)** and **(1.4)**, **Page 5**, we write

**(1.2a)** $E_{pot} = [M+mf(R_1)]c^2$, $\mathbf{K = \frac{dE_{pot}}{dR} = mc^2\frac{df}{dR_1}\frac{dR_1}{dR} = \frac{Mmc^2}{M+m}f'(R_1) = \frac{GMmf(R_1)}{R^2}}$ $\Leftarrow$ **(1.4a).**

From this, we derive in the same manner as before $\ln f = -\frac{G(M+m)}{c^2R}$, written as an **e**-function:

$$\boxed{\mathbf{(1.5a)} \quad \mathbf{f(R_1) = e^{-a/R}} \quad \text{with} \quad \mathbf{\frac{a}{R} = \frac{G(M+m)}{c^2R} = \frac{GM}{c^2R_1} = \frac{Gm}{c^2R_2}}.}$$

When applying Equ.(1.6) to (1.9), it should be realized that $R_1$ and $R_2$ in the exponent a/R refers to the common center of gravity and *not* to the distance R between m and the central mass, M. If the whole distance, R, between the two masses is written in the exponent, then we must write the sum "M+m" instead of "M". Then, the symmetry of the equation is evident.

$R_o$ in the exponent $(a/R_o)$ of Equ. (1.6) to (1.9), **Page 6**, must be replaced by $R_1$ or $R_2$.

## 3.4 Dependence of Mass on Direction

**Fig. 3.2** shows the mass when observed from various angles, $\alpha$, relative to the direction v of free fall. When $\alpha = 0$, then the mass decreases by the factor $e^{-a/R}$ according to **Fig. 1.3, Page 6**. Then no energy will be *extracted* orthogonally to this direction because the orthogonal velocity $v_{quer} = 0$. However, if viewed from an $90^o$ angle, the mass appears increased relativistically to $m/\sqrt{1-v^2/c^2}$, like any other mass with the same transverse velocity, v, regardless of the cause of that velocity. Of course, v is caused by free fall, but the cause does not matter when the distance *to the observer* does not change.

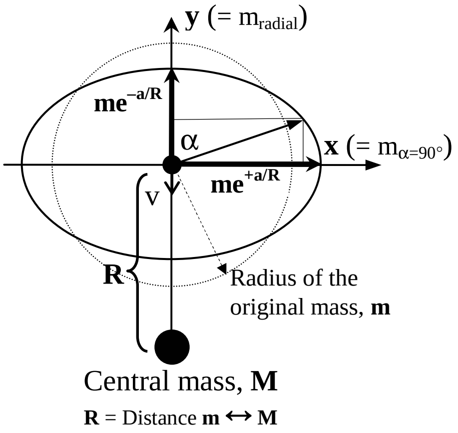



**Fig 3.2**

As will be shown later, Equation (**3.4**) $\sqrt{1-v^2/c^2} = e^{-a/R}$ is true for falling from $R = \infty$. Hence, the gravitational mass is

in the direction of R $\quad = me^{-a/R} = m\sqrt{1-v^2/c^2}$

and orthogonal to R $\quad = me^{+a/R} = m/\sqrt{1-v^2/c^2}$

For observation angles $|\alpha| < 90^o$, the mass has two orthogonal components, shown in the diagram by squeezing a circle to an ellipse. The equation of the ellipse is $x^2/A^2+y^2/B^2 = 1$.
With the semi-axes $A = me^{+a/R}$ and $B = me^{-a/R}$, we obtain

$\mathbf{x^2e^{-2a/R} + y^2e^{+2a/R} = m^2}$, or, expressed by the angle $|\alpha| \le 90^o$, as parameter (shown by a simple calculation):

$$\mathbf{x = m_{transv} = \frac{me^{+a/R}tg\alpha}{\sqrt{tg^2\alpha + e^{+4a/R}}}}, \quad \mathbf{y = m_{radial} = \frac{me^{+a/R}}{\sqrt{tg^2\alpha + e^{+4a/R}}}}, \quad \mathbf{\frac{x}{y} = tg\alpha}$$

The <u>relation</u> of the semi-axes is $= \dfrac{m_{\alpha=0^o}}{m_{\alpha=90^o}} = e^{-2a/R}$, because $m_{\alpha=0} = me^{-a/R}$ and $m_{\alpha=90} = me^{+a/R}$.

For R = 0, the mass $m_{\alpha=0}$ disappears completely. The gravitational quality of the mass, m, decreases in the direction of R by the factor $e^{-a/R}$, but orthogonal to that direction, it increases – by the reciprocal factor, $e^{+a/R}$, which is the factor of its relativistic increase due to velocity (the velocity, v, of free fall). So already here, the important fact can be recognized that the kinetic energy has no gravitational quality in the direction it moves, but it is not lost, because its gravitation is twice as much in the orthogonal direction ($e^{+2a/R}$). (This will be confirmed later by further arguments.) The doubled gravitation is the cause of two effects:

(1) the small rotation of the axis of the planetary orbits ("advance of the perihelion") and
(2) twice the deflection of light near large masses, both compared with the classical values.

For many scientists, the <u>de</u>crease of a mass when approaching the center of gravity may be a surprise but nevertheless convincing because the mass supplies the kinetic energy. However, that the mass decreases exclusively in the direction of movement seems to be arbitrary and even incompatible with the theory. Should "mass" not be independent of direction because mass is a scalar? However, it differs to a certain extent from a scalar. The dependence of mass on direction of movement is even one of the best established facts in Special Relativity. There are two forms of mass: <u>Longitudinal</u> (radial) and <u>Transversal</u> Mass (orthogonal to R). Just one crucial problem has not been answered because not recognized: Which of this two is responsible for gravitation? The answer is simple, because responsible can only be that mass which can be recognized by the falling mass from its point of view. If that problem had been seen and answered earlier, then most likely the Energy-conserving Gravitation would not have been overlooked, and the history of the theory would have been different.

The <u>product</u> of the semi-axes is $AB = m^2$. This means that the area of the ellipse (= $AB\pi$) is proportional to the square of the original mass, this means with the square of the total energy. The latter is $mc^2$ = constant (not dependent on direction). Of course, both, the area of the ellipse and the area of the circle, are equal.
The area of the two crescent-shaped sections of the circle above and below the ellipse is proportional to the square of the kinetic energy. That area equals the area of the crescents attached right and left of the circle. The overlapping area of circle and ellipse is proportional to the square of the remaining gravitational energy. "Original Mass" and "Rest Mass" are synonymous in this context. For radiation, the area of the circle is zero. Radiation consists solely of kinetic energy.

The sum of kinetic energy and potential energy remains constant = $mc^2$. If a mass m drops from an infinite distance to R then its energy decreases by the amount of the kinetic energy from $mc^2$ to $mc^2e^{-a/R}$. However at any distance the kinetic energy acquired can be refunded to the mass by storing the energy equivalent of the kinetic energy inside the mass.
For instance the kinetic energy can be stored by elastic deformation of the dropping mass, or in form of heat in it. However the energy stored in this way is not of the same kind as the intrinsic energy of the atomic mass at infinite distance (the rest mass). That means: Even if the energy is stored as elastic energy or as heat the mass of its atoms remain less than that at infinite distance, hence at the distance R each spectral frequency of the atoms is less than at infinite distance.

## 3.5 Force Orthogonal to Velocity

One result of the Relativity Theory was disturbing for many physicists. If a force is applied *orthogonally* to the velocity of a mass, then the standard relativistic calculation (derived by using the law of conservation of momentum) yields an increase of the mass by the third power of the common relativistic transform factor $1\Big/\sqrt{1-v^2/c^2}$ , that is: $m\Big/\left(\sqrt{1-v^2/c^2}\right)^3$ . This implies that one and the same object should have two different masses, called "transversal" and "longitudinal" mass. Multiplying by $c^2$ yields two different energies:

**(3.8)** The one is $E_{trans} = \dfrac{mc^2}{\sqrt{1-v^2/c^2}}$ and the other is $E_{long} = \dfrac{mc^2}{\left(\sqrt{1-v^2/c^2}\right)^3}$.

Some physicists present this result without comment. If comments are made, they may be difficult to understand; in any case, the result is disturbing. It makes no sense to quote these comments without its context, particularly since the solution for this problem is simple. With the Energy-Conserving Gravitation Law it is easy to explain where the additional energy, $E_{trans}- E_{long}$, is concealed and why it is *not* part of the kinetic energy of the orthogonal movement.

First, the problem must be specified more precisely because different kinds of energy are involved. Let us assume a well-defined mass, m, moves at the velocity, u. At the same time we accelerate it orthogonal to u, however in such a way that the intrinsic (inner) energy, $mc^2$, of the mass, m, will not be changed by gravitation. We wish to know only the change of mass which is caused by its acceleration due to the laterally applied force, K. I will explain why, see Fig.(3.3):

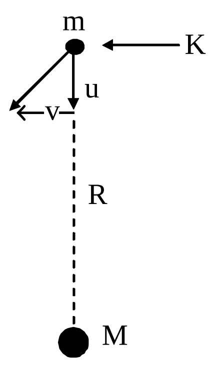



**Fig. 3.3**

**Fig. (3.3)** shows the velocity, u, of the mass, m, by an arrow pointing downward. All the masses of the universe are continually exposed to mutual gravitation, hence we can assume that the velocity, u, is caused by free fall of the mass, m, toward an imagined central mass, M. The value of M must be defined: it should produce the momentary velocity, u, of m. The location of M can be used as reference point.

No other location fits better to all possible constellations, because, with this assumption, each system can be transformed into a closed system. I will show that this is a consequence of Energy-Conserving Gravitation. Let us start with Einstein's **Principle of Equivalence**, that is: inside a closed system it is impossible to decide whether an accelerating velocity of a mass, m, is an effect of an opposite *acceleration* of the whole system or an effect of an external *gravitational* Mass M. Due to energy conservation, we can, for *any* movement, calculate such a gravitational mass, M.
First we state:

The movement of the mass, m, depend on three functions of time:
1. Direction, 2. Velocity, 3. Acceleration (b).

The central mass to be determined must be located in the direction of acceleration, b (b pointing toward M). With both, the velocity component, $u_b$, in the direction of acceleration, and the amount of acceleration, we can calculate M and R by using the following Equations of **Page 22**:

**Equ.(3.3)** $b = -GM\dfrac{\sqrt{1-u_b^2/c^2}}{R^2}\cdot e^{-a/R}$ and **Equ.(3.4)** $\sqrt{1-u_b^2/c^2} = e^{-a/R}$ .

Of course, the mass, M, may also have a velocity component, $\vec{u}_b$, orthogonal to the acceleration. Then, the vectors $\vec{u} = d\vec{R}/dt$ and $\vec{b} = d\vec{u}/dt$ define the relative movement of the masses M and m.
The two equations (**3.3**) and (**3.4**) yield M and R as a function of these vectors:

$$M = M(\vec{u}, \vec{b}, m) \qquad \text{and} \quad R = R(\vec{u}, \vec{b}, m), \qquad \text{with } \vec{u}, \vec{b} \text{ being functions of time.}$$

By solving these equations we obtain the movement of the mass, m, for the preceding and the following time. So we have proved: Every movement of a mass in any time interval can be understood as a two-body problem of gravitation, which, *in principle*, is solvable. (The calculation need not be made in detail here.)

Now we accelerate the mass, m, orthogonally to the velocity, u, until the transverse velocity, v, is reached. According to Special Relativity, the amount of the transmitted kinetic energy must be

**(3.10)** $$E_{\mathbf{kin/orthogonal}} = \frac{mc^2}{\sqrt{1-v^2/c^2}} - mc^2$$ (*<u>This</u> kinetic energy corresponds to the transverse velocity,* v.)

The first term expresses the increased mass $m_{\mathbf{pot/orthogonal}} = \frac{m}{\sqrt{1-v^2/c^2}}$, indicated as “potential”.

That mass must be inserted into Equations (1.6) and (1.8) in the place of m, since the gravitation of the kinetic energy acts orthogonally to the direction of movement. Hence Equ.(**1.6**) and (**1.8**), **Page 6**, must be written with the increased masses:

**(3.11)** $$E_{pot} = (M + \frac{m}{\sqrt{1-v^2/c^2}} e^{-a/R})c^2$$ and **(3.12)** $$E_{kin} = \frac{m}{\sqrt{1-v^2/c^2}} c^2(1 - e^{-a/R}).$$

The transverse velocity, v, has increased the *radially* acting mass. This increased mass, $\frac{m}{\sqrt{1-v^2/c^2}}$, has been substituted for m in Equ.(3.11). Note that we have *two* kinetic components of the energy:

1. the u component in the direction of R (↓ to the center, M), and
2. the v component orthogonal (⟵) to R.

According to energy-conserving gravitation, the kinetic energy of *free fall* emerges at the *expense* of the primary mass. However, above, we have emphasized that the primary mass must remain constant with the exception of the increase caused by the force which is applied laterally. This we have done in order to find the energy required to accelerate m *exactly* orthogonally to the velocity, u ($\neq 0$). It implies that the mass, m, should not be altered by other effects. Free fall *is* another effect. In this case, however, this is impossible to realize because stopping the free fall would slow down the velocity, u, and this would destroy the premise. However, an alternative exists: *The energy supplied by the orthogonally acting force must be restored in the equation by exactly the same amount of energy which is lost in free fall at the expense of the falling mass.* This means the kinetic energy of Equ.(**3.11**) for the rectangular acceleration of m must be made equal the kinetic energy of the free fall according Equ.(**3.12**). Then, both energies increase simultaneously by the same amount. The one is added and the other subtracted, so the mass will not change. This is the case when

**(3.13)** u = v *and* Equ.(**3.10**) = Equ.(**3. 21**): $$\frac{mc^2}{\sqrt{1-v^2/c^2}} - mc^2 = \frac{m}{\sqrt{1-v^2/c^2}} c^2\left(1 - e^{-a/R}\right).$$

In order not to become lost in abstract formulas, it will be helpful – prior to further calculations – to look at the trajectory of a mass when the condition above is met. The shape of the curve follows directly from the condition u = v. This is the condition of the so-called **<u>logarithmic spiral of Fig. 3.4</u>** when the radius, R, intersects the curve at each point with the same constant angle, in this case 45°.

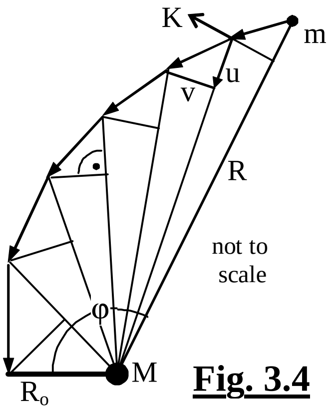



**Fig. 3.4**

the equation of the logarithmic spiral is:

**(3.14)** $R = R_o \cdot e^{\varphi}$ with $R = R_o$ at $\varphi = 0$. ($\varphi$ in radians).

After solving the brackets at the right formula of Equ.(**3.13**) and reduction, an equation remains which can easily be recognized as the condition for energy conservation for $E_{pot}$:

**(3.15)** $$mc^2 = \frac{m}{\sqrt{1-v^2/c^2}} c^2 e^{-a/R}$$ (This means: the energy decrease by $e^{-a/R}$ is compensated by the increase of m by the root in the denominator)

With dv/dt = b and dR/dt = v, we get the derivation with respect to t

**(3.16)** $$0 = \frac{mv}{c^2\left(\sqrt{1-v^2/c^2}\right)^3} b \cdot e^{-a/R} + \frac{m}{\sqrt{1-v^2/c^2}} \cdot \frac{a}{R^2} \cdot e^{-a/R} u\,.$$

Since $a = \frac{GM}{c^2}$ and because an orthogonal force requires that u = v [Equ.(3.13)] (the condition for orthogonality of K and u), the equation can be reduced by v, u, $e^{-a/R}$ and $c^2$. The result is

**(3.17)** $$\mathbf{b.\frac{m}{\left(\sqrt{1-v^2/c^2}\right)^3} = -G\frac{M.\frac{m}{\sqrt{1-v^2/c^2}}}{R^2} = -K\,.}$$

**<u>This is the Law of Inertia for a force orthogonal to gravitation</u>**

The factor $e^{-a/R}$ has vanished. This factor stands for the decrease of the potential energy. In this case however, the decrease of energy was returned by applying the orthogonal force. Three energy quantities had to be introduced by the orthogonal force in order to maintain the orthogonality.

1. The kinetic energy for the orthogonal velocity, v: $E_{kin(v)} = m\left(\frac{1}{\sqrt{1-v^2/c^2}} - 1\right)c^2$.
2. The kinetic energy of the free fall, which has to be restored to the mass, m. Because u = v , its value is the same as $\mathbf{E_{kin(v)}}$ of Item 1 above.
3. This, however, is not sufficient for conservation of the primary mass, m. The reason is the additional gravitational effect caused by the kinetic energy of the orthogonal movement. This effect increases the energy of the free fall which in any case is extracted from the mass (its source). This additional loss of mass must be restored, too. Its value equals each one of the other two energies as can be seen in Formula (**3.17**) where m on the right side is increased by the same reciprocal root factor.

That threefold energy increase introduced by the orthogonal force corresponds to the third power of the reciprocal root factor on the left side. It appears as an "**<u>Orthogonal Mass</u>**" which includes the additional fall energy and the additional potential energy, each having the same value. (The increased mass in the *<u>orthogonal</u>* direction is well known in the Special Theory, but its designations, "longitudinal" and "transverse", are sometimes confused in the literature.)

The right side of Equ.(**3.17**) represents the gravitational force with the effective mass. In the Special Relativity Theory, usually only this mass is discussed, and *in this text* it is designated "**<u>Longitudinal Mass</u>**".

Calculation of the orthogonal mass as shown in this text reveals more than an explanation of the phenomenon "Orthogonal Mass"; it provides additional insight which would be difficult to find by using the customary source-free gravitation. It is explained as following:

1. An acceleration exactly orthogonal to *gravitation* occurs only if the orthogonal force causes a velocity of the same absolute value as the velocity due to gravitation. If a two-body system is assumed, then the condition for orthogonality requires a force of an amount which is equal the gravitational force toward M. If the force has a greater value, then only that part which equals the gravitational force will satisfy Equ.(**3.17**). An excess satisfies the mass increase according to Equ.(**2.2/1**) of Page **14**. It would be difficult to understand this with the usual interpretation of the Relativity Theory.
2. A force orthogonal to gravitation generates a trajectory in the form of a logarithmic spiral which intersects the radial direction at an angle of 45°.

3. The mass, m, in Equ.(**3.17**) can be eliminated on both sides. This is of great importance. It means that the equation remains valid when the mass, m, changes, and it can change if the energy for the orthogonal movement is extracted from that mass. This does not contradict the required constancy of the mass mentioned above, since that constancy is required only for the *relationship* of the three parts of that mass, not for the absolute value of their sum. This can be seen easily if we subdivide the movement into small steps and consider each step by itself. Between each step, the mass can be reduced by that small part, dm, which produces the rectangular movement of the following step. Within each step itself, however, the mass remains constant.

## 3.6 Relativistic Orbits

**Equation of an Ellipse** in Polar coordinates R and φ:

(3.18) $\mathbf{R} = \dfrac{p}{1+\varepsilon\cos\varphi}$, with $p = \dfrac{b^2}{a}$ and $\varepsilon = \dfrac{e}{a} < 1$

Designations: Perihelion = point nearest the sun
Aphelion = point farthest the sun.

φ = "true anomaly" E = "average anomaly".

**Symbols: R**

Primed: Derivative respective to φ, e.g. $R' = dR/d\varphi$, $R'' = d^2R/d\varphi^2$

Point: Derivative resp. t, e.g. $\dot{R} = dR/dt$, $\ddot{R} = d^2R/dt^2$, $\dot{\varphi} = d\varphi/dt$

Velocities: commonly v or u.

$\dot{\varphi}$ = angular velocity, $\dot{R}$ = radial velocity

$v_q$ = velocity orthogonal (transverse) to distance R, $v_q = R\dot{\varphi}$

If confusion is excluded v may be written in place of $v_q$ and $\dot{R}$

$v = \sqrt{v_q^2 + \dot{R}^2}$ = orbital (tangential) velocity

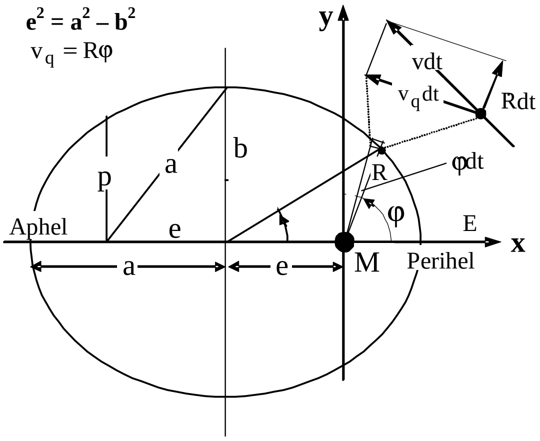



**Fig. 3.5**

The following is assumed to be known:

(3.19) **Kepler's Law of Equal Areas $R^2\dot{\varphi} = F$ = constant** (valid for all central forces). Hence

(3.20) $\int_0^t R^2\dot{\varphi}dt = \int_0^t Fdt = Ft.$ **2nd Law of Kepler** and **(3.21) Transverse velocity** $v_q = \dot{\varphi}R = \dfrac{F}{R}$.

(3.22) **Centripetal acceleration** $b = \dfrac{d^2R}{dt^2} = \dfrac{v^2}{R}$ ($v = v_q$ = velocity orthogonal to the distance R).

Now Newton's friction free equation of movement can be written directly as the condition of equilibrium of all forces acting upon m according to the principle actio = reactio:

**Inertia + mass attraction K = centripetal force** (**K= GMm/R²** = Gravitation Law of Newton).
Commonly that is written with interchanged components as follows:

(3.23) $m\ddot{R} - mR\dot{\varphi}^2 = -\dfrac{GMm}{R^2}$. Additionally, the Law of Equal Areas: $\dot{\varphi} = \dfrac{F}{R^2}$, which is the supplementary condition that $GMm/R^2$ is a central force. Integration of this differential equation yields:

(3.24) $R = \dfrac{F^2/GM}{1+\varepsilon\cos(\varphi-\alpha)}$. **General Equation for Orbits and Comets according to Newton**

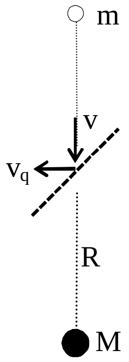



**Fig. 3.6**

Now the *Relativistic* Equation of Movement can be derived. Consider **Fig. 3.6** where a mass, m, while falling a short distance to M, is deflected in the horizontal direction. The horizontal component, $v_q$, reaches its maximum when the velocity, v, toward the center disappears. The following does not deal with the mechanism which leads to the horizontal deflection but with the effects resulting from such a deflection.

In the course of falling, the mass, m, *decreases* by the mass of the kinetic energy, $E_{kin}/c^2 = mv_q^2/2c^2 = m_q$, and with it, its force of gravitation. *If*, however, that energy is *not* removed but *returned* to the mass, m, then neither m nor its gravitational force will decrease. This can be realized by slowing down the mass by braking in such a way that its kinetic energy becomes stored *inside* the mass, e.g. as *heat*, or as *tension in a spring* which is part of m. In our case, the mass m becomes accelerated by transforming the energy of free fall into kinetic energy = $mv_q^2/2$ to a velocity, $v_q$, orthogonal to R until the energy of the fall reaches zero. The increase of the centrifugal force controls the braking. The deceleration force can be compared with a buffer spring (which is a part of the falling mass, m).

Note: The *cause* for retaining the original mass is not the orthogonal velocity, $v_q$, but *deceleration* of the velocity of free fall. To take this into account, the factor $e^{-a/R}$, or simply the change of the mass on the way from $R_{max}$ to $R_{min}$, is governed by the Law of Gravitation. That, however, will not be sufficient because it would restore the original condition only if the gravitation of the kinetic energy would be independent of direction (as it is for bodily masses). For instance, energy stored as heat or as tension in a spring exerts gravitation independent of direction. Kinetic energy however, has no gravitation in the direction of movement. The *decrease in mass* in the direction of movement is equal to the *increase* in mass orthogonal to it, and in this direction it excerts gravitation. The average value of the mass, m, remains constant. Because gain and loss are equal relative to the average value, the mass difference is twice the mass of the kinetic energy. The mass of the kinetic energy is $\underline{m}_q = E_{kin}/c^2$. Hence the increase in gravitational mass compared with the mass as defined by inertia is twice $\underline{m}_q$, and due to the 90° deflection, that increase is active in the radial direction. Formulated mathematically:

Compared with the inertial mass, $\underline{m}_q$, the gravitational mass of the kinetic energy is $= 2\,mv_q^2/2c^2$.

The argumentation must be reversed if the mass regains its gravitation potential through an *increasing* distance, R. Then, the horizontal movement slows down and its kinetic energy restores the potential energy.
The same consideration follows from the condition of orthogonality, which also requires two identical amounts of energy. One is the kinetic energy needed for the orthogonal movement, the other is the additional energy of free fall (returned by braking), as already pointed out with Equ.(3.13) on Page 26-27.

Because the horizontal velocity, $v_q$, of planets is always far less than the velocity of light, the kinetic energy can be expressed by the classical formula without a measurable loss of accuracy.

**(3.25)** $E_{kin/orth}v_q = \dfrac{mv_q^2}{2} = \dfrac{mF^2}{2R^2}$ $\quad [v_q = \dot{\varphi}R = \dfrac{F}{R}$ see Equ.(3.21)]. Its Mass $m_q$ is

**(3.26)** $m_q = \dfrac{E_{kin/orth}}{c^2} = \dfrac{mv_q^2}{2c^2} = \dfrac{mF^2}{2c^2R^2}.$ (For the following, see Chapter 13, Page 82)

Due to the twofold effect, we have to add twice the force of that utterly small mass ($m_q$) to the gravitation. Since for planets $e^{-a/R}$ is always nearly 1, the *classic* formula $E_{pot} = GMm_q/R$ is extremely accurate.

**(3.27)** $E_{pot/orth} = 2\dfrac{GMm_q}{R} = \dfrac{GMmF^2}{R^3c^2} = \dfrac{2GM}{Rc^2}\cdot\dfrac{mF^2}{2R^2} = \dfrac{v^2}{c^2}\cdot\dfrac{mv_q^2}{2}$ $\quad [m_q, v_q$ from Equ.(3.26)], and

**(3.28)** $K_{kin/orth} = \dfrac{dE_{pot/cross}}{dR} = \dfrac{d}{dR}\left(\dfrac{GMmF^2}{R^3c^2}\right) = -3\dfrac{GMmF^2}{c^2R^4}$ = an *additional* force of gravitation.

In order to obtain the relativistic setup of the mechanics for celestial bodies, we only have to insert this *additional* force into the classical setup, Equ.(3.23) (instead the *relativistic* factor $e^{-a/R}$).

Equ.(**3.23**) $m\ddot{R} - mR\dot{\varphi}^2 = -\dfrac{GMm}{R^2}$ (Classic Differential Equation for Planetary Orbits**)** **+** Equ.(**3.28**):

(3.29) $$\mathbf{m\ddot{R} - mR\dot{\varphi}^2 = -\frac{GMm}{R^2} - 3\frac{GMmF^2}{c^2R^4}}$$ **Differential Equation for Planetary Orbits according to Energy-conserving Gravitation**

The sign of the additional force must be the same as the sign of the central force. The equation is identical with the relevant equation in textbooks. In these textbooks, however, it is derived in a much more complicated way from the Schwarzschild solution of Einstein's field equations using the tensor algorithm. Now, with the Energy-conserving Law of Gravitation, we have obtained the same equation in a simpler way. The formula is valid for any R where the factor $e^{-a/R} \cong 1$, that is, when the condition of Equ.(3.25) is met.

Bernhard Baule (see Page 110) showes the two components of the gravitational force: (1) the radial componente directed to the center, and (2) the component which is orthogonal the radial direction in the plane of the orbit. An energy exchange (= force $\times$ way) occures only if the radial direction changes. Then the mass changes relativistically. But the force orthogonal to the movement is in balance with the centrifugal force. It causes bending of the movement with the radius ρ of curvature and proportional to 1/ρ. This can be seen on the moon circling around the earth. Though the moon continually "falls" toward the earth his distance does not decrease. Hence its fall energy (longitudinal energy) is cero, but the rotational energy is part of the system energy and is not cero (= transversale energy, this means tangential).
The same holds true for the movement of planets around the sun.

the forces are (**ρ** = Krümmungsradius):

$$\mathbf{k \rightarrow = \frac{m_0}{\left[1-\left(\frac{v}{c}\right)^2\right]^{3/2}} dv/dt} \quad \textbf{(tangential)} \qquad \mathbf{k \downarrow = \frac{m_0}{\sqrt{1-\left(\frac{v}{c}\right)^2}} \frac{v^2}{\rho}} \quad \textbf{(longitudinal)}$$

The setup of Equ.(3.29) is composed of derivations with respect to time. In order to find the trajectory in *polar coordinates* R and φ, i.e. R = R(φ), we need the differential equation in R and φ. For that we have to substitute the time derivatives by derivatives with respect to R and φ

(3.30) $$R' = \frac{dR}{d\varphi}, \qquad R'' = \frac{d^2R}{d\varphi^2}$$ in the following way ( $\dot{\varphi} = \frac{F}{R^2}$ eliminates the time):

$$\dot{R} = \frac{dR}{d\varphi}\frac{d\varphi}{dt} = R'\dot{\varphi} = R'\frac{F}{R^2},$$ and the second derivative:

$$\ddot{R} = \frac{d\dot{R}}{d\varphi}\frac{d\varphi}{dt} = F\frac{R^2R'' - 2RR'^2}{R^4}\dot{\varphi} = \frac{F^2}{R^6}\left(R^2R'' - 2RR'^2\right).$$ With Equ.(**3.29**) and $\dot{\varphi} = \frac{F}{R^2}$:

(3.31) $$\frac{F^2}{R^6}\left(R^2R'' - 2RR'^2\right) - R\frac{F^2}{R^4} = -\frac{GM}{R^2}e^{-a/R} - 3\frac{GMF^2}{c^2R^4},$$ That multiplied by $\frac{R^2}{F^2}$:

(3.32) $$\mathbf{\frac{RR'' - 2R'^2}{R^3} - \frac{1}{R} = -\frac{GM}{F^2} - 3\frac{GM}{c^2R^2}}$$ **Relativistic Equation for Orbits with Energy-conserving Gravitation.**

That equation can be simplified by the substitutions

(3.33) $y = 1/R$, $R = 1/y$, $y' = -\frac{R'}{R^2}$, $R' = -\frac{y'}{y^2}$, $y'' = -\frac{R''R - 2R'^2}{R^3}$. We obtain

(3.34) $$\mathbf{y'' + y = \frac{GM}{F^2} + 3\frac{GM}{c^2}y^2}$$ **Energy-conserving Relativistic Motion with y = 1/R.**

**Einstein's** Relativistic Equation of Motion is identical: (c = velocity of light)

(3.35) $$y'' + y = \frac{\overline{m}}{h^2} + 3\overline{m}y^2.$$ Therein h = F/c, $\overline{m} = GM/c^2$, $F = R^2\dot{\varphi}$, y = 1/R.

If the quoted symbols are introduced, then Equ.(3.34) is identical with Einstein's Equ.(3.35). However, our deduction of Equ.(3.34) is simpler because, due to Energy Conservation, no additional curvature of space is required (with its extremely intricate mathematics).

The setup for the **Classical Celestial Mechanics** is given in Equ.(3.23) $m\ddot{R} - mR\dot{\varphi}^2 = -\frac{GMm}{R^2}$.
Because there is no "disturbance" term, the deduction of Equ.(3.32)+(3.34) given above is simpler:

**(3.36)** $\frac{RR'' - 2R'^2}{R^3} - \frac{1}{R} = -\frac{GM}{F^2}$. **Differential Equation for Celestial Bodies according to Newton.**

With the same substitution Equ.(3.33)] but without the term $\frac{3GMmF^2}{c^2R^4}$, it remains

**(3.37)** $y'' + y = \frac{GM}{F^2}$. This can be verified by differentiation. Its solution is

**(3.38)** $y = \frac{GM}{F^2} + C\cos(\varphi - \alpha) = \frac{1}{R}$ (C and α are integration constants).

The solution has already been quoted in its reciprocal form in Equ.(3.24). We insert C = $\varepsilon GM/F^2$:

**(3.39)** $\mathbf{y = \frac{GM}{F^2}(1 + \varepsilon\cos\varphi)}$ General equation for all orbits (α = 0). With R = 1/y:

**(3.40)** $\mathbf{R = \frac{F^2/GM}{1 + \varepsilon\cos(\varphi - \alpha)}}$ **= Equ.(3.24) General Equation for Orbits of Planets and Comets according to Newton**

Comparison with Equ.(3.18) for the **ellipse** shows p = $F^2/GM$. F and ε depend on the initial conditions. In case of an ellipse, $|\varepsilon| < 1$, shown in **Fig. 3.5 (P. 28)** with the principal axis at φ = 0, α = 0, 0< ε < 1. The principal axis of the **ellipse** is inclined by the angle α to the coordinate axis ($\varphi_{axis}$ = 0). The shortest distance, R, from m to M, the perihelion, appears at $\varphi = \alpha$ where $\cos(\varphi - \alpha) = 1$.

An advancing perihelion would be indicated by an increase of α in each cycle.

Orbits other than ellipses also result from Equ.(3.18). These are:

**Circle** for ε = 0 (p = R), **Hyperbola** for ε = 1, and **Parabola** for ε > 1.

Typical values for $e^{-a/R}$ differ from 1 only by $10^{-9}$ to $10^{-10}$, whereas for G only four decimal places are known; by measurements with satellites, additional decimal places will be added. So, in most cases, the factor $e^{-a/R}$ can be ignored if R >> a, since the difference is far beyond being measurable. It is important only as a principle.

The last term, $3\frac{GM}{c^2}y^2$ in Equ.(3.34) or (3.35), prevents a closed solution. In order to find an approximate solution, an iterative method can be used, beginning by inserting for y the classical solution Equ.(3.39) into the right side of Equ.(3.34). Next, a new y should be found as a particular solution of this new equation. The same procedure can be repeated, but in this case, the first approximation is already very accurate and sufficient. So we insert the square of y from Equ.(3.39) into the right side of Equ.(3.34):

**(3.41)** $y'' + y = \frac{GM}{F^2} + 3\frac{G^3M^3}{F^4c^2}(1 + 2\varepsilon\cos\varphi + \varepsilon^2\cos^2\varphi)$. Now we have to find particular solutions and insert them at the left of the respective classical differential equations. By superposition, we obtain the disturbance functions at the right. We check each one of these functions by equalizing $y'' + y$ with one of the disturbance terms:

[note: $\cos^2\varphi$ = ½+ ½ cos2φ]

**(3.41-I)**. $y'' + y = 3\frac{G^3M^3}{F^4c^2}$ particular solution: $y = 3\frac{G^3M^3}{F^4c^2}$

**(3.41-II)** $y'' + y = 2\varepsilon 3\frac{G^3M^3}{F^4c^2}\cos\varphi$ particular solution: $y = \varepsilon 3\frac{G^3M^3}{F^4c^2}\varphi\sin\varphi$

**(3.41-III)** $y'' + y = \varepsilon^2 3\frac{G^3M^3}{F^4c^2}\cos^2\varphi$ particular solution: $y = \varepsilon^2 3\frac{G^3M^3}{2F^4c^2} - \varepsilon^2 3\frac{G^3M^3}{6F^4c^2}\cos 2\varphi$.

The sum of the classic solution and all the particular solutions is a solution of Equ.(3.41).

Let us compare the two terms on the right side of Equ.(3.34):

$$\frac{\text{Last term}}{\text{First term}} = \frac{\frac{3GM}{c^2}y^2}{\frac{GM}{F^2}} = \frac{3F^2}{R^2c^2} = \frac{3R^2\dot{\varphi}^2}{c^2} \cong 3\left(\frac{\text{Orbital velocity}}{c}\right)^2 \cong \begin{cases} 7.65\cdot 10^{-8} \text{ for Mercury} \\ 3.0\ \cdot 10^{-8} \text{ for the Earth} \end{cases}$$

The last term (the term with $y^2$) is extremely small when compared with the first term. But the last term makes the difference between the relativistic and the classical equation. The influence of such a small component is measurable only if its effect accumulates over time. Periodic disturbances and non-recurring constants can be ignored. The particular solution 3.41-I is a non-recurring constant, 3.41-III is periodic, hence only 3.41-II with the non-periodic increasing value φ is worth mentioning. Its solution is not negligible and has to be added to Equ.(3.39):

**(3.42)** $$y = \frac{1}{R} = \frac{GM}{F^2}\left(1 + \varepsilon\cos\varphi + \frac{3G^2M^2}{F^2c^2}\varphi\varepsilon\sin\varphi\right).$$

Now we define an angle, $\beta = \frac{3G^2M^2}{F^2c^2}\varphi$ which is extremely small.

For that small angle is $\sin\beta \cong \beta$, $\cos\beta \cong 1$. With this, the last two terms inside the brackets can be written

$$\varepsilon\left(1\cdot\cos\varphi + \frac{3G^2M^2}{F^2c^2}\varphi\sin\varphi\right) = \varepsilon(\cos\beta\cos\varphi + \sin\beta\sin\varphi) = \varepsilon\cos(\varphi - \beta) = \varepsilon\cos\varphi\left(1 - \frac{3G^2M^2}{F^2c^2}\right).$$

The condition for *one* period of the cosine is $2\pi$ for the argument: $\cos\varphi\left(1 - \frac{3G^2M}{F^2c^2}\right) = \cos 2\pi.$

Hence $\varphi = \frac{2\pi}{1 - 3G^2M^2/F^2c^2} > 2\pi$, that means the same radius will be reached at an angle > 2π.

<u>**Fig. 3.5**</u> shows: $R_{min} + R_{max} = 2a$, $R_{min} = a - e$, $R_{max} = a + e$, thus $R_{min}R_{max} = a^2 - e^2$.
From $b^2 = a^2 - e^2$ and $p = b^2/a$ follows: $p = b^2/a = (a^2 - e^2)/a$.

Hence: $\frac{1}{R_{min}} + \frac{1}{R_{max}} = \frac{R_{max} + R_{min}}{R_{min}R_{max}} = \frac{2a}{a^2 - e^2}.$ According to Equ.(3.42), with φ = 0 and φ = π:

$$\frac{1}{R_{min}} = \frac{GM}{F^2}(1+\varepsilon), \quad \frac{1}{R_{max}} = \frac{GM}{F^2}(1-\varepsilon), \quad \text{hence} \quad \frac{1}{R_{min}} + \frac{1}{R_{max}} = \frac{2GM}{F^2}.$$

With e = εa [Equ.(3.18) and <u>**Fig. 3.5**</u>] we obtain $\frac{GM}{F^2} = \frac{1}{a(1-\varepsilon^2)}$. The deviation between φ and 2π is:

**(3.43)** $$\mathbf{\Delta\varphi = \frac{2\pi}{\underbrace{1 - 3G^2M^2/F^2c^2}_{\text{Denominator} = 1-3G^2M^2/F^2c^2 \cong 1\text{, hence neglected}}} - 2\pi \cong \frac{6\pi G^2M^2}{F^2c^2} = \frac{6\pi}{c^2}GM\frac{GM}{F^2} = \frac{6\pi GM}{ac^2(1-\varepsilon^2)}}.$$

This is the famous <u>**Equation of Einstein for the Advance of the Perihelion**</u>.

This calculation is correct only because the angle β (defined above) is very small.

## 3.7 <u>Light Deflection by Large Masses</u>

Equ.(1.5) to (1.9) represent the Energy-conserving Gravitational Law for movements only in the *(one-dimensional)* radial direction to a gravitational mass. The equations (3.29) and (3.34) are generalized insofar as they describe the movements in the *two* dimensions of a plane. These equations differ from the classical ones, *but they have not been postulated;* they are a consequence of the proportionality between the change of the course of time and the change of the gravitational field, verified by measurements with extreme precision. These equations are also true for the propagation of light. However because light consists only of kinetic energy and has no rest mass, m, for light, the two-dimensional equations assume a simpler form. Moreover, the mass, m, is a common factor on both sides of Equ.(3.29) and can be reduced. The physical meaning of the two terms on the right is not quite the same. The law $GMme^{-a/R}/R^2$ stands for the gravitation in the radial direction of a body having a mass, m. For light, however, m = 0: no bodily rest mass exists. Hence, the term $(GMme^{-a/R}/R^2)$ cannot supply any gravitational energy, consequently it cannot cause a gravitational force in the direction in which the light propagates. (The *deflection* of light towards a mass is *orthogonal* to the direction of propagation and will be discussed in the next chapter.)

After omitting the Gravitational Force the Equ.(3.29) has the following form:

**(3.44)** $$\ddot{\mathbf{R}} - \mathbf{R}\dot{\boldsymbol{\varphi}}^2 = -3\frac{\mathbf{GMF}^2}{\mathbf{c}^2\mathbf{R}^4}$$ **Differential Equation for Light in a Gravitational Field**

In the same way as for Equ.(3.29), the substitution of Equ.(3.30) in (3.33) yields the equation in polar coordinates R and φ. With the substitution for R = 1/y, the equation has a simpler form:

**(3.45)** $$\mathbf{y}'' + \mathbf{y} = 3\frac{\mathbf{GM}}{\mathbf{c}^2}\mathbf{y}^2$$ **Equation for the Propagation of Light**

This equation, **obtained without curvature of space**, is identical with its equivalent in Einstein's source-free Theory of Relativity where it had been deduced from the Schwarzschild solution of field equations. I present its solution in order to save the reader's time for its calculation or searching it in various reference lists.
If the term on the right were zero, then the solution would be:

**(3.46)** $y = \frac{\sin\varphi}{R_o}$. According to **Fig. 3.6** (left) this is a straight line presenting the *first approximation.*

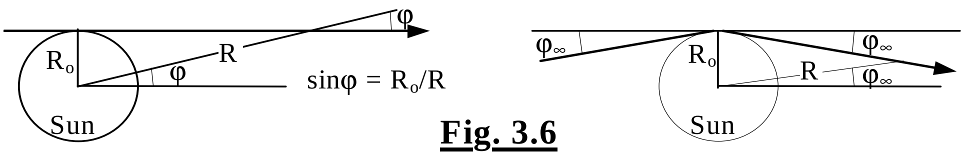



**Fig. 3.6**

By the same method as applied for the advance of the perihelion, the solution can be approximated through iteration. After inserting the first approximation into the right side of Equ.(3.45), a particular solution should be found and can be inserted into the left side and so on, but the first step is already very accurate. That step begins with y from Equ.(3.46):

**(3.47)** $$\mathbf{y}'' + \mathbf{y} = 3\frac{\mathbf{GM}}{\mathbf{c}^2\mathbf{R}_o^2}\left(1 - \cos^2\boldsymbol{\varphi}\right) = \frac{3\mathbf{GM}}{\mathbf{c}^2 2\mathbf{R}_o^2}\left(1 - \cos 2\boldsymbol{\varphi}\right)$$ (mit $\sin^2\varphi = 1 - \cos^2\varphi = ½–½ \cos 2\varphi$).

For the 1st Term $\mathbf{y}'' + \mathbf{y} = 3\frac{\mathbf{GM}}{\mathbf{c}^2 2\mathbf{R}_o^2}$ is the **partikular solution B**: $\mathbf{y} = 3\frac{\mathbf{GM}}{\mathbf{c}^2 2\mathbf{R}_o^2}$ and:

For the 2nd Term $\mathbf{y}'' + \mathbf{y} = -3\frac{\mathbf{GM}}{\mathbf{c}^2 2\mathbf{R}_o^2}\cos 2\boldsymbol{\varphi}$ is the **partikular solution C:** $\mathbf{y} = \frac{\mathbf{GM}}{\mathbf{c}^2 2\mathbf{R}_o^2}\cos 2\boldsymbol{\varphi}$.

The sum **of the partikular solutions A + B + C** is [compare with the solution to Equ.(3.41)]

**(3.48)** $$y = \frac{\sin\varphi}{R_o} + \frac{3GM}{2c^2R_o^2}\left(1 + \frac{1}{3}\cos 2\varphi\right).$$ (y = 1/R. φ is defined for R = ∞)

$\cos^2\varphi = (\frac{1}{2} - \frac{1}{6}\cos 2\varphi)$, hence $(1 - \cos^2\varphi) = (\frac{1}{2} + \frac{1}{6}\cos 2\varphi)$, multiplied by $\frac{3GM}{c^2R_o^2}$ + Equ.(3.41-III).

To Equ.(3.41-III) a particular solution already exists – with another constant factor.

In any case, φ will be small. Then, $\sin\varphi \cong \varphi$, $\cos 2\varphi \cong 1$. For R = ∞ is y = 1/R = 0. (φ in radians).

$$\varphi_{(R=\infty)} = -\frac{2GM}{c^2R_o}\cdot$$ Inserted into Equ.(3.48) with these values we get: ·

This is the angle of the *departing* ray according to **Fig. 3.6** (right). The angle of the *incident* ray (left) has the same value due to symmetry. For the total deflection of light, we obtain

**(3.49)** $$2\boldsymbol{\varphi}_{(\mathbf{R}=\infty)} = -\frac{4\mathbf{GM}}{\mathbf{c}^2\mathbf{R}_o},$$ **Bending of Light in the Gravitational Field of the mass M.**

According to that formula, the light is bent 1.75 seconds of arc for stars near the rim of the sun during an eclipse. This agrees with the measured values within the accuracy of such difficult measurements. The classical theory also predicts a deflection of light, but half of that value. This was of historical importance as an indication for the validity of the General Theory of Relativity.

(For comparison: Viewed at a distance of 118 meter, 1 mm will be bent at an angle of 1.75 sec. of arc.)
The accuracy of the measurements was considered sufficient for accepting the Relativity Theory.

## 3.8 Curvature of Space

The bending of light by gravitation confirms the curvature of space. However, near the Schwarzschild radius, $R \cong R_S = 2GM/c^2$, the curvature is far less than it has been calculated using the conventional theory. It can never become a closed curve. According to an idea of I. I. Shapiro, the curvature can be measured by the delay of a radar echo from a planet on the other side of the sun. Due to curvature, the transit time of a radar signal lasts about 0.2 ms longer.

The location of the observer on earth is defined by the distance, R, to the sun, and the local time, t. Location and proper time of the radar photons along the points of the trajectory are designated as $R_{phot}$ and $t_{phot}$. For length differentials – dR and $dR_{phot}$, and time intervals – dt and $dt_{phot}$, the following relativistic expressions are true:

Viewed from earth: $dR = dR_{phot} e^{-a/R}$ (length decreased), hence $dR_{phot} = dR e^{+a/R}$ and
$dt = dt_{phot} e^{+a/R}$ (time intervals extended, according the "twin paradox")

At point $R_{phot}$, $dt_{phot} = \frac{dR_{phot}}{c}$ = [$dR_{phot}$ inserted] $= \frac{dR}{c} e^{+a/R}$. Also inserted into the 2nd equation:

Viewed from earth: $dt = \frac{dR}{c} e^{+2a/R}$. With $e^{2a/R} \cong 1 + 2a/R$ the sun–earth transit time is:

$$\mathbf{T_{sun-earth}} = \int_{sun}^{earth} \frac{\mathbf{dR}}{\mathbf{c}} \mathbf{e}^{+2a/R} \overset{(R_{earth} >> R_{sun})}{\cong} \frac{\mathbf{R_{earth} - R_{sun}}}{\mathbf{c}} + \frac{\mathbf{2a}}{\mathbf{c}} \int_{sun}^{earth} \frac{\mathbf{dR}}{\mathbf{R}} = \frac{\mathbf{R_{earth} - R_{sun}}}{\mathbf{c}} + \frac{\mathbf{2a}}{\mathbf{c}} \ln \frac{\mathbf{R_{earth}}}{\mathbf{R_{sun}}}.$$

This, $T_{sun–earth}$, added to the time calculated for the planet, $T_{sun–planet}$, yields (the distance $R_{sun}$ neglected):

$$\mathbf{T = T_{sun-earth} + T_{sun-planet}} = \frac{\mathbf{R_{earth} + R_{planet}}}{\mathbf{c}} + \frac{\mathbf{2a}}{\mathbf{c}} \ln \frac{\mathbf{R_{earth} R_{planet}}}{\mathbf{R_{sun}^2}}. \quad \text{For the sun, } a = \frac{GM}{c^2} = 1.48\,\text{km}.$$

The echo needs twice that time. The right term of the sum is the extra transit time due to curvature, calculated for **Mercury** = **0.20** ms ($R_{mercury}$= 58·10$^6$ km), for **Mars** = **0.22 ms** ($R_{mars}$= 228·10$^6$ km).

The greatest delay is near the sun, hence the result is not very different for different planetary distances, and the formula is approximately true for a greater angular distance from the sun. The reader can derive the exact formula by (1) inserting the projection of each planetary distance upon the distance earth–planet and (2) adding 2 times the diameter of the sun. From the difference of two radar echoes for different distances $R_{sun}$, the increase of the distances due to the curvature of space has been verified very precisely [measurement according to the proposal of I. I. Shapiro: Phys.Rev.Lett.13, 789 (1964)].

## 3.9 Masses with Volume

Extended masses can be treated like point masses. This has to be proved:

Assume a mass, M, with spherical surface, and a mass, m, localized on that surface. In order to find the force, K, a mass M exerts upon m we can calculate the potential energy of m with respect to the spherical mass. The sum of *all* sub-masses is $M = \sum_i \Delta M_i$. For each ΔM which we insert, we multiply m with the factor $e^{-a_i/R_i}$, then we obtain the potential energy of m with respect to all $\Delta M_i$:

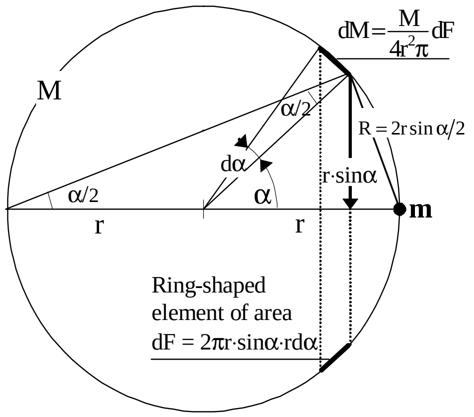



**Fig. 3.7**

$$E_{pot} = c^2\Sigma\Delta M + c^2 m\, e^{-a_1/R_1} e^{-a_2/R_2} e^{-a_3/R_3} \cdots =$$

$$= c^2M + c^2 m e^{-\frac{G\Delta M_1}{c^2R_1}} \cdot e^{-\frac{G\Delta M_2}{c^2R_2}} \cdot e^{-\frac{G\Delta M_3}{c^2R_3}} \cdots =$$

$$= c^2M + c^2 m e^{-\frac{G}{c^2}\left(\frac{\Delta M_1}{R_1} + \frac{\Delta M_2}{R_2} + \frac{\Delta M_3}{R_3} + \cdots\right)}$$

**(3.50)** $$\mathbf{E_{pot} = c^2M + c^2 m e^{-\frac{G}{c^2}\int_{\alpha=0}^{\pi}\frac{dM}{R}}} \quad (\text{for } \lim \Delta M_i \to dM)$$

**Fig. 3.7** shows $dM = \frac{M}{4r^2\pi} 2\pi r \sin\alpha \cdot r d\alpha = \frac{M}{2}\sin\alpha \cdot d\alpha$, and

$$\frac{dM}{R} = \frac{M}{2}\frac{\sin\alpha d\alpha}{2r\sin\alpha/2} = \frac{M}{2}\frac{2\sin(\alpha/2)\cos(\alpha/2)}{2r\sin\alpha/2} d\alpha = \frac{M\cos\alpha/2}{2r} d\alpha$$

$$\int_{\alpha=0}^{\pi}\frac{dM}{R} = \frac{M}{r}\int_0^{\pi}\cos(\alpha/2)\cdot d(\alpha/2) = \frac{M}{r}\sin(\alpha/2)\Big|_0^{\pi} = \frac{M}{r}.$$

(The letter r is exceptional used in place of R because R has been used for the distance from m to M.)

The result for that integral in Equ.(3.50) is the same as in the classical law, namely the gravitation of a spherical mass, M, remains the same as if it were concentrated in its center.

**(3.51)** $$E_{pot} = c^2M + c^2 m e^{-\frac{GM}{rc^2}} \quad \text{and} \quad K = \frac{dE_{pot}}{dr} = \frac{GMm}{r^2} e^{-a/r} \quad \text{with} \quad a = \frac{GM}{c^2}.$$

If the mass, m, is not *upon* the surface of the sphere but at a distance R > r (the letter R is now available), then the spherical shell could be thought of as being developed from a surface of the larger radius (R > r) where the formula (3.51) is valid. If the mass, m, were placed on that shell while the shell contracts to the radius, r, then the equation would remain valid for each intermediate position as well as for the first and the last one. However that cannot depend on whether the movement is simultaneous or not, since, regardless of time and shape of the trajectory, the energy must be conserved. The transformation of potential energy into kinetic energy does not depend on that sequence.

The calculation has been made as if the mass must be upon the surface of the sphere. However since the whole mass can be thought as composed of spherical shells the calculation applies also for the mass of the three dimensional sphere.

The effect of the shell masses upon a mass inside the shell has been explained in Chapter 1.1 and Fig.1.1.

On Page 38 below, it will be explained that “absolute space” (as understood by the definitions of space by I. Newton and E. Mach) is *not* the totality of all fixed stars, it is the observer being per definition the point at rest. That can be expressed by the truism that no observer can move relative to himself. Another definition of “observer” is not possible. The gravitation at the center of all the spherical cosmic “masses at rest” must always be zero. This statement is synonymous to "symmetric distribution".

## 3.10 Calculation of the Diameter of the Universe

Due to gravitation, the masses of the universe must collapse, regardless whether the mass or its density changes in space at any time. The idea that a uniform mass distribution would prevent the mass from forming clumps (forming stars) can be disproved (even if the force of gravitation would be proportional not to the squared but to the linear reciprocal distance, 1/R). If the mass distribution is *homogeneous*, then the force of (classical) gravitation is proportional to the distance from the center. The masses must collapse if there is no restoring force greater than any possible force of disturbance. As pointed out in the text to **Fig. 1.1**: if there would be a hollow spherical cavity in the center of the earth, then the gravitational effect of the masses outside that cavity upon masses inside compensate mutually. But for any two masses inside the cavity, their *mutual* gravitation is not effected by these external masses. This is true also if inside the cavity would be a vacuum. As will be explained later, an observer at any point inside the universe considers ("sees") its own location as the center of the universe. If masses are distributed in the space they should collapse.

How long will a collaps continue? Would it reach a limit? Energy-conserving Gravitation Law can not only answer that question, it yields also the diameter of the universe and its geometry as well.

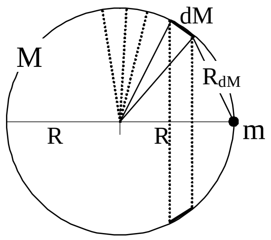



**Fig. 3.8**

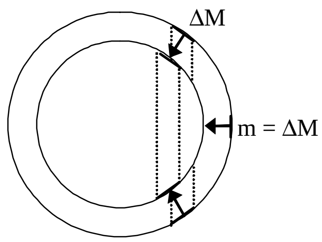



**Fig. 3.9**

Let us start with Equ.(**3.50**) and (**3.51**) derived for masses distributed over a limited volume according to **Fig. 3.7**.

We write Equ.(**3.50**) with a new notation shown in **Fig. 3.8 and 3.9**:

$$\mathbf{E_{pot} = c^2M + c^2 m e^{-\frac{G}{c^2}\int_0^M \frac{dM}{R_{dM}}} = c^2M + c^2 m e^{-\frac{GM}{c^2R}}} \quad \textbf{and}$$

$$\mathbf{K = \frac{dE_{pot}}{dR} = \frac{GMm}{R^2} e^{-\frac{a}{R}}} \qquad \textbf{with} \quad \mathbf{a = \frac{GM}{c^2}.}$$

We consider a spherical shell which collapses due to the mutual gravity of its mass elements, ΔM. In this case, we have to insert ΔM in place of m.

M = ΣΔM. All the forces acting upon each ΔM can be added formally as if all the partial forces would have the same direction. In a certain sense, they have the same direction if we define the direction to the center as a special class of “direction”: We distinguish these forces from parallel forces by calling them “**weight**” of the spherical mass, **M**, of the shell.

The equations above do not depend on the thickness of the spherical shell. Since the total *volume* of the sphere can be thought of as composed of shells, the gravitational effect upon a point outside remains the same as if the mass, M, were concentrated in the center of the sphere as already mentioned.

For a Euclidean space, the volume can be calculated using the formula $V = 4R^3\pi/3$. For the closed space of the universe, the cosmologist sometimes uses the formula $V_k = 4\pi^2R^3$. In order not to exclude the formula of these cosmologists right from the beginning, we use the letter **A** as the common factor of $R^3$:

**(3.52)** $\mathbf{V = AR^3}$ with $A = 4\pi/3$ for Euclidean space, and $A = 4\pi^2$ if that space were closed.

By multiplying the volume by the average density, ρ, we obtain the mass, M, of the universe:

**(3.53)** $\mathbf{M = AR^3\rho.}$

According to Equ.(**3.51**), each partial mass, ΔM, of M represents a potential energy element with respect to all other masses of M. ΔM is part of the mass, M, and will be attracted by all other mass elements of M but not by itself. This means it has to be subtracted from M:

$$E_{pot/\Delta M} = c^2(M-\Delta M) + c^2\Delta M e^{-a/R} \qquad \text{with} \quad a = \frac{GM}{c^2} = \frac{G}{c^2}AR^3\rho.$$

The contribution of each partial mass to $E_{pot}$ is $-c^2\Delta M + c^2\Delta M e^{-a/R} < 0$, negative (because it transforms into $E_{kin}$). All partial masses together represent the total potential energy. The first term disappears because $\Sigma\Delta M = M$, so we obtain by integration:

**(3.54)** $$\mathbf{E_{pot} = c^2 M e^{-a/R}}$$

Cross check: for $R \to \infty$, that should become $E_{pot} = c^2M$; for $R \to 0$ $E_{pot} = 0$: both conditions are met.

The sum of the forces is defined as "weight". Because M = constant, the following must be true:

**(3.55)** **Weight** $$K = \frac{dE_{pot}}{dR} = \frac{GM^2}{R^2} e^{-\frac{GM}{Rc^2}} = GA^2R^4\rho^2 e^{-\frac{GM}{Rc^2}} = GA^2R^4\rho^2 e^{-\frac{G}{c^2}AR^2\rho}.$$

After division by the total mass, M, (assumed to be distributed uniformly over the surface) we obtain the summarized force upon one unit of mass, the so-called gravitational acceleration:

**(3.56)** $$\mathbf{b = \frac{GM}{R^2} e^{-a/R} = GAR\rho e^{-\frac{G}{c^2}AR^2\rho}}$$

(In the Classic Theory, $b = GM/R^2$).
For $R \to \infty$ is b = 0, see diagram on Page 83.

With $A = 4\pi/3$, that formula gives the value of the gravitational force on the surface of any sphere with an average density, $\rho$. The sphere may be located at any point in the universe. The masses of each hypothetical sphere must collapse. According Equ.(**3.56**), its gravitation depends only on R and the density $\rho$.

What is the shape of that mathematical function of R if the *density* $\rho$ *is constant*? The function has a maximum, since there exists an R where the derivative of Equ.(3.56) is zero:

$$\frac{db}{dR} = \left(GA\rho - 2GAR^2\rho\frac{G}{c^2}A\rho\right)e^{-a/R} = 0 \quad \text{thus:} \quad \left(1 - 2R^2\frac{GA\rho}{c^2}\right) = 0 \quad \text{and}$$

**(3.57)** $$\mathbf{R^2 = \frac{c^2}{2GA\rho}} \quad \textbf{or} \quad \mathbf{R = \sqrt{\frac{c^2}{2GA\rho}} = \sqrt{\frac{c^2}{2G\rho}}\frac{1}{\sqrt{A}}}.$$ (That means: R = proportional to $1/\sqrt{\rho}$ )

It should be noted that the maximum has been calculated on the condition that the density, $\rho$, is constant. Hence, the differentiation of Equ.(**3.56**) does not refer to contraction of the universe (where dR = 1) – in the customary theory, contraction would increase the density. Rather, the differentiation shows the change of gravitation for the universe when its diameter, R, contracts by dR *under the condition that the density remains constant*. This condition is an intrinsic consequence of the Energy-conserving Gravitational Law. "Constant density" means that the contraction is understood to be similar to an immersion in a liquid universe. Then, only the gravitation of the inner sphere (between observer and the observed object) is active. Equ.(3.56) and its derivative Equ.(3.57) reveal the very unexpected result that **the gravitation of the universe *has a maximum* which depends solely on its density, $\rho$** (proportional to $1/\sqrt{\rho}$ ).

Some numerical values are required for calculations:

| | |
|---|---|
| **1 lightyear** = 1 Lj = $0.946 \cdot 10^{18}$ cm | **Constant of gravitation, G** = $6.6726 \cdot 10^{-8}$ $cm^3/gs^2$ |
| **1 cm** = $1.056 \cdot 10^{-18}$ lightyears | **Velocity of light c** = $2.998 \cdot 10^{10}$ cm/s |

Average **density of the universe** (for instance, according to Harrison), $\rho$ = 1 H-atom/$m^3$ = $1.675 \cdot 10^{-30}$ for visible matter. Due to unknown dark matter, the average density should be higher. For lack of a better estimate, we may assume four times that value; that is: $6.7\ 10^{-30} g/cm^3$. (This should not be confused with the much greater density of a galaxy.)

Applying Equ.(**3.57**) on the universe as a whole yields for an Euclidean Space (having that density) for the first factor: $\sqrt{\dfrac{c^2}{2G\rho}} = \dfrac{3\cdot 10^{10}}{\sqrt{2\cdot 6.67\cdot 10^{-8}\cdot 6.7\cdot 10^{-30.}}} = 0.317\cdot 10^{29}$ cm, hence

$R = 0.317\cdot 10^{29}\sqrt{\dfrac{3}{4\pi}} = 0.155\cdot 10^{29}\,\text{cm} \cong 16\cdot 10^{9}\,\text{Lj}$, (Lj = Lightyears). This is the radius where the gravitation of the universe (if its density is 4 hydrogen atoms/$m^3$) reaches a maximum.

The second surprise is the fact that maximum gravitation occurs at that *radius of the universe* which has been estimated by many cosmologists for a closed space, that is $R \cong 16{\cdot}10^9$ lightyears. For a closed space, such a maximum must exist because no larger mass is possible than that encircled by that radius. Thus, the assumption of the cosmologists may be better confirmed than could be hoped for. However, please note: "closed" can also be defined for a space having an insurmountable borderline where the red shift is infinite. If the density is really 4 hydrogen atoms/$m^3$ and if we insert $4\pi/3$ for A, then the radius of the universe is **$R \cong 16{\cdot}10^9$ lightyears**.

According to Equ.(**3.57**), $R = \dfrac{c}{\sqrt{2GA\rho}}$, or $\rho = \dfrac{c^2}{2GAR^2}$. (The constant A can be omitted.) The density, ρ, can also be expressed by:

Equ.**(3.52)** and (**3.53**): $V = \dfrac{M}{\rho} = AR^3$, or $\rho = \dfrac{M}{AR^3}$. Both values must be equal. Hence R must be:

**(3.58)** $$\mathbf{R = \sqrt{\frac{3c^2}{8G\pi\rho}} = \frac{2GM}{c^2}}$$ = **Radius of the Universe** (See also **Chapter 6, Page 71**.)

This distance, **R**, can be called radius since the best possible *definition* of the radius is the same as for all celestial bodies: It is the distance at which its gravitation has its maximum. (Of course, deviations are possible due to inhomogeneity.) Because G, M and c are constants, R must also be a constant.

The radius is identical with the Schwarzschild Radius of the conventional theory. According to that theory, ***we would be inside a Black Hole*** – where living creatures would be impossible. Such a remark is often said to be irrelevant because nothing can exist *outside* the universe, not even an observer; consequently nothing can be *observed* from the outside. However, we can argue that *all* Black Holes are unobservable from the "outside" because there, only one indication exists for their existence: the concentration of a certain amount of mass in a defined volume, provided it can be measured. However the argument "observing from the outside" is a vicious circle because it needs the possibility of the Black Hole in order to prove that it is possible! If Energy-conserving Gravitation is true, then even the greatest mass concentration *cannot* produce a Black Hole, therefore, high concentration is not an argument for its existence.

## How the Spherical Symmetry of the Universe can be Understood?

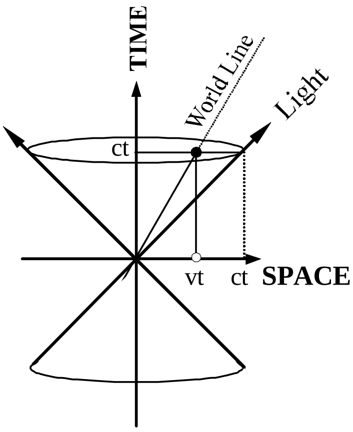
One can admire a rainbow, whether in the sky or due to the haze of a sprinkler nozzle, or in the clouds below a flying airplane; in any case you will find yourself in the center of a rainbow. You can move as you wish or even reach your hands into the rainbow, but you will never see a rainbow from the side, where it would be an ellipse. The rainbow will follow you like a saint's halo or, if that metaphor doesn't suit you, like the corona around a lantern in a nocturnal mist. The Principle of Relativity may appear to be just such an illusion. In a similar way, you are caught inescapably in the center of the gravitational grip of the starry sky. The more the spectra of remote nebulae are shifted toward red, the faster the stars seem to recede. But when they seem to reach the velocity of light, they vanish entirely from reality and with it all its physical qualities. Relativity deals with that cosmic sphere which is associated with us like the corona of a lantern. If we can imagine a lantern, then we can imagine the relativistic universe. This applies to the illusion of each of us – of every living entity – that we are the center of the world, just due to the sheer fact of our own individual existence. Many years ago, the great biologist Jakob von Uexküll remarked: there exist as many worlds as there are living beings.

This is not the end the list of surprises.

# 3.11 How Space and Time Pass Out of Sight

In textbooks on relativity, diagrams similar to railroad timetables are often used. Though the rails are curved two of the three real coordinates of the movement are *ignored*, if only effects of velocity are examined. From the curvilinear movement in the three spatial dimensions we single out the one having the direction of the velocity because, in this case, the velocity in the other two coordinates is zero and need not to be drawn. Consequently, it is not an unrealistic restriction, if – for the gravitational movement of a mass – we consider only the coordinate in the actual direction of that movement.

The direction of movement can be understood as the tangent on a great circle of a large sphere representing the space of the universe. Why a sphere instead a plane? The reason is that the idea for a closed universe should not be excluded. In such a universe, the physical laws are the same and apply to every point in the universe, and the total mass will not be infinite since it is limited and distributed within a finite volume.




Graphical representation of movement in space and time in the Minkowski diagram. The generating lines of the “light cone” coincide with the path of light. Their inclination is 45° if the measuring units for space and time, t, in the drawing are equal.

**Fig. 3.10**
**Minkowski Diagram**

**Fig. 3.10** shows a diagram used by Hermann Minkowski. An object has the two-dimensional coordinates x and y and moves on the hypotenuse $v^2t^2 = x^2 + y^2$ if it starts at the origin with constant velocity, v. From the mass at the point (x, y), we plot the time, ct, orthogonal to the x-y plane (multiplied by c because t must be expressed in units of length).

Minkowski called the line of the moving mass in the diagram **world line.**

Light emitted by the mass when crossing the origin of the reference system has the world line $x^2 + y^2 = c^2t^2$. When light reaches the distance ct, then the mass has moved only vt < ct.

The root of the difference of the two squares

$$S = \sqrt{c^2t^2 - v^2t^2} = ct\sqrt{1 - v^2/c^2}$$ is called **interval**.

If we had three coordinates, then this equation (squared) would be

$$S^2 = c^2t^2 - (x^2 + y^2 + z^2) \quad \text{or differentially} \quad (dS)^2 = (cdt)^2 - (vdt)^2.$$

With three spatial dimensions, time is a *fourth* dimension. Time, too, is represented by a length because its measurement is based on the transit time of light.

The structure of the formula is similar to the Pythagorean theorem generalized to four dimensions, however, with the fundamental difference that the sign of the *squared* spatial term is negative. This defines a new geo-metry, which, although formally consistent, is not conceivable, hence the Relativity Theory is one of the most inaccessible physical theories.

One of the important relativistic discoveries is Time Dilatation. This effect seems to be one of the most difficult to understand. It states: “The time interval between two events is different for different observers". Most likely you will remember the famous “twin paradox”. If one of the twins returns from a high-velocity expedition, then he has aged less than the brother left at home. For the interval between departure and arrival, the clock of the traveler indicates a shorter time. The traveler himself would not notice a decrease in the course of time, even if he had approached the velocity of light (where the "time dilatation" becomes unlimited). (The acceleration to such a velocity would only be a problem due to the stress for the crew.) Today, the relativistic time difference can be measured very accurately even for moderate velocities.
As shown on **Page 14**, according to calculation, the time read on the traveler’s clock is the

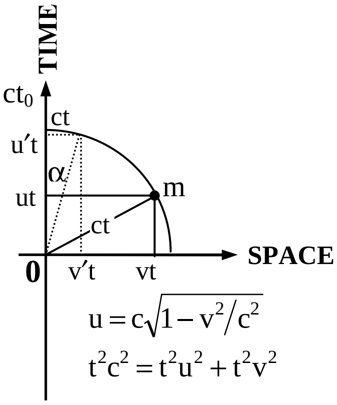
Equ.**(2.2/2)** **Time Dilatation =** lengthened time from $T_0$ to $T = \dfrac{T_o}{\sqrt{1 - v^2/c^2}}$.

$T_o$ is the time read on the moving clock, T is the time read on the clock at rest.

Two important aspects should be noticed:

1. In the Minkowski diagram, the time drawn on the time axis, is the time, t, read on the clock at rest.
2. Time is understood as the fourth dimension of a space-time geometry. Such a geometry is possible only if the time is measured by spatial distances covered by light. In other words: The drawing can be plotted only when time is expressed in units of length. This means: in the Relativity Theory, distance is defined by the transit time of light, hence, by the reverse definition, time can be drawn as the distance, ct, the light covers. This means: the time, t, must be represented on the time axis by the product ct.

We use the diagram **Fig. 3.11**. It differs from **3.10** because only the spatial distance, vt, drawn horizontally and expressed by the coordinates x, y, z, is identical with that in the Minkowski diagram. Only one of three can be plotted in the drawing (or two in a perspectival representation).




**Relation of space and time**.
$mc^2$ = total energy,
therein potential energy =

$$= \mathbf{c^2me^{-a/R} = c^2m\sqrt{1-v^2/c^2}}$$

$$\mathbf{= c^2 \cdot m \cdot \frac{u}{c} = c \cdot m \cdot \frac{dS}{dt}}$$

**Fig. 3.11**

Velocities in the coordinates not drawn are assumed to be zero.

The SPATIAL coordinate, R = vt, lies in the direction of movement. It represents the length of the path the mass moves, regardless of curvature (similar to a timetable showing the miles on the curved rail).

The TIME coordinate, however, is defined differently.

It represents *not* the transit time, t, of *light* for covering the distance from 0 to m (as it is read on a clock at rest), but the shorter time, $t_0 < t$, read on a clock which moves with the mass along that distance (each time, t, is multiplied by the velocity of light, c).

When a clock in the *resting* reference frame shows the reading t, then the distance covered is vt. The reading $t_0$ on the *moving* clock is shorter than t due to the relativistic time dilatation. *That* reading is plotted on the time axis (multiplied by c):

$\mathbf{ct_0 = ct\sqrt{1-v^2/c^2}}$ according to **Equ.(2.2/2)** of the Relativity Theory.

Consider an astronaut returning from a long high-velocity trip. He truthfully asserts that he was $t_0 < t$ years in the moving vehicle. Meanwhile, however, an observer at rest has aged by t years. (Unfortunately for the astronaut: only his own time counts!)

**Fig. 3.11** shows how the time coordinate, t, can be drawn very simple if we add vectorially the two components vt and ut of the path, ct (ct is the path covered by light in the transit time, t).

The formula for the velocity, u, is defined in **Fig.3.11** by $\mathbf{u = c\sqrt{1-v^2/c^2}}$ .

As can be seen, ut is the obscure interval S, because $u^2t^2 = c^2t^2 - v^2t^2 = S^2$. In order to realize the meaning of the interval, we write it as follows:

**(3.59)** Definition of the interval: $\mathbf{S = ut = ct\sqrt{1-v^2/c^2}}$, or differentially $\mathbf{dS = cdt\sqrt{1-v^2/c^2}}$ .

The time coordinate represents the reading on the moving clock, read by an observer at rest. Each mass is its own clock. For a time interval, t, read on the closk at rest, the corresponding interval on the clock of the *moving* mass is shorter: $t_0 = t\sqrt{1-v^2/c^2}$ . For the moving clock, the time runs slower.

The section on the time axis $ct_0$ is called "interval" ($t_0$ read on the *moving* clock) which corresponds to ct of a clock at rest. The time $t_0$ is called the "proper time" of the moving mass ("proper" means: *its own* time).

Let me remind: A general mathematical relation between physical quantities is accepted as a *physical* law only if it is independent of coordinate transformations.

It should not be a surprise that *all* observers, regardless of their own velocities, find the same time intervals between the same events, if all quantities (measured in different systems) have been transformed into *the same* (arbitrarily selected) reference system. The Transformation Equations (**2.2**) of the Special Relativity Theory, quoted on **Page 14**, meet that condition. This is called the "**Lorentz Invariance**".

**Lorentz Invariance** means: **The universe is similar to itself at any time and at any location.** Further discussion is omitted here, it is not the objective of this paper and can be found in any relevant textbook.

**<u>Fig. 3.11</u> reveals some fundamental physical relations:**

1. It shows that $u = c\sqrt{1 - v^2/c^2}$ defines the famous relativistic root factor not only formally, but 'u' is also a *real* velocity, namely the velocity at which *time proceeds in a mass when moving with a velocity, v*, as seen by an *observer at rest*.
2. Of interest is the fact that for any observer himself ("himself" means v = 0), time proceeds at the velocity of light. **All masses proceed at the velocity of light in time when seen from their own reference point.** Simplified: If the time axis is subdivided by markers into equal sections of 300,000 km, then a flash of light at the zero point will reach subsequent markers at intervals of one second. The observer can read his time by counting the seconds. (Of course, the time axis can be folded by reflecting the light by mirrors. This is called a "light clock".) If the reading of the <u>moving</u> clock were plotted on the time axis, then it would show the time delayed by the factor $\sqrt{1 - v^2/c^2}$ .
3. The time velocity, c, of an observer A, if seen by another observer B, having the relative velocity v, appears to be composed of two rectangular components called *<u>time velocity</u>* u, and *<u>spatial velocity</u>* v, which obey the relation $c^2 = u^2 + v^2$.
4. If a mass has the spatial velocity v, then its time axis, ct, is inclined by an angle, α, with sinα = v/c as seen from a mass at rest. For smaller velocities, v′< v, α is smaller, shown dotted in the drawing.
   If, at the other extreme, the velocity v approaches the velocity of light, then α approaches 90°.

   | | |
   |---|---|
   | Valid <u>for light</u>: | Light moves <u>in space</u> at the velocity c. The consequences are:<br>The light's velocity <u>in time</u> is zero, hence,<br>for light, (1) no time, and (2) no spatial distances exist. |
   | Valid for a <u>body at rest</u>: | Its <u>time</u> proceeds at c (velocity of light). This means: if v = 0, then its velocity <u>in space</u> is zero; and because there, no length contraction exists, light covers distances in a *resting* reference system in *the greatest possible* time. |

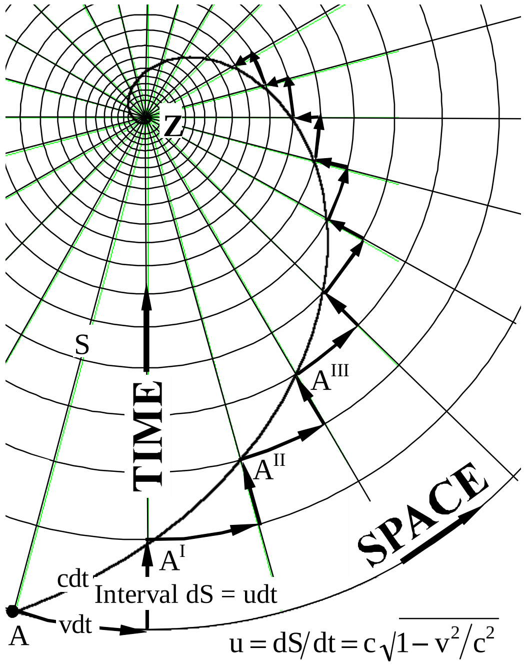
   If the spatial velocity is constant, then the inclination, α, of the time axis is also constant.
   Only a bodily mass can have a time axis; for light, however, a time axis does not exist.
5. By the *same* factor at which time slows down, the length in the radial direction decreases according to Equ.(2.2/4), Page 14. Moreover, the mass and the volume also decrease linearly by *that* factor *if* the mass accelerates to v by gravitation without energy supplied from outside. Recall the formulas:
   **Equ.(2.2/4)** $L = L_o\sqrt{1 - v^2/c^2}$ and **Gl.(2.2/1)** $m = m_o\sqrt{1 - v^2/c^2}$ **P.22, 1st line**
6. The second equation confirms an old speculation: Does an effect comparable with the Doppler shift also exist for gravitation? The Doppler shift implies: If a mass, m, has a receding velocity, v, then its light is red-shifted. The question is: Does the gravitation of a mass (M upon m) also decrease if M is red-shifted? Does it disappear when v = c? **Now we see that this *does* happen because the <u>mass</u> decreases when it falls. It decreases to zero if its <u>radial</u> velocity approaches that of of light.**

Therefore, Fig. 3.11 reveals the following essential features of the Relativity Theory:
(A) Masses "propagate" in time, that means: "Time" and "Mass" are correlated (cannot be separated),
(B) The <u>proper time of a "mass</u>" is determined by the *constant* velocity of light, c, and
(C) For external observers, the velocity, c, is the vectorial sum of a *spatial* (≡ space) and a *temporal* (≡ time) component. Moreover, **Fig. 3.11** (above) and the following **Fig.3.12** disprove the often-heard assertion that the Relativity Theory is beyond the capability of human understanding.

Additional advantages of **<u>Fig. 3.11</u>** compared with the customary Minkowski diagram:

(1) *Identical* and *undistorted* units for time and length, and
(2) Right angles between the coordinates for time and space. Acute angles are not used. The different movements (velocities) of masses appear as differently inclined ct lines. (Note the difference if the velocities change from v to v′< v.)

The meaning of **Fig. 3.11** will be understood better after looking at **<u>Fig. 3.12</u>** where we integrate over velocity and time. This is simpler than it looks. It just means adding up all the small path differentials, vdt, for successive time increments, dt. For simplicity, the diagram is plotted with *finite* sub-diagrams, each for constant velocity and equal intervals dt = Δt > 0. Replacing the infinitely small diagrams by finite diagrams causes no loss of generality (in this context) because a change of v effects only the angle, $\alpha$, of inclination (curve with radius S). Each small vectorial diagram repeats the differentials vdt, cdt, udt (**Fig. 3.11**).




Movement in space (= v) and time (= u)
seen from the viewing point A.
Each vector diagram is similar to Fig. 3.11.

## Fig. 3.12
**"Perspective in Time"**
(view into the future)

**Fig. 3.12** represents the universe, which is *collapsing*. A mass, m, starting at point A, participates in the gravitational collapse and gains a velocity, v, over the distance A to $A^{I}$, as seen by an observer remaining at rest relative to point A. In his view, the mass decreases over the distance A to $A^{I}$. The decrease equals the difference $m_o - m$.

$$m = m_o\sqrt{1-v^2/c^2} = m_o\frac{u}{c} \qquad \text{(Page 22, 1}^{\text{st}}\text{ line).}$$

An additional observer is placed at *each* of the following points: $A^{I}$, $A^{II}$, $A^{III}$, ...; each retains the velocity already reached, but without further acceleration in this sector.

With respect to each of these observers, the initial velocity of the mass, m, is zero, then m accelerates continually and reaches the *next* point with the velocity v. Each observer sees his own triangle having exactly the *same* shape as the observer at point A sees *his* triangle.

For each observer at A, $A^{I}$ and $A^{II}$, ..., the root factor of **decrease** is the same for equal increments of the distance dR = vdt (due to the same velocity, v). This applies for each distance, vdt, *and* for each time interval (udt). This means: *each* distance decreases by the *same* factor, hence all angles of the initial triangle, A, will be repeated in each of the following triangles: $A^{I}$, $A^{II}$, $A^{III}$, ... .

With respect to an observer *remaining at rest at the first point*, A, the velocity of free fall steadily increases between the points A, $A^{I}$, $A^{II}$, $A^{III}$, ... ; thus, the slope of the curve grows continually. The resulting curve is a logarithmic spiral, asymptotically converging into an infinite point, due to a constant decrease of each measuring unit within equal time intervals.

The time velocity is u = dS/dt, hence, **the time radius of the universe must be S**.

The observer at A will recognize that the world seen from the next point $A^{I}$, would not differ from his own world which he sees from A, because at $A^{I}$, length, time and mass are reduced by the same factor, $\sqrt{1-v^2/c^2}$. This means that their *relations* do not change. For the observer at point $A^{I}$, no reduction exists. Therefore, the triangles A-Z-$A^{I}$, $A^{I}$-Z-$A^{II}$, $A^{II}$-Z-$A^{III}$ as well as all the others have identical angles.

The logarithmic spiral, intersecting the time axis by the same angle at all locations A-$A^{I}$-$A^{II}$-$A^{III}$-$A^{IV}$- ..., has the equation

**(3.60)** $$S = S_o e^{-\frac{\sqrt{c^2-v^2}}{S_o}t} = S_o e^{-\frac{u}{S_o}t} = S_o e^{-\frac{t}{t_o}} \quad \text{with} \quad t_o = \frac{S_o}{u}$$. This can be checked using known points:

for v = 0: $S = S_o e^{-\frac{c}{S_o}t}$, hence $\frac{dS}{dt} = -ce^{-\frac{c}{S_o}t}$, and for v = c: $S = S_o$ = constant for each t.

For a mass at rest is v = 0. Then for t = 0, the velocity dS/dt = –c (negative because S decreases).

For the remote future (that is, for $t \to \infty$), dS/dt decreases to zero if measured with the units of today.

For light, v = c and dS/dt = 0. With the formula for an infinite power series, $q+q^2+q^3+\cdots = q/(1-q)$, and with

$q = \sqrt{1-v^2/c^2}$, we obtain for the sum of all successive sections, $\Delta S$, between all circles $S = \frac{\sqrt{1-v^2/c^2}}{1-\sqrt{1-v^2/c^2}}c\Delta t$.

From the *observer's* viewpoint, v = 0, we get, $S = \infty$ (since $dt = \Delta t > 0$). That means: for any observer, the time distance to the center of the universe is infinite, hence the geometry is planar (Euclidean). For light however, where v = c, we obtain zero for the distance: S = 0, and the length contraction factor is also zero. This means: for *light*, the temporal and the spatial diameter of the universe is zero. **For light itself, time does not exist; light reaches any point in the future at the same instant: if a clock travelled with a light ray as it propagates, the ray's own time (= proper time) would not change.**

Such conclusions cannot be deduced from the customary Relativity Theory. Hypnotized by the *formula* $m = m_o \Big/ \sqrt{1 - v^2/c^2}$ , some physicists assume that the mass will <u>in</u>crease when it falls in a field. Consequently, when the reasoning is based on the Classical Potential Theory, the energy must be thought to be *created* in the field (or the vacuum). Nobody suspected that the falling mass itself could be the source of the energy because its intrinsic energy, $mc^2$, was not known at the time of classical physics. The "field" was the only conceivable source where the kinetic energy could originate (without time delay). Since no other source of energy could be imagined for accelerating a falling stone except the field, "field equations" were thought to be the magic formula.

Energy-conserving Gravitation demands the contrary because – as shown by the Clock Experiment – all alternatives have been excluded except that the mass must get energy from its own substance like a migratory bird when it consumes its own fat when flying. For an observer situated on the falling mass, m, then the argumentation can be reversed symmetrically: For him, the mass of the earth appears like a migratory bird.

In this paper, space is assumed having no mass. In customary texts about Relativity Theory it was not realized that a mass decreases when dropping: only the decrease of the other two fundamental quantities – distances and time intervals – had been recognized. The third quantity, the mass, had sometimes even been assumed as *increasing* (due to the falling velocity), and the quantum vacuum was postulated to be the source of that energy – though for this no empirical evidence exists.

If the change of mass in a gravitational field is not taken into account, then the relativistic geometry of space appears to be distorted. The distortion can be compared with a perspective drawing if the shortening is ignored in one of the three spatial coordinates. The result might appear as if the drawing-paper were no longer flat. It was an almost unbelievable achievement when Einstein successfully presented a curved-space geometry which is nearly a correct approximation of such a distorted space. This could explaine the small <u>deviations</u> between empirical observations and Newton's Law. (If the mass concentration is extremely great, then such an additional curvature even leads to singularities called "Black Holes" where some physical quantities become infinite.)  The fact that such <u>deviations</u> are associated with a mass has led to the incorrect conclusion that the mass would be an *effect* of the curvature of space, rather than its *cause*.

In reality, a mass decreases when falling toward a central mass. In the customary theory, however, the curvature of space was assumed to be a quality of the *field* surrounding a dominant central mass. This is a contradiction: if incompatibilities with energy conservation are caused by a decrease of mass, then it is an effect of mass and not of an additional curvature of space (where mass would be a constant). Moreover, because not only lengths are contracting but as well masses and time intervals, the relativistic vision becomes comparable with a perspectival view in each dimension. So, in this context, the relativistic behavior of the world appears to be a *generalized* perspective view of the world. "*Generalized* perspective" means: not only spatial distances are contracting, but as well time intervals, each an effect of the falling masses. In Euclidean geometry, parallel lines are defined by constant distances, although parallel lines cannot be seen. We always *see* that parallel lines converge to a vanishing point. Now, we can draw an analogy: all events are passing from the past into the future. This applies also for distances, masses and time intervals, all are converging to a "vanishing point". *If energy is conserved*, then they can be defined as being *parallel*. "Parallel" means "constant", analogous to the customary perspective where two lines are defined as being parallel if the distance between them remains constant. Though Mass causes curvature of space, the curvature is by far to small for isolating (cutting out) a closed domain in the space.

In any case, we are familiar with the concept of curved space. An example is a map with <u>contour lines</u> representing a *three*-dimensional mountain on a flat, *two*-dimensional map. Of course, the area of a mountain slope is greater than its horizontal geometric projection on the map. We interpret the *density* of the contour lines as a measure of the degree of inclination of the sloped area. If a road crosses the contour lines, then we interpret this as a change of altitude in the third dimension, though it is a projection on the horizontal surface of the map. If we generalize the idea of "contour *lines*", we can define the density of a "four-dimensional *space*" by three-dimensional interlocked "contour *surfaces*". These contour *surfaces* define the four-dimensional geometry, imaginable as a *compressed volume*. This is greater than the volume in a flat "Euclidean" space. Analogous *expanded* volume can be defined. Of course, geometry defined in this way does not have the same properties as Euclidean geometry.

For instance, the *formula* for the volume of an object in a curved space is different from that in a Euclidean space. The volume can be calculated if the density of the interlocked "contour *surfaces*" is known. These are closed *surfaces* corresponding to the closed contour *lines* on the map. For instance, a volcano cone on a map is represented by concentric *circles*. Its four-dimensional counterpart is a "four-dimensional volcano", corresponding to the circles are concentric *spheres* in the three-dimensional "map".

Compared with Einstein's Theory, the curvature of space is small. For Gravitation with Energy Conservation, the curvature is far too small for surrounding a domain in space, and there are no infinite singularities when approaching the center of gravitation. (The curvature of space is too small to be visible in the diagrams used in this paper.)

## 3.12 Time – Visualized as "Central Perspective in the Well of Time"

The diagram of **Fig. 3.12** *appears* as if it were a perspective view into an infinitely deep well. Of course, that is just an analogy, but it may be helpful for us to *imagine the concept* of relativistic gravitation. With this diagram the relativistic variations of time intervals, mass and length can be understood as an analogy to the perspective we see the world. Of course, the familiar optical perspective relates to spatial dimensions only. Now we generalize this perspective by including the view into the time axis. A marble thrown into the well at the velocity of light, c, passes out of sight along either a straight line, S, or – when starting tangentially (that is, with a *spatial* component, v) – spirals on the wall down into the abyss. Its trajectory is drawn in the diagram as the logarithmic spiral seen from the rim of the well.
The velocity components (tangential = v and vertical = u, condition: $c^2 = u^2 + v^2$) can be integrated:

Horizontally for the spatial coordinate $R = \int vdt$, vertically for the time coordinate $Tc = \int udt$.

From the mass, m, of the marble, only the fraction $m\sqrt{1-v^2/c^2}$ is subjected to gravitation, expressed by the formula $K = G\frac{Mm}{R^2}e^{-a/R} = G\frac{Mm\sqrt{1-v^2/c^2}}{R^2}$. (R = *spatial* distance m to M).

From the viewing point at the rim, the gravitational mass decreases with the *same* root factor as the time. This shows that the gravitational mass is *Energy of Movement ("kinetic energy")* *on the **time** axis*. Therefore, **it is justified to say that *any* energy is kinetic – is energy of movement**. If we calculate the energy of movement on the **time axis** when the marble is *at rest* in space, v = 0, then we obtain $mc^2$. In this case, the marble falls *into time* at the velocity of light, c. If, however, v > 0, then from the original $mc^2$, only the fraction $c^2m\sqrt{1-v^2/c^2}$ is active for gravitation.

We can summarize:

*Any* energy of movement exerts gravitation, however only at right angles to the direction of the movemenmt. A special case is the movement in the *time* axis: It causes gravitation in all three *spatial* directions (all are orthogonal to the time axis). The same is true for the central mass, M, which is at rest in all *spatial* directions, but "moves" on the *time* axis with c. Hence, it exerts gravitation in *all* spatial directions (each is at right angles to the time axis). In the preceding chapters we have considered only movements in one of the spatial directions.

## 3.13 Collapsing Universe

The luminosity of a special type of Delta Cephei-Stars is known to be dependent only on its periode. Hence its brightness is an indicator for its actual distance to us. Combined with Hubble's measurement of the red shift of distant galaxies it seemed to be obvoius that the distance would be the greater the greater the red shift of its light. So Hubble's red shift could be explained very simple by expansion of the universe. The explanation seemed to be so evident that it was difficult to imagine an alternative. However expansion leads to an almost imaginable event in the past, a “Big Bang”, where the whole universe had to be emerged from a volume “smaller than a nutshell”.

Cosmic Background Radiation was first discovered in 1941 by Andrew McKellar (who correctly recognized it as radiation of a black body) and later by Penzias and Wilson in 1965. Since 1965, this has been understood as evidence and “relict” of the Big Bang according to an assumption of George Gamow in 1949, unnoticed at the time. Let us pretend, for a moment, that the background radiation had been found prior the discovery of red shift. In this case, it seems unlikely that anyone would have concluded that background radiation and the present distribution of the elements could be explained by no other hypothesis than the most absurd one, the Big Bang. In deed some pioneers of the theory of the nuclear synthesis where sceptic about the idea of Big Bang, especially Al Cameron, Margaret and Geoffrey Burbidge, William Fowler, Fred Hoyle and others.

The conditions for a Big Bang have been deduced from measurements in laboratories. Because the hypothetical assumptions for a Big Bang have to be assumed arbitrarily, any result we want can be specified. There was no evidence that no other process than a Big Bang would produce the observed background radiation and the assumed cosmic distribution of elements. Let me quote the critics with their own words (quoted from “A Different Approach to Cosmology” by Fred Hoyle, Geoffrey Burbidge and Jayant V. Narlikar):

*“It is common to find that students emerge from a cosmology course in modern times believing that the big-bang theory explains a cosmic helium value with Y close to 0.25. This is to distort the meaning of words. Explanations in science are normally considered to be like theorems in mathematics, to flow deductively from axioms and not to be mere restatements of the axioms themselves. As, for instance, the Dirac equation turned out to explain the fine structure of the hydrogen atom. Thus the radiation-dominated early universe is an axiom of modern big-bang cosmology, and the supposed explanation of the microwave background is a restatement of that axiom.”* (Page 97) ... *“When a theory is specifically adjusted to have a certain property, it cannot be given over-much credit for having that property. Which is how it is with the production of helium in the hot big bang. Examination of the papers cited earlier shows that the theory was quite explicitly constructed to fit the helium requirement. Consequently, its ability to give $Y \cong 0.25$ is not in itself worth a great deal as an indication of its correctness or otherwise.”* (Page 99).

For many physicists, Einstein included, the discovery of the red shift of remote galaxies was a welcome explanation for the problem of why the universe, in its long history, had not already collapsed by gravitation. The red shift seemed to solve that “problem”. If, however, these physicists had examined what happens in a collapsing universe, then they had experienced a surprise: the relativistic view shows that *fossil light has a red shift proportional to its age*! This leaves nothing to be explained. Because the sophisticated formulas of General Relativity are difficult to understand, mathematical thinking remained bound to Classical Physics. Let us consider the simple facts: The tremendous space of the universe allows all cosmic masses to fall until they reach almost the velocity of light. This happens long before they would collide mutually or converge to a hypothetical Black Hole. The latter would be possible only if the principles of relativity are ignored or not understood because, in a collapsing universe, the falling masses and their distances and time intervals decrease relativistically. This means: They must arrive a velocity where the *relation* of the distances is constant. Then the universe remains similar to itself at all times (as in fractal geometry). This can be recognized only in the relativistic view, where Big Bang and Black Holes do not exist. If we throw off the ballast of theorems not explained or not understood in their full meaning, then both, Big Bang and Black Holes, disappear, and with these hypotheses, all their intrinsic contradictions. The universe remains unchanged *because* it collapses. If this appears to be contradictory, please refer to **P. 41**. The collapse is an event in the time axis. This can be proven in many ways, because the physical reality does not depend on how we approach to it. Whatever relativistic way we go, we always see *why* the red shift of remote galaxies disproves both, Doppler shift by velocity as well as expansion of the space (see Chapters 1.1 and 1.2).

Today, the red shift of remote galaxies is commonly explained by “expansion of space”, and with it, the length of the light wave *on its way to us* is assmed expanding too. But “light *on its way*” is a phantom. A clock moving with the velocity of light stands still; this means: for light, the time between emission and arrival is zero, and nothing can change in zero time.

## 3.14 Self-Similarity, Contraction with Constant Diameter

The distance to remote celestial objects has been determined indirectly. In any case it should be the greater, the greater their red shift. The explanation of the red shift by expansion of the universe was considered so obvious that an alternative could not be imagined. Evidently the whole universe must have emerged at a "Big Bang" from a volume "smaller than a nutshell". If it had collapsed, then any amateur could calculate that over such a long period the collapse had already ended long ago as a Black Hole, but in contrast it has existed for eons, as long as its oldest stars, or even longer.

Correct in that logic is only the remark that this would be an amateur's calculation. A less amateurish calculation, however, doesn't ignore relativistic effects when the collaps or expansion approaches the velocity of light. What happens if actually the universe is collapsing?

It is not easy to find a Big-Bang-advocate who accounts for the decrease of the measuring units for length and time when, as generally assumed, space *expands* at nearly the velocity of light. However, if space is collapsing, then the relativistic effects must be of even greater importance because then the velocities increase, and when approaching the velocity of light, mass and length would shrink without limit – and the measuring units are shrinking too. In this case, we have to ask:

(1) What are the values of the (shrinking) measuring units we should apply for distances and for "age"?

(2) If the question of measuring units is excluded from Cosmology, then we can not expect an answer.

Energy-conserving Gravitation does not ignore the question of measuring units and it provides the answer.

Suppose a mass starts falling with v = 0 at a distance, $R_o$, from the center.

As time, t, proceeds, the distance decreases from $R_o$ to $R_o - \int_{t=0}^{t} v \cdot dt$. An observer sitting upon that mass may measure the remaining distance with a ruler. At the start (t = 0), the length of the ruler should be = 1.

Due to the velocity, the ruler shrinks relativistically from 1 to $\sqrt{1 - v^2/c^2} < 1$.

Applying the shortened ruler to the original distance, $R_o$, we would measure a distance greater than $R_o$. If we measure with this ruler the remaining distance, R, then at the velocity v we would measure an unchanged distance only if the decrease of the distance equals the decreased length of the ruler. That means:

**(3.61)** The ratio "distance to ruler" must remain the same. It must be $\dfrac{\mathbf{R_o - \int_o^t vdt}}{\sqrt{\mathbf{1 - v^2/c^2}}} = \mathbf{R_o}$.

Such a velocity is possible. It is the velocity $v = c \cdot \sin\dfrac{ct}{R_o}$, because if we insert that velocity into the integral, then the left side of the formula becomes $R_o$. At ¼ period, the sinus wave reaches its maximum (= 1) for the positive half-wave when $ct_o/R_o = \pi/2$. Then, v = c. That marks the time $t_o = R_o\pi/2c$. At this time v = c and the total mass would be transformed into radiation.

This calculated velocity, v, is not the real velocity, it is the velocity *required*, if the distance is to decrease by the same factor as the measuring unit used for measuring the distance. However that velocity must be reached by any mass because nothing in the tremendous space between the masses can stop their acceleration while the universe is collapsing. The velocity depends on $R_o$ and will be reached within the interval t according to $0 \le ct \le ½R_o\pi$. (The mass starts at t = 0 when the distance is $R_o$ and the initial velocity is zero.) The greater $R_o$, the greater is $½R_o\pi$, thus there is no time limit for acceleration.

At which velocity does the measuring unit shrink by exactly as much as the distance is contracting? We can calculate this if we substitute for the root in the formula the gravitational factor $e^{-a/R}$ according to Equ.(3.4).

By isolating the integral, we obtain $\int_{t_0}^{t} vdt = R_o(1 - e^{-a/R})$.

That we can differentiate with respect to t, ($\frac{d}{dR}\frac{dR}{dt}$), and we obtain:

**(3.62)** $v = -R_o \dfrac{a}{R^2} e^{-a/R} \dfrac{dR}{dt}$. v can be reduced because v = –dR/dt. We get $\boxed{\dfrac{R_o}{a} = \left(\dfrac{R}{a}\right)^2 e^{+a/R}}$.

This means: For any distance, R, a correlated initial distance, $R_o = R^2e^{a/R}/a$, exists where the condition is met that, in the view of an observer, the size of the universe does not change. Then the size appears to be the same in spite of continuously collapsing. When falling from $R_o$, the mass arrives at R, and the distance and the measuring unit are seen decreased by the same factor; hence, no contraction of the universe can be observed. That is true even for distances $R \leq a$ because even when $R = a/2$, there is sufficient space for free movement of the masses. This applies to the universe, not to collapsing stars.

Stars cannot collapse by their own gravitation, because the conditions for stars are different: For a star, the value $a = GM/c^2$ is very small, it is within the volume of the mass, M. The path is free over cosmological distances between galaxies but not between stars, even when accelerating to nearly the velocity of light.

Shouldn't the red shift of distant galaxies almost disappear when approaching the velocity of light? Yes, but for the light emitted *now*! An observer had to wait a few billion years until that light has arrived on earth. For galaxies we see today, the light was emitted far in the past when the universe was larger and the wavelength on the same spectral line was longer. This explains once more the red shift of the light from remote objects.

**Fig. 3.13** may explain the red shift and the processes involved.

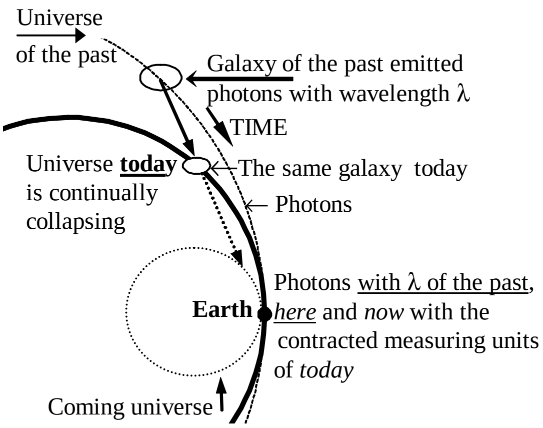



**Fig. 3.13**

1. All the masses of the universe are collapsing by gravitation. At any given time, each mass has a defined velocity of free fall *relative* to the observer.
2. *At each location* of an observer, the same *proportions* for time, length and mass apply. (The proportions between the measuring units of *different* observers are defined by their *relative* velocities.)

For each observer upon any mass in the universe is the *physical* world identical at all times. If we have that in mind and look at **Fig. 3.13**, then it is easy to understand why each observer has the impression that the universe is expanding: photons carry with them the measuring units *which they had at the place where they originated*. Each collapsing mass, however, has *its own* measuring units which are valid at *its* momentary location. That is called "scale invariance", and it is the guarantee that the same physical laws remain valid for each location in the universe.

In the view of a local observer, his own measuring units do not change. *This is essential*. Changes observed by other observers are of no relevance to him, except that he may wonder why the fossil photons of remote galaxies are "red-shifted", verified by its greater wavelength, and this is all we can see of the collapse of the universe. The red shift can be explained by strict application of the Principles of Relativity. The Relativity Principle therefore expresses very clear a truism: "absolute size" is a senseless abstraction. What remains of the "size" of an object in an absolute void where nothing comparable exists?

It is still possible to "explain" the "recession" of remote galaxies by "expansion of the universe", but this explanation is no better than assuming a collapse. All these explanations are similar with respect to physical laws. Instead of "explanations", a simple expression of the physical units as function of time and location could also be emphasized, and this we can call the "guarantee" that physics can be applied universally.

**This is the Principle of Relativity.** As far as I know, it has not been recognized with all its consequences. Until now the discussion followed the accustomed mathematical logic of Classical Physics with its *absolute* measuring units. Why had the unimaginable weirdness of Big Bang and Black Holes not raised any suspicion that anything could be wrong? The impressive mathematics introduced by Einstein's General Theory have prevented realization of the simplicity of relativistic thinking, simple and familiar to us since childhood. Without any difficulty, we can imagine being transformed into the Lilliputians' world, and television depicts us as tiny creatures on an expedition inside the human body. Is such a vision really beyond our imagination? *This is the Principle of Relativity*.

The red shift is the proof that, in the past, the universe (and the wavelength of light) was greater than it is today. The red shift reflects the fact that the measuring units of today are shorter than they were in the past. This has been erroneously interpreted as expansion of the universe or as the Doppler shift of fossil light. Expansion of the universe is a fallacy. This can also be realized in **Fig. 3.12** (P. 42), "**Perspective in Time",** where the velocity approaches that of light. "Length" is defined by the time a light ray requires to travel a certain distance. The distance of a galaxy is the projection of its light upon *the spiral line* of Fig. 3.12; hence, it is the arc length on the spiral line around the time axis. The higher the velocity of collapse, the more turns are covered by the light ray *on the spiral line,* i.e. the greater the distance.

Now it should be clear why the universe never changes in spite of collapsing (or expanding): Both, "collapsing" or "expansion", can only be measured with a scaled ruler, however the ruler also "collapses" (or "expands").

This is true not only for the red shift of light. It is also true for the time distance of any two events at a remote location because we cannot use other measuring units than the one we have at our location.

We can imagine a universe falling endlessly toward a goal beyond reach. All physical quantities change in proportion so that for an accompanying observer, the *relations* of these quantities – that is, the physical laws – remain the same. This is the essential feature of "**Fractal Geometry**". We can imagine space as a contracting spherical surface where all its parts, called masses, and all lengths converge asymptotically according to a time scale, while all its relations remain preserved. The time is synchronized as it is in the famous running match of Achilles and the turtle, however in such a way that the falling never ends. An analogy would be a contracting world which remains similar to itself (or even identical) if observed with a zoom lens of increasing magnification. That proportionality, not an absolute measure of length, is the constant of the world.

**The world is shrinking, but remains similar to itself at all locations and at all times. That correlates to an unlimited fractal geometry. Proportionality means self-similarity; its mathematical expression is the Lorentz Invariance of its laws.**

Any engineer would be glad if he could build a model of a construction in such a way that its performance corresponds exactly with the original. However this is an ideal realized only by the universe with all its parts. It shrinks forever and simultaneously remains the same in its structure and properties.

The law of free fall can be applied to the universe as a whole when it is shrinking. The distance where the gravitation of the universe has its maximum may be defined as **Radius of the Universe**. It is (Page 38):

**(3.58)** $$\mathbf{R = \frac{2GM}{c^2} = 2a.}$$ (M is the mass of the universe within that radius).

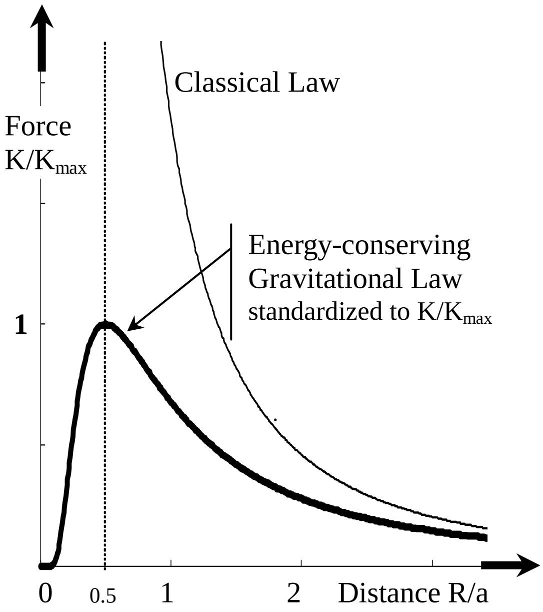
The potential energy at the distance R = 2a is $E_{pot/max} = c^2Me^{-a/R} = c^2Me^{-1/2}$. The difference to the total energy, $Mc^2$, is the kinetic energy which corresponds to a certain velocity. The velocity can be calculated by inserting the radius R = 2a of Equ.(3.58) into Equ.(3.6):

$$v = c \cdot \sqrt{1 - e^{-2a/R}} = c \cdot \sqrt{1 - e^{-1}} = 0.795 \cdot c\,.$$

In the view of an observer at *rest*, that is the velocity of collapse at the radius $R = \dfrac{2GM}{c^2}$. Because the falling continues (at the expense of the falling mass), the increasing velocity must approach the velocity of light, but at that velocity, the gravitational mass is zero. This means: the "rim" of the universe is not defined by a line but by the maximum of gravitation. Beyond that maximum, the gravitation decreases, but galaxies could be observed even there.

## 3.15 After all: should a Black Hole exist?

A friend has proposed the following experiment of thought. According to Energy-conserving Gravitation, the potential energy decreases by exactly the same amount as the Kinetic Energy increases. The original mass, m, decreases to $me^{-a/R}$ when descending from an infinite distance to the distance R. The decrease is true for a shift in radial direction only. Orthogonal to its movement, the mass and its gravitational quality do not decrease, and that is also true for a light ray. Now the friend's argument: If the central mass, M, were sufficiently concentrated, a light ray could pass by at such a short distance that it would be deflected to a circular path about the center. That should be possible because *orthogonal* to the light ray, its gravitation is not decreased. At such a short distance, the light should be trapped in an orbit from which it could not escape, but if it carries an unlimited amount of energy, then this would be a Black Hole.




**Explanation of Gamma Bursts**

**Fig. 3.14**

The argumentation is correct for all gravitational theories except the Energy-conserving Gravitational Law.

First it must be noticed that light is deflected in the direction *toward the central mass,* M; this is *radially.* The shorter the distance between light ray and center, the smaller is the space left for the volume of the central mass.

However, due to energy conservation, the gravitational force of the *central* mass, M, decreases when it contracts to the remaining small volume around the center because in this case part of its own mass is transformed into kinetic energy when it collapses into its center. This is shown in the diagram at the left.

The *standardized* distance to the maximum of the gravitational force (and the Schwarzschild Radius) is always R/a = 0.5, regardless of the values of R or the central mass, M.

Consequently, neither by making the central mass, M, larger nor by making the distance, R, smaller, can the deflection of light be increased to a circular orbit.

The gravitation is always less than it would be under Classical Law. When the distance, R/a, is less than 0.5, then the gravitation – and with it, the deflection of light – even decreases when R decreases, and remains considerably below the value required for a circular orbit, regardless of the density the concentrated central mass may be compressed.

It must be taken into account that at such a high concentration, a substantial part of the intrinsic energy, $Mc^2$, of the central mass has been transformed into kinetic energy. That is not a steady state condition, it is an unimaginable, dynamic *process* because such a compression can be reached only during the instability of a gravitational implosion of the central mass itself. In such an implosion, its parts would accelerate to almost the velocity of light when nearing the center. The enormous kinetic energy of the imploding central mass does exert no gravitation in the radial direction, because kinetic energy has no gravitation in the direction of movement. The falling parts of the central mass would reach the velocity of light exactly in the center as can be seen in the formula $\mathbf{v = c\sqrt{1-e^{-2a/R}}}$ . There is v = c only when R = 0. At such a velocity, a mass must be transformed into radiation. That does not preclude that radiation of the mass due to other physical processes takes place *before* the center is reached. The energy of radiation is not subject to gravitation in the direction it propagates, hence it can leave the center, without loss of energy. The characteristic decline in the curve below 0.5R/a reflects exactly the transformation of potential energy into kinetic energy.

**The gravitational collapse of the mass of a star or a group of stars appears as a brief gamma and x-ray burst with the utmost photon energy possible in the universe.**

# 3.16 Inertia and Gravitation

**Equ.(3.2)**, Page 22, has been derived for a gravitational force according to Energy-Conserving Gravitation. Is the Law of Inertia true also for other kinds of forces? Other *central* forces exist, e.g. the electrostatic force. In any case, gravitation is an intrinsic property of mass (energy), no matter how weak the force may be. If it can be proofed that the Law of Inertia is valid for *any* central force, then this problem would be reduced to hypothetical *non-central* forces. However, possible effects of hypothetical non-central forces cannot be examined before such forces are identified. Up to now, only central forces are known.

Let us consider the electrostatic force known as Coulomb's force, $Q_1Q_2/R^2$. It has to be added to gravitation (with minus sign, because $Q_1$ *or* $Q_2$ must be negative when $-Q_1Q_2 > 0$ is attractive). Remember:

**Equ.(1.2)** $E_{pot} = [M+m\cdot f(R)]c^2$ mit $0 < f(R) < 1$, For attraction with $-Q_1Q_2/R^2$ we write:

**(3.63)** replacing (1.4) $K = \dfrac{GMmf(R)}{R^2} - \dfrac{Q_1Q_2}{R^2}$, as before is valid **Equ.(1.3)**: $K = \dfrac{dE_{pot}}{dR} = mc^2\cdot f'(R)$.

$$E_{kin} = -\int_\infty^R K dR \quad \text{and} \quad E_{pot} = (M+m)c^2 - E_{kin} = (M+m)c^2 + \int_\infty^R K dR.$$ **Equ.(3.63) = Equ.(1.3)**, that is:

$$G\frac{M\cdot mf(R)}{R^2} - \frac{Q_1Q_2}{R^2} = mc^2\cdot f'(R), \quad \text{rearranged:} \quad f' - \frac{GM}{c^2R^2}f = -\frac{Q_1Q_2}{mc^2R^2}.$$ Its solution is

$$f = \frac{Q_1Q_2}{GMm} + \Gamma e^{-a/R} \quad (\Gamma = \text{constant of integration}, \quad a = \frac{GM}{c^2}).$$ Inserted into Equ.(1.2):

$$E_{pot} = Mc^2 + \frac{Q_1Q_2}{GM}c^2 + \Gamma mc^2e^{-a/R}, \quad \text{hence} \quad E_{kin} = (M+m)c^2 - E_{pot} = mc^2 - \frac{Q_1Q_2}{GM}c^2 - \Gamma mc^2e^{-a/R}.$$

For $R = \infty$ is $E_{kin} = 0$, $e^{-a/R} = 1$, thus $\dfrac{Q_1Q_2}{GM}c^2 + \Gamma mc^2 = mc^2$, or $\Gamma = 1 - \dfrac{Q_1Q_2}{GMm}$, inserted into f:

$$f = \frac{Q_1Q_2}{GMm} + \Gamma e^{-a/R} = e^{-a/R} + \frac{Q_1Q_2}{GMm}\left(1 - e^{-a/R}\right)$$ now f inserted into Equ.(1.2) and Equ.(3.63):

**(3.64)** $$E_{pot} = \left[M + me^{-a/R} + \frac{Q_1Q_2}{GM}\left(1 - e^{-a/R}\right)\right]c^2 \quad \text{and} \quad E_{kin} = \left(m - \frac{Q_1Q_2}{GM}\right)\left(1 - e^{-a/R}\right)c^2.$$ f into Equ.(3.63):

**(3.65)** $$K = \frac{GMm - Q_1Q_2}{R^2}\cdot e^{-a/R}.$$

It appears as if masses and charges were equivalent, however the difference is 'a' in the exponent which depends solely on M, not on $Q_1$ or $Q_2$. According to Equ.(3.1), $E_{kin}$ can be expressed as a function of the velocity. Equating it with $E_{kin}$ in Equ.(3.64, right), we can write:

**(3.66)** $$E_{kin} = mc^2\left(1 - \sqrt{1 - v^2/c^2}\right) = \left(1 - \frac{Q_1Q_2}{GMm}\right)\left(1 - e^{-a/R}\right)mc^2.$$

For v = c, the left side becomes $E_{kin} = mc^2$ and the total mass will be transformed into kinetic energy. Then, the right side yields the relevant distance, $R_o > 0$, (note that $-Q_1Q_2 > 0$ because one of the charges must be negative. $a = GM/c^2$)

**(3.66a)** $$mc^2 = \left(1 - \frac{Q_1Q_2}{GMm}\right)\left(1 - e^{-a/R_0}\right)mc^2, \quad \text{from that,} \quad \mathbf{R_o} = \frac{\mathbf{a}}{\mathbf{ln}\left(\mathbf{1} - \dfrac{\mathbf{GMm}}{\mathbf{Q_1Q_2}}\right)} = \frac{\dfrac{\mathbf{Q_1Q_2}}{\mathbf{mc^2}}}{\mathbf{ln}\left(\mathbf{1} - \dfrac{\mathbf{GMm}}{\mathbf{Q_1Q_2}}\right)^{\frac{\mathbf{Q_1Q_2}}{\mathbf{GMm}}}}.$$

For $Q_1Q_2/R^2 >> GMm/R^2$ the denominator is 1, because then the numerus of the logarithm is e.

At the distance $\mathbf{R = R_0}$ the whole mass has been transformed into kinetic energy.

Due to the additional attractive force of the charges, the mass reaches the velocity of light at a distance $R_o > 0$. This means that the mass is transformed entirely into radiation. $R_o$ can be zero only when the charges are zero. Then the logarithm is ∞.

An even more interesting result appears if both sides of Equ.(3.66) are derived with respect to t:

$$\left(\text{left } \frac{d}{dt} = \frac{d}{dv}\frac{dv}{dt}, \quad \text{right} \frac{d}{dt} = \frac{d}{dR}\frac{dR}{dt}\right) \qquad \left(\frac{dR}{dt} = v\right)$$

$$\frac{mv}{\sqrt{1-v^2/c^2}} \cdot b = \left(-\frac{GMm}{R^2} + \frac{Q_1Q_2}{R^2}\right) \cdot e^{-a/R} \cdot v = -K \cdot v$$ [K from Equ.(3.65)]. We obtain

**(3.67)** $$\mathbf{b\frac{m}{\sqrt{1-v^2/c^2}}} = -K,$$ **≡ Equ.(3.2) [≡ Gl.(3.2) on P.22] This is the law of inertia.**

<u>Thus, the law of inertia is also valid for electrostatic forces</u>. It is even <u>valid for any central force</u>, as we can realize if we repeat the calculation for an arbitrary central force, Z:

**(3.63a)** $$K = G\frac{M \cdot mf(R)}{R^2} + Z.$$ However Equ.(1.2) and Equ.(1.3) remain unchanged:

**Equ.(1.2)** $E_{pot} = [M+m \cdot f(R)]c^2$ with $0 < f(R) < 1$. **Equ.(1.3)** $K = \frac{dE_{pot}}{dR} = mc^2 \cdot f'(R)$.

**Equ.(3.63a)** must be equal **Equ.(1.3)**, because K is the same for both the equations:

$$G\frac{M \cdot mf(R)}{R^2} + Z = mc^2 \cdot f'(R),$$ rearranged: $f' - \frac{GM}{c^2R^2}f = \frac{Z}{mc^2}$. Its solution is:

$$f(R) = e^{-a/R}\int \frac{e^{+a/R}}{mc^2} Z \cdot dR.$$ f(R) inserted into **Equ.(1.2)** and $\mathbf{E_{kin} = E - E_{pot}}$ (= **Equ.1.8):**

**(1.2a)** $$E_{pot} = Mc^2 + e^{-a/R}\int e^{+a/R} Z \cdot dR$$ and **(1.8a)** $$E_{kin} = mc^2 - e^{-a/R}\int e^{+a/R} Z \cdot dR$$

$$K = \frac{dE_{pot}}{dR} = \frac{ae^{-a/R}}{R^2}\int e^{+a/R} Z \cdot dR + Z = G\frac{M \cdot mf(R)}{R^2} + Z.$$ [f(R) inserted].

Analogous to Equ.(3.66), $E_{kin}$ (function of v) in **Equ.(3.1)** must be equal $E_{kin}$ (function of R) in **Equ.(1.8a)**:

**(3.66b)** $$E_{kin} = mc^2(1 - \sqrt{1-v^2/c^2}) = mc^2 - e^{-a/R}\int e^{+a/R} ZdR.$$ Deriving each side with respect to t:

$$\frac{mv}{\sqrt{1-v^2/c^2}} \cdot b = -\left(\frac{ae^{-a/R}}{R^2} \cdot \int a^{+a/R} Z \cdot dR + Z\right) \cdot v = -\left(\frac{M \cdot mf(R)}{R^2} + Z\right) \cdot v = -K \cdot v,$$

[= **Equ.(3.63a)**]. The result is again the Law of Inertia according to **Equ.(3.67)**.

Essential in these equations is the gravitational term. With the function $e^{-a/R}$ that term controls the energy management of *all* forces and can be compared with the fuel tank of a vehicle, which represents reserve energy. The vehicle must stop when the tank is empty. Control of the energy management is imperative for maintaining a force along a path. Though gravitation is often negligible compared with other forces, due to this factor no other force can exist without gravitation. Forces greater than gravitation will cause a greater acceleration, but correspondingly, the energy reserves will be exhausted sooner. To produce a given amount of kinetic energy, *any* force must provide the same amount of energy. The balancing factor $e^{-a/R}$ ensures that the reserves are reduced by that amount of energy.

Note the third term in Equ.(3.64), $\left[\frac{Q_1Q_2}{GM}\left(1-e^{-a/R}\right)\right]c^2$. The term vanishes only if $R = \infty$, but for $R = R_0$ this term represents a new phenomenon. This can be realized by considering Equ.(3.66). For $R_o < R < \infty$: the term represents a <u>**potential energy localized in the field**</u>. That is the source of *electromagnetic energy*, as can be seen when comparing Equ.(3.64) with the gravitational energy Equ.(1.6), Page 6: $\mathbf{E_{pot} = \left(M + me^{-a/R}\right)c^2}$.

It is beyond question that electric charges are not the source of that energy. Although the acceleration is due to the electrostatic attraction, acceleration does not occur at the expense of an electric charge. Only some mass (= potential energy) will be expended. Hence electron/positron pairs *must* consume (annihilate) their two masses ($2m_e$) completely when transforming the total mass into kinetic energy. After that, their bodily *masses* have ceased to exist, but not the *charges* as shown in Equ.(3.64) and Equ.(3.66). Then, the "fuel" for maintaining the electrostatic force has been exhausted. The calculation in textbooks can be explained in the following way:

$$E_{electron} = m_e c^2 = \frac{9.108}{10^{28}} \cdot 8.987 \cdot 10^{20} = \frac{8.18586}{10^7} \cdot \frac{10^{12}}{1.602} = 511{,}000 \text{ electron volts} = \nu h \qquad \nu = 1.235 \cdot 10^{11}\ \text{Gc/s}$$

↑$m_e$[g] ↑$c^2$[$cm^2/s^2$] ↑[$gcm^2/s^2$] ↑[converted to eV] ↑$h = 6.626/10^{-27}$[$cm^2g/s$]

$m_e$ = mass electron or positron [1 $gcm^2/s^2$ = $10^{12}$/1.602 electron volts] Frequency, ↑ν of gamma quants

After annihilating electron and positron, the *total* energy is kinetic and $E_{pot} = 0$. Kinetic energy without potential energy can exist only as radiation; Coulomb's force no longer exists here. The two particles (positron/electron pair) are transformed into a photon pair radiated in opposite directions with opposite polarization. The shortest distance, $\mathbf{R_o}$, where this must have occurred can be calculated with Equ.**(3.66a)**. Then, the total energy, $m_e c^2$, of each particle has been transformed into kinetic energy, $E_{kin}$. Because the gravitational force, $GMm/R^2$, of such a small particle is negligible compared with its electrostatic force, $Q_1Q_2/R^2$, its ratio is $GMm/Q_1Q_2 \cong 0$. Thus, in Equ.(3.66a), the numerus of the logarithm is $\cong e$ and the logarithm = 1.

With the charge $e_o = \dfrac{4.803}{10^{10}} \dfrac{cm^{3/2} g^{1/2}}{s}$ of each particle, we obtain for $R_o$:

$$R_o = \frac{e_o^2}{c^2 m_e} = \frac{\left(4.803 \cdot 10^{-10}\right)^2}{\left(2.998 \cdot 10^{10}\right)^2 9.108 \cdot 10^{-28}} = 2.82 \cdot 10^{-13}\,\text{cm} \qquad \text{(called "electron radius").}$$

At that distance, the particle's mass must have been annihilated by radiation.

This can be understood as an analogy to the hypothetical Schwarzschild Horizon of Black Holes because at $R_o > 0$, the masses reach the velocity of light due to the electrostatic amplified central force.

**Conclusions from Equ.(3.2)** (≡3.67)**: 1. No force exist other than central forces**. – **2. "actio = reactio"**.

For the derivation of Equ.(3.2) Energy-conserving Gravitation has been assumed, nothing else.
The minus sign in Equ.(3.2) expresses Newton's axiom **actio = reactio**. It means: a given force provokes an opposing force of equal magnitude, Equ.(3.67):

**(3.68)** $$b.\frac{m}{\sqrt{1 - v^2/c^2}} + K = 0$$ **Law of Inertia,** identical with Equ.(3.2), Page 22..

If all forces in nature can be traced back to central forces, then the Law of Inertia is a universal law. To date, no other forces than central forces are known. It appears as though electromagnetic forces would contradict such a statement because the direction of magnetic forces is perpendicular to the radius. Since single magnetic poles do not exist, magnetic forces cannot act directly. Magnetic forces are caused by electric currents, and all forces between currents act on the moving charges; these charges are always the point upon which such forces are acting.

# 3.17 Rotating Reference System

### Invariability in case of Coordinate Transformation

Criticism of a theory may be provoked if explanations or essential calculations are left to the reader, especially when the search for the sources in literature is obviously impossible within a reasonable time. Every student knows the frustrating experience when his desire to acquire the best possible knowledge is frustrated, that is when he should tolerate questionable passages without reference. In such moments, the student may become uneasy.

One instance is the doubts some students feel about the *equivalence* of different frames of reference, mainly when rotation is involved. Does not the absence of centrifugal force indicate the preference of *one* particular frame of reference, namely the one which does not rotate in relation to the universe? The existence of centrifugal forces seemed to be inconsistent with the idea of "absolute space" at least with respect to radial or tangential direction. It is difficult to imagine that the laws of physics could remain invariable if our laboratory begins to rotate. The rotating earth is such a laboratory and we can calculate that even the nearest fixed stars, for instance in the constellation Centauri, are moving over the sky at right angles to their distance from earth with a velocity of roughly 6000 times the velocity of light. The theory asserts that such a velocity is impossible. Either the velocity of a body can exceed any fixed value, or a rotating reference system is not allowed. Each of these assumptions contradicts the theory.

If however we interpret the Relativity Theory not just as a result of a formalistic transformation of coordinates, but in accordance with the *physical definition* of the Relativity Theory, then such a conflict will not arise because – to the surprise of some students of physics – frames of reference with imaginary objects moving faster than light are *not* excluded by the theory. If this appears as a surprise and theoretically impossible, then that may indicate a fundamental misconception of physics, because then physics is reduced to quoting formulas without revealing their physical meaning. A formula as such cannot reveal a "physical" meaning if it is not precisely defined. For instance, the meaning of the statement "no energy transport faster than light" must be defined. It will *not* be learned in a course about tensors. Formulas can be handled like a cooking recipe, but in order to learn its physical significance, the action "transport" needs a precise definition. The definition can be deduced neither from the formula nor from its algorithm. A mere *mathematical* expression; for example, the mere definition of a tensor by using only symbolic letters and rules of operation, does not constitute physics. The statement "transport of energy" makes no sense if it is not related to *existing* objects, in this case: related to emitter and receiver. Abstracts such as "line of sight" are possible as a mathematical reference, but lines are not physical objects. No observer can sit on a line because a line has no mass.

It is by no means self-evident or trivial that in the universe no emitter and receiver can exist other than "mass". Before that was recognized at the end of the 19$^{th}$ century, is was a controversial philosophical problem to realize that "space" is a senseless concept if nothing exists to be used as "hooks" onto which we can mount signposts to define a location. Today, that is often even more abstract expressed in the notation of the Set Theory, but that does not dispense us from the requirement of a physical definition.

The fixed stars appear to circle around us, perpendicular to the line of sight, with velocities greater than that of light. *That* however is a mathematical or geometrical movement, *not* a physical one. Applying a formula does not create a physical meaning: The essential fact is that by such a formal movement, no atom moves and no physical information is transmitted from one star to the other. A mental rotation does not change any *relative* distance between *masses*. That contrasts to other kinds of rotation where masses are shifted *relative to other masses*. An example of a relative movement is an electron circling in a magnetic field or the movement of atoms in a transmission belt relative to the environment though the belt's shape does not move.

A *physical* definition of relativity refers to distances *between masses*. With this definition we can understand why stars can circle around us at a velocity greater than that of light – relative to a geometrically defined point. However, one problem remains: If we are at rest relative to the rotating frame of reference of the stars, then the masses within a rotating laboratory will experience centrifugal forces. That should be our next concern, see **Fig. 3.15**:

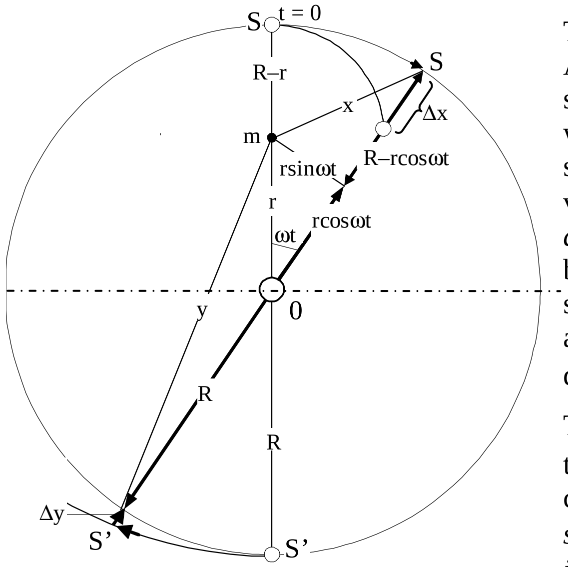



**Fig. 3.15**

The center of rotation is the point 0 *inside the laboratory*. At the distance r from 0 is a mass, m. If nothing else is said, we consider the laboratory as our frame of reference, where we are at rest. Seen from our reference point, the stars of the universe revolve around us with the angular velocity ω. Moreover, the stars which are at that moment *above* the dash-dotted horizon can be thought substituted by an *equivalent* mass, S, and all stars *below* that horizon should be substituted by an *equivalent* mass, S'. S and S' are both at a distance R from 0 on the *elongated* line of the distance vector $r = \vec{r} = \overline{0m}$.

The mass S, when circling around 0, moves perpendicular to the vector $\vec{r}$ with the angular velocity ω (in the drawing clockwise). Within each of the successively following *short* time intervals, t ($0 < t \approx 0$), its distance, x (S to m), *increases* by Δx – as shown in the drawing.

(We assume r = constant, and for $t \to 0$, Δx and Δy are infinitesimally *small*. Then the direction of r coincides with the direction of x and y – in contrast to the drawing, where the differentials Δx and Δy are shown > zero.) The stars of the hemisphere opposite S are substituted by the mass, S', which also rotates around us, however their distance y of S' to m *decreases* by Δy.

After *each* time interval, t, the masses S and S' must be defined *anew* as substitute for the star's mass of the hemisphere (per definition: the masses above each new position). In order to retain the drawing in its upright position, we compensate the small movement ωt of S by rotating the *drawing* back by –ωt. Then, for an observer inside the rotating laboratory, the *drawing* is always in the position where S remains at the zenith and S' remains at the nadir during the summation over all intervals, t.

For any *observation* time, T, is T = the sum $\Sigma t > 0$. If n is an arbitrarily large number, then we can write for the time interval $t = \frac{T}{n}$ and $T = \frac{T}{n} + \frac{T}{n} + \frac{T}{n} + \cdots + \frac{T}{n}$. (n terms). Then: $t \to 0$ if $n \to \infty$.

As shown in the drawing, we can write for the distances x and y
at the angular velocity ω of the stars circling round the center 0 of the laboratory:

| | |
|---|---|
| $x^2 = (R - r\cos\omega t)^2 + r^2\sin^2\omega t$ | $y^2 = (R + r\cos\omega t)^2 + r^2\sin^2\omega t$ |
| (for $t \to 0$ is $x = R - r$) | (for $t \to 0$ is $y = R + r$) |

First and second derivation of both sides of the equations (reduced by the factor 2):

$$\mathbf{x\frac{dx}{dt} = +(R - r\cos\omega t)r\omega\sin\omega t + r^2\omega\sin\omega t\cos\omega t = +Rr\omega\sin\omega t,} \quad \textbf{hence}$$

$$\mathbf{\frac{dx}{dt} = +\frac{Rr\omega}{x}\sin\omega t \quad (= 0 \quad for \quad t \to 0),}$$

$$\mathbf{\frac{d^2x}{dt^2} = +Rr\omega\frac{x\omega\cos\omega t - \frac{dx}{dt}\sin\omega t}{x^2}.}$$

$$\mathbf{y\frac{dy}{dt} = -(R + r\cos\omega t)r\omega\sin\omega t + r^2\omega\sin\omega t\cos\omega t = -Rr\omega\sin\omega t,} \quad \textbf{hence}$$

$$\mathbf{\frac{dy}{dt} = -\frac{Rr\omega}{y}\sin\omega t \quad (= 0 \quad for \quad t \to 0),}$$

$$\mathbf{\frac{d^2y}{dt^2} = -Rr\omega\frac{y\omega\cos\omega t - \frac{dy}{dt}\sin\omega t}{y^2}.}$$

*For the vertex (highest point), that is for $t \to 0$, the second derivations yield a permanent radial acceleration of*

$$\frac{d^2x}{dt^2}\Big|_{t\to 0} = +r\omega^2\frac{R}{R-r}, \qquad [x = R–r]$$

$$\frac{d^2y}{dt^2}\Big|_{t\to 0} = -r\omega^2\frac{R}{R+r}. \qquad [y = R+r]$$

It can be seen that the acceleration has a maximum at the vertexes (where the interval t changes from negative to positive). Hence, the sign of the accelerations $d^2x/dt^2$ and $d^2y/dt^2$ cannot change (because cosωt = 1 and sinωt = 0). The directions of both accelerations must coincide with the vector ↑mS. When $d^2y/dt^2$ has a negative sign, then it has the opposite direction relative to ↓mS', which in turn is opposite to ↑mS.

The expression $d^2x/dt^2 > 0$ is the *acceleration* by which the distance x between m and S *increases* (if the distance r is held constant). The other expression, $d^2y/dt^2 < 0$, shows the *decrease of the acceleration* of the distance y between m and the other mass, S', at the same condition. The two factors $R/(R\pm r) = 1/(1\pm r/R)$ differ from 1 by an immeasurable small amount because R is billions of lightyears, r is some light seconds. If, for the present, these factors (≈1) are neglected, then the two accelerations have the same value and same direction. Hence, they must disappear if m has the same acceleration as S and S'. Exactly that is the case if other forces are absent. This can be realized by two arguments:

1st A mass cannot (in contrast to Münchhausen) pull *itself* in a direction relative to its environment.

2nd When seen from the mass, m, the universe is identical with the masses S and S', both having the *same* direction of acceleration as the radius vector $\overline{0m}$. Since no energy is transmitted to the mass, their location cannot change, m will remain at rest relative to *its* own universe, that is S and S' respectively.

One may ask, why do the two masses S and S' not fly away due to their acceleration – in the direction of the vector $\vec{r}$? In spite of their upward acceleration, they remain at the same distance, R – that is relative to the center. The reason is their definition. The masses S and S' are only *imagined* (imagined anew at every moment) in order to substitute the *effect* of those cosmic masses which are, at *that* moment, above the horizon. It is true that the *masses* are accelerating, but their summed effect remains constant at that place where the masses pass the hemisphere above the horizon at that moment. The *location* where their gravitation acts is not accelerated. The stars are just passing through that hemisphere. The *passing by* of the stars has the effect of an accelerating mass at the distance of R. That means:

The two masses S and S' should not be considered as real masses with real movements. Of course they *are* real and they do move, but only as abstract mathematical quantities, *being real only for that moment* where they imitate the gravitation of the celestial bodies of the upper and lower hemisphere.

The axis of symmetry common to both hemispheres, is by definition the direction $\vec{r} = \overline{0m}$. Each turn of our laboratory around 0, and with it of the vector $\vec{r}$ (counterclockwise if viewed from the stars), correlates (viewed from the laboratory) to a clockwise turn of the substituted masses S and S'. The drawing shows the laboratory's view *prior* to t approaching 0. Like a transmission belt, the whole rotating association of stars passes through the two hemispheres, each represented by S and S' respectively. Masses emerge from the one half of the equatorial cross-section and disappear in the other one, exactly like the masses of a belt are passing by while the belt's shape remains unchanged. The vector $\vec{r}$ pierces the celestial hemispheres in their vertexes where (for a hypothetical observer) the masses could move faster than light.

Seen from the center of rotation, a free mass, m, accelerates in the direction away from the center. The product of acceleration times mass (= b·m) is called centrifugal force. The force can be measured by the force required to maintain the distance between m and 0. It is equivalent to an acceleration in the direction toward 0 by a centripetal force (= $m\,\omega^2 r$). If however the mass is released, then it "follows" the masses S and S'. "Follow" means, in this case, that it remains at rest relative to the accelerated masses S and S'. Seen from the mass m, the masses S and S' are at rest; hence, for m, no other universe at rest exists than that represented by the masses S and S' which are accelerating away from the center. Correctly, we would have to say that *in our view*, the center, 0 (where we are), is accelerating away from S and S'.

This finding is a surprise inasmuch as we have deduced it solely from the classic theory already known two centuries before the Relativity Principle was published. The argumentation remains the same, whether under the classical or the relativistic theory. We have used only the *physical* meaning of the formulas and the kinematics of movement. A mere formalism not related to any physical reality would be meaningless.

In the text above, we have neglected the small difference between the values of the accelerations $d^2x/dt^2$ and $d^2y/dt^2$ and the known value, $\omega^2 r$, of the centripetal acceleration. The difference is expressed by the factors R/(R–r) and R/R+r) mentioned above. Small as this deviation may be, it has to be proved that it does not hide an error in the argumentation. In three steps, it will be shown that the deviation disappears when *all* centrifugal forces are taken into account.

1. S is always on the extended line of r and rotates around the center, 0. In a reversed view, m can be considered circling around S. In other words: Each mass – m or S (or S') – can be considered as center and the other one, S or m, circling round it at the same angular velocity $\omega$. (It makes no difference, if we restrict the consideration to infinitesimal sections of circles where the masses S and S' are continually redefined at each moment.)

2. The gravitational attraction of S upon m is slightly weakened by the centrifugal force due to that rotation. If two bodies are circling around each other, then we expect that the amount of the centrifugal forces are equal, but that is not true in this case. The centrifugal force acting on S due to its rotation around 0 cannot be balanced by the centrifugal force acting on m due to the rotation of m around S, because the centrifugal force is proportional to the distance to the center (if $\omega$ is the same). In this case however, the distance for both masses is different. S rotates round 0 at the distance R. The mass m remains always at the *near* side of S, circling at the distance R–r around S; hence, the centrifugal force is smaller by the factor (R–r)/R. The gravitation force is weakened (less) by this factor, hence it appears stronger by the factor R/(R–r).

3. The remaining *stronger* gravitational force must be balanced by a force proportional to the acceleration $d^2x/dt^2 = r\omega^2R/(R–r)$. In this expression, the quantity $r\omega^2$ is multiplied by the same factor as the gravitation. Therefore, the gravitation is balanced by $r\omega^2$. The same argumentation can be applied to $d^2y/dt^2$ and S'. Since the mass, m, is always on the *far* side of S', we have to use the reversed factors R/(R+r) and (R+r)/R. The outcome is the same.

The result of this argumentation is the following: If a mass, m, moves in a circle, then the gravitational effects of the cosmic masses are no longer balanced. A component of gravitational acceleration, with the value $r\omega^2$, remains, which is directed away from the rotation center.

However, the same conclusion can be derived directly from **Equ.(3.22)**, Page 28, **$b = v^2/R$.** According to that equation, a circular movement of a mass, m, requires a centripetal acceleration, $d^2r/dt^2 = \omega^2r$, as a balance to gravitation from the cosmic masses. If the same acceleration is caused by the cosmic masses S and S', then we can conclude that their combined effect is the centripetal acceleration, $d^2r/dt^2 = \omega^2r$. In this case, the conclusion is the same as the one we reached above with the more complicated argumentation.

Such cross-checking is an additional and even more convincing proof for the assertion that the centrifugal force can be understood as difference of the gravitational effects of the cosmic masses, S and S'.

## What means “Invariance with respect to Coordinate Transformations”?

Sometimes one of the essential features of physical quantities is accentuated "as *invariable* with respect to *coordinate transformations*". One of these quantities is the velocity of light. It can be used as an example to illustrate how a statement could make an understanding more difficult if the *physical meaning* is vague, though it is *mathematically* correct. A person speaking of a “coordinate transformation” may have an entirely different idea in mind than the person adressed. For instance, a student may wonder why it should be proved that a physical law is independent of transformation of the coordinate system. We use coordinates as the “language for *representation*". The language – Cartesian or Polar Coordinates, moving or at rest – do not effect the *physical* quality of the law to be presented, especially if “transformation” refers to the kind of coordinates. We can choose a coordinate system as the language for *presenting* a problem, but its physics does not depend on the language of presentation. This should be obvious and surely doesn’t need to be proved. What the speaker means – but does not say explicitly – is not simply a transformation of the coordinate system. He wants to express that the *Physical laws* remain invariable when the *mutual* distances and velocities of the masses change. Events expressed by physical laws are *mass transports* or objects related to such transports, distances, velocities, or masses – these are parameters having a physical function.

*Relative* distances and velocities have a *physical* function. They must be distinguished from “coordinates” which are abstracts without having a physical meaning in itself. In many respects, distances and velocities can be expressed by the same formulas, but it is impossible to associate a physical function with coordinates as such. A mathematical function refere to a physical quality when it implies a dependence on *relative* distances and velocities of *masses*. “Invariance” refers to *any* change of coordinates, including those which do not change *relative* distances and velocities. A physically relevant invariance cannot be distinguished from an invariance which is due to a mere shift of the reference system if both are expressed by the same formulas.

The statement “invariable” can have a physical meaning only if it refers to *relative* changes of distances and velocities, but it makes no sense to apply it to a change of the coordinate system in which *relative* distances and velocities remain unchanged. In order to avoid confusion, I have preferred in this paper to speak only of relative quantities and not of coordinates.

For instance, without becoming physically inconsistent, we always can *imagine* an observer who rotates in the sky around us but does not interfere in the interaction of the masses. A physical conclusion however cannot be drown from such an imagined rotation. We see the fixed stars moving *in the sky* faster than the velocity of light orthogonal *to our line of sight* to the sun. This seems to contradict the postulate of invariance of the velocity of light. However, we should remember that the statement “the velocity of light remains constant” refers only to *relative* movements of masses. The paradox arises if the invariance of the velocity of light where defined only *formally*, that is for “light itself”, without referring to other objects. “Light itself” does not exist physically, there exists no massless observer sitting upon an imaginary “line of sight”. Light can exist only as a relation between emitter and receiver, that is, as a *relation between masses*. A photon which is not emitted and not received is a ghostly apparition and cannot exist physically. Where no emitter and no receiver exist – both are masses – nothing can be transported.

A consequence of that is not only the Relativity Principle but Quantum Physics as well. There is always the risk of confusing formal ideas with physics. Formalism is made within our brain, consequently it is quite possible that we know what we are speaking about, but dealing with physics means that we have to deal with the unknown. Physics is our concept of the unknown. The most misleading sources in our search for knowledge are “definitions”, for instance the “definition of life” (or of our concept of it), because the reality of life is already defined before someone offers to define it. An unknown reality can be accepted but it cannot be defined.

We believe that we can define objects which are *existing*, but this does'nt make it to exist. We do not *know* anything by a mere definition.

# 4. Empirical Evidence

The gravitational law *with* energy conservation confirms many astronomical observations not explainable by any other known theory. In the following publications, many of these unexplainable observations are quoted together with hypotheses postulated solely for their explanation. All observations have been made with the best instruments available today, for instance with the Hubble telescope, the Röntgen satellite ROSAT, etc.:

1. **A Different Approach to COSMOLOGY**, by Fred Hoyle, Geoffrey Burbidge and Jayant Narlikar**,** 336 pages, Cambridge University Press, 2000, ISBN 0 521 66223 0
   The Edinburgh Building, Cambridge CB2 2RU, UK www.cup.cam.ac.uk
   (The very theoretical text of this book requires knowledge of the General Theory of Relativity)
2. **Seeing Red: Redshifts, Cosmology and Academic Science**, by Halton C. Arp, 306 Pages, 1998, Apeiron 4405, rue St.Dominique, Montreal, Quebec H2W 2B2 Canada. *http://redshift.vif.com.*
3. Additionally an essay by Halton. C. Arp: **Observational Cosmology Impacts Physics**, 4 pages, in Physics Essays, Volume 8, Number 3, 1995.

### What does “empirical verification” mean?

As explained in Chapter 2.1, Page 12ff, the Relativity Theory would be completely misunderstood if a physical quantity used for describing the world (for instance “mass”) were interpreted as a “quality” of the observed object. We do not know anything about a quality of a physical object as such. The definitions of physical qualities are based exclusively on the *effects* upon the observer’s senses and the measuring devices. For instance, if I look at you, then I do not see you. What I see is the *image* which appears in my “imagination”. Reality and image are entirely different entities. You are not an image, you are a world of your own and only you is the person recognized within itself.

If we speak of “empirical verification”, then we are speaking of the *images* identified with (and called) ”observation”. In Chap. 2.1 we have seen that, for instance, if we are speaking of the change of a “mass” (perhaps due to a gravitational field or a velocity), then “mass” is not understood as a quality of the body itself, rather it is a quality correlated with the *image* of it, and it is that image *in our brain* which we experience. Our experience takes place at our location, not within the body observed. We correlate it to our definition of “mass”, but definitions are also made by means of an experimental arrangement imaged in our brain. *All* quantities of objects are defined by qualities in our imaged world, for instance “inertia” or ”spectral frequency”. The fact that physical laws are not self-contradictory, expresses the experience that any observed change of the “mass” (defined as a quality *of its image* in our brain) is correlated with a simultaneous change of other physical quantities in such a way that a given physical law never comes into conflict with any other physical law. That can be condensed to a physical principle: At all locations and at any time the physical world is “similar to Itself ”.

Another instance is the course of time. If a mass is moving in the view of an observer, then its course of time is different from the course of time within a mass (a mass does not move relativ to it self) or would be in another gravitational field or in the past/future. Similarly, "contraction of the universe" refers to an observer identified with the image *we* have of remote objects, but that does not mean that the observed object sees itself contracting.

## 4.1 Groups of Galaxies

Since Edwin Hubble has discovered the correlation between the distance of a galaxy and the red shift of its light, the red shift has been interpreted either as Doppler shift due to a receding velocity of remote galaxies – or as expansion of the space of the universe. This interpretation implies that there was a starting point in the past, the famous and celebrated Big Bang. However, about two decades ago, Halton C. Arp has reported on discoveries which are not compatible with any such interpretation.

Galaxies tend to be grouped in clusters. In most cases, a dominant massive central galaxy is surrounded by smaller companion galaxies. Evidently, the members of a cluster can hold together only by gravitation. This implies that the mean frequency shift of all members *relative to its gravity center* must be zero because the *relative* red and blue Doppler shifts due to individual orbital velocities must be distributed statistical symmetric around the central mass. The measurements presented by H. C. Arp are inconsistent with this because the light of each of the companion galaxies has a greater red shift than the massive central galaxy in the center. Blue-shifted counterparts are missing. Therefore, the average of red and blue shift is not zero and the interpretation as Doppler shift or as expansion of space must be incorrect. (Physics Essays, Vol.8, No.3, 1995). Attempts to explain this result by at present accepted theories have failed.

What we see is a central galaxy surrounded by smaller galaxies. Such an association *can* be thought to be the result of a free fall of each companion galaxy from $R_\infty = \infty$ to its present distance, R. As shown by the Clock Experiment, the mass of a falling body (e.g. a companion galaxy) decreases on the way from $R_\infty = \infty$ to the present distance R by the factor $\sqrt{1-v^2/c^2} = e^{-a/R}$ = **Equ.(3.4), P. 22**.

Now we define a mass at $R = \infty$: It should be $m = m_{R=\infty} = m_o/\sqrt{1-v^2/c^2}$. With this definition we can replace each $m_o$ by an equal mass $m\sqrt{1-v^2/c^2}$. [Remember: $\sqrt{1-v^2/c^2} = e^{-a/R}$]. Of course, the velocity of the free fall is of no importance. The intention of such a replacement of each mass by its theoretical primordial mass at $R = \infty$ is just to simplify the calculation. Then, each calculation can be related in the formula to a primordial mass, m, at the distance $R_\infty = \infty$. The distance $\infty$ defines a frame of reference where no gravitation exists (defined as "Inertial System").

A falling mass decreases whilst its velocity, v, increases. This is no contradiction to Special Relativity because in this case the energy for accelerating is *extracted* from the falling mass (as confirmed by the Clock Experiment – the energy would have to be *added* only if it were inserted from an external source). The velocity, v, is the velocity of free fall when the original potential energy at $R_\infty$ was $mc^2$. The decreased potential energy at the distance R is $= mc^2\sqrt{1-v^2/c^2}$, the energy difference has been transformed into kinetic (falling) energy, and the velocity, v, is reduced because the kinetic energy may be stored, dissipated, or emitted.

As already explained [Chapters **1.3, and 3.2, Equ.(3.1)],** the remaining gravitational mass is:
$m\sqrt{1-v^2/c^2} = me^{-a/R}$. R and v are correlated, explicitly for v: **Equ.(3.6)** $\mathbf{v = c.\sqrt{1-e^{-2a/R}}}$.
All formulas and their consequences (including the following) are confirmed by the clock experiment.

Only the remaining mass, $me^{-a/R}$, exerts gravitation symmetrical in all directions, where the kinetic energy has no gravitational effect in the direction of movement. Each atom of the mass – and, with it, each of its natural frequency – decreases by the same factor. Hence, the emitted light is red-shifted relative to the light we receive from the central galaxy of this remote cluster.

**That explains the additional red shift relative to the center of the cluster observed by H. C. Arp**
– and it is a consequence of the proportionality $E = h\nu$ of the photon's energy, E, and its frequency, ν.
The correlated mass, $E/c^2 = h\nu/c^2$, is carried away by each photon emitted (h = Planck's constant). But note:

The decrease of mass of a falling body is true for an observer *at rest* relative to the central mass. If the observer has a velocity > 0 relative to the center, then all its energies (masses) show an additional relativistic change of the inertial mass due to this velocity. A mass appears not decreased if the observer is sitting upon it, he has no falling velocity *relative to himself*. Kinetic energy, a relative entity, depends on *relative* velocity. For instance, the *mutual relation* of masses inside a falling cabin (called "inertial system") does not change. The same is true for all fundamental physical units, hence the physical laws inside and outside the cabin are identical (being "similar to itself", and this is called Lorentz invariance).

The kinetic energy is correlated with the falling velocity, however the equivalent mass of kinetic energy has no gravitation in the direction it moves. If, for instance, the falling velocity becomes reduced **Fehler! Keine gültige Verknüpfung.**, then, of course, this energy becomes dissipated (radiated as heat) and will not restore the original mass. We are free to think that each atom of each companion galaxy has fallen initially from R= ∞ to its present distance by gravitation, even if its velocity has been reduced long ago (by dissipating its kinetic energy). When the individual companion galaxies have reached different distances (relative to the larger central galaxy), then the mass of each atom is decreased compared with its original value at $R = \infty$. The shorter the distance to the central galaxy, the less is the atomic mass (and each natural frequency correlated with it), as verified by its red shift. Even if the velocities of free fall have been slowed down long ago, we can express the factor of mass decrease due to the velocity it had long ago. The factor is $e^{-a/R} = \sqrt{1-v^2/c^2}$, calculated by using **Equ.(3.6)** $\mathbf{v = c\sqrt{1-e^{-2a/R}}}$

[$a = GM/c^2$. M is the dominant "central mass" responsible for gravitation. G = gravitational constant.]

$2a = 2GM/c^2 = R_S$ is called the "Schwarzschild Radius". We use this designation though $R_S$ is also used for the radius of a so-called Black Hole (with a mass M) whose existence has been disproved by Energy-conserving Gravitation. If $R >> a$ (that means $R >> R_S$ ). We can write $e^{-2a/R} \cong 1 - 2a/R = 1 - R_S/R$.
With that approximation, we obtain for v

**(4.1)** $$v = \mathbf{c\sqrt{1-e^{-2a/R}} = c\sqrt{\frac{R_S}{R}}}.$$ $c = 3 \cdot 10^5$ km/s. (The formula is *not* true for $R \cong R_S$!)

If, for instance, the central mass were similar to our own galaxy with about $2 \cdot 10^{11}$ times the mass of the sun, then $R_S = 2 \cdot 10^{11} R_{S(sun)} \cong 6 \cdot 10^{11}$ km ($\cong$ 0.06 lightyears = 4000×the distance earth-sun). ($R_{S(sun)} \cong 3$ km).

For a companion galaxy at the distance $R = 10^6$ lightyears $\cong 10^{19}$ km, the velocity, v, would be

$$v = c\sqrt{\frac{R_S}{R}} = 3 \cdot 10^5 \sqrt{\frac{6 \cdot 10^{11}}{10^{19}}} = 74 \text{ km/s.}$$ (The red shift is often specified by this velocity.)

This velocity agrees with some of the red shifts relative to the central galaxy, observed by H.C. Arp. The value may be greater if the central galaxy has a greater mass due to unknown dark matter. If, for instance, the central mass were 4 times the mass assumed in Arp's observations, and if the distance were half the assumed value, then <u>v would be 208 km/s</u>, in good agreement with the average observed by Arp.

For exact calculation, the *mutual* gravitation of the companion galaxies must *also* be taken into account. If no central mass exists, then the calculation can be made with the *mutual* gravitation of the cluster group.

The relation between red shift, z, and velocity, v, or distance, R, can be calculated as follows:

Assume a natural frequency, $\nu_R$, of an atom at a distance, R, from a central mass. If the atom were raised to infinite distance, $R_\infty = \infty$, then the atomic mass would increase by the mass equivalent of the energy applied. Proportional to the mass, the spectral frequency increases to $\nu_\infty$.

The relation of the frequency increase $\nu_\infty - \nu_R$ to the frequency $\nu_R$ is called **frequency shift z**: It is

$$z = \frac{\nu_\infty - \nu_R}{\nu_R} = \frac{\nu_\infty}{\nu_R} - 1, \qquad \text{or} \qquad \frac{\nu_\infty}{\nu_R} = z + 1.$$

If the atom is moved in the reverse direction from $R_\infty = \infty$ to R, then the frequency would be <u>red-shifted</u>:

**(4.2)** $$\frac{\nu_R}{\nu_\infty} = \frac{1}{z+1} = e^{-a/R}.$$ $a = GM/c^2$ and $e^{-a/R}$ is the factor of mass decrease.

If 'a' is expressed by the Schwarzschild Radius, $R_S = 2GM/c^2 = 2a$ as defined above, then we obtain

**(4.3)** $$\frac{1}{1+z} = e^{-a/R} = e^{-2a/2R} = e^{-R_S/2R}.$$

If we apply this formula to larger structures of the universe consisting of <u>**associated galactic clusters**</u>, then we can often obtain ten times that value for the observable *gravitational* red shift, as has also been measured by H. C. Arp.

## 4.2 <u>Red Shift of Remote Galaxies</u>

*Outside* clusters, the formulas confirm the red shift of <u>**very remote galaxies**</u>. It is not caused by expansion of the universe but it is an effect of the <u>gravitation of all those galaxies</u> which have less distance to us than the red-shifted galaxy observed (this has already been found by another argumentation in **Chapter 1.1, Page 1**).

This can be calculated by considering only the masses which are <u>within</u> a sphere having the radius R. If R is the distance to the red-shifted galaxy, then only the galactic masses within the huge spherical mass with radius R are gravitationally effective. Within a concentric sphere, a mass is not attracted by the gravitation of the masses outside that sphere because the gravitational effects of the masses of a shell outside compensate to zero. In other words: The masses outside R have no gravitational effect inside R.

According to the energy-conservation law, the force of attraction upon a mass, m, is $GMme^{-a/R}/R^2$. It is directed toward the center, where the observer is. Compared with the original value, m (at $R = \infty$), the mass appears decreased to $me^{-a/R}$ with a corresponding red shift of its natural frequencies. In contrast to the red shift for the *group* of galaxies considered above, the value of 'a' is not a constant with respect to R. Within a <u>group of galaxies</u>, the intergalactic space is almost empty, hence the galaxies behave like point masses ($a = GM/c^2$ = constant). However, if we consider a mass at a large distance, R, in the *universe* (which is filled with countless galaxies), then the gravitational effect upon it is the combined effects of all the galaxies *within* the sphere of radius R with the observer in the center. The smaller the distance R, the smaller is the mass of that sphere, $M = 4R^3\pi\rho/3$, and the smaller is also the "constant" $a = GM/c^2 = G4R^3\pi\rho/3c^2$.

In order to obtain the red shift for a galaxy having the distance R, we calculate the factor $e^{-2a/R}$ (Equ.3.6) for the mass M *within* the large sphere of radius R. We write (ρ = mass density of the universe ≥ 1 H-atom/$m^3$):

**(4.4)** $$e^{-a/R} = e^{-4GR^2\pi\rho/3c^2}, \qquad v = c\sqrt{1-e^{-2a/R}} = c\sqrt{1-e^{-R_S/R}} = \underline{\mathbf{c\sqrt{1-e^{-8GR^2\pi\rho/3c^2}}}}, \qquad a = GM/c^2.$$

For such a gigantic sphere, we have to use the underlined formula instead of $v = c\sqrt{1-e^{-2a/R}}$ . Note $R^2$ in the exponent instead of 1/R. Although that velocity may have been slowed down long ago, we use its abstract value as an indicator of mass decrease and hence for red shift. The exact correlation of v and red shift will be discussed in Chapter 4.7 ("**Velocity, v, as Function of Red Shift, z**"). If R goes to 0, then v and the red shift also go to zero. If R goes to ∞, then v goes to c (this corresponds to an infinite red shift). However, as long as R is "small" but still greater than the distances inside a group of galaxies, we have to use the formula $v = c\sqrt{1-e^{-2a/R}}$. Within such intermediate distances, the velocity, v, increases (large red shift) only when R decreases. If at least R is less than the distances *within* the group – that is, if the galaxies penetrate each other – then the red shift disappears when R→ 0, because then, v again goes with R to zero.

We can summarize:

In a cluster of galaxies, we can treat each galaxy as a point mass; hence, M = const. in the formula $a = GM/c^2$. Then, the red shift *de*creases when R increases. However for remote galaxies, as observed by E. P. Hubble, the red shift *in*creases when the distance R increases, because the number of galactic masses distributed within a sphere with radius R (= distance R) increases with $R^3$, hence the ratio $a/R=4GR^2\pi\rho/3c^2$ increases with $R^2$. Whether the masses are considered to be point masses or distributed, the red shift is always an effect of gravitation. All these facts are based on measurements. They are inconsistent with the hypothesis of an expanding universe. For very large distances, R, the function $e^{-a/R} = e^{-4GR^2\pi\rho/3c^2}$ approaches zero. Then v approaches c and the red shift would be infinite.

## 4.3 Red Shift and Radius of Quasars

Two observations present compelling evidence that within quasars and within the nucleus of some galaxies there must be enormous, extremely concentrated masses, indicated (1) by great orbital velocities of objects near the center, and (2) by rapid changes of luminosity. The high concentration has substantial consequences upon the frequencies of their spectrum because, in the course of concentration, all masses approach their gravitational center, thereby each atomic mass decreases by the factor $e^{-a/R}$. If, for instance, an atom falls from infinity to the distance 2a toward the center, its mass – and, with it, each of its natural frequencies – decreases by the factor $e^{-\mathbf{a/2a}} = e^{-1/2} = 0.6$. If red shifts were either Doppler shifts or an effect of expansion of the universe (as asserted by the conventional theory), then the red shift of 0.6 would indicate a receding velocity, and this could be (and has been) misinterpreted as an enormous distance from us. Of course, if (or because) such a collapse does not indicate a decreasing velocity, this red shift cannot be an indicator for distance.

Nevertheless, the *large-scale* gravitational red shift mentioned above is always present and is superimposed on the *local* gravitational red shift. As pointed out, the mass within a sphere with a radius, R, (encompassing the observer who is upon the earth) causes a red shift of the light of a source on its surface according

**Equ.(4.4)** $v = c\sqrt{1-e^{-8GR^2\pi\rho/3c^2}}$ . (ρ = mass density of the *universe*, R = distance to a remote galaxy).

At first it seems to be impossible to distinguish the parts of that sum: the local and the large-scale red shift. In some cases however, quasars have a "label" which is independent of the *local* red shift caused by the gravitational collapse of the quasar. By "label" I mean galaxies near a quasar, often showing a faint luminous bridge of "connecting material" to the quasar. Halton C. Arp investigated these "labels" carefully. In the so-called "**Einstein Cross**", for instance, a central galaxy shows a red shift of 0.039, but the red shift of four nearby quasars is 1.7. At least one of the four quasars shows a luminous bridge connecting it with the central galaxy. If the red shift were an indicator for distance, then quasar and galaxy would be separated by billions of lightyears. Of course, a physical bridge over such an enormous distance is impossible. Now, when this was published, a strange thing happened: many astronomers refused to *see* the bridge, although it was visible very clearly. Let me quote page 134 in the essay of Fred Hoyle et al (**Ref. 1** on **Page 58**):

*The community remained skeptical of these results apparently because the implications are so great. Apart from claims that the statistical arguments of Arp were never made correctly, one argument made against the reality of the associations by a leading observer was that if these results were correct, we had no explanation of the nature of the red shift! In other words, if no known theory is able to explain the observations, it is the observations that must be in error!*

*Arp's own colleagues at the Mount Wilson and Palomar Observatories became so disturbed and so disbelieving of the results he was getting that, in the early 1980s, they recommended to the directors of the two observatories that his observational program should be stopped, i.e. that he should not be given observing time on the Palomar or Carnegie telescopes to carry on with this program. Despite his protests, this recommendation was implemented, and after his appeals to the trustees of the Carnegie Institution were turned down, he took early retirement and moved to Germany where he now resides, working at the Max-Planck Institut für Physik und Astrophysik in Munich. Arp's account of this whole episode is described in his book Quasars, Redshifts and Controversies. Thus, Arp was the subject of one of the most clear cut and successful attempts in modern times to block research which it was felt, correctly, would be revolutionary in its impact if it were to be accepted."*

Of course, it will be accepted some day, at least when the last of the Big-Bang missionaries have died. The following two interpretations have been proposed for Arp's observations.

**Interpretation 1:** Arp's observation of the **Einstein Cross** (**Object G2237+0305**) can be explained and calculated without additional assumptions, if the red shift of z = 0.039 is interpreted as an indicator for the distance *to both*: the four quasars and the galaxy. The red shift, z, at the distance R is

defined by Equ.**(4.2)**: $z = \dfrac{\nu_\infty - \nu_R}{\nu_R} = \dfrac{\nu_\infty}{\nu_R} - 1.$ Hence $\dfrac{\nu_R}{\nu_\infty} = \dfrac{1}{1+z} = e^{-a/R}.$

The red shift 1,7 of the quasars is the sum of a distance-depending red shift ($z_g$ = 0,039) and the local gravitational red shift $z_{grav}$ = 1,661 ≅ 1,7– 0,039. The latter is caused by the large local gravitation upon the (radiating) surface of each quasar. (According to the Energy-Conserving Theory a radius less than the Schwarzschild radius, $R_S$ = 2a, is possible, veryfied by various clock-experiments (Hafele and Keating i.a., Chap.1.1, and the Gravitational-Dopplereffect, Kap.1.2). The resulting red shift of the quasars as seen from the earth is $z_{qu}$ = 1.7, expressed by the product $1+z_{qu} = (1+z_{grav})\cdot(1+z_g)$.

From that we obtain the gravitational red shift on the surface of each quasar:

$1 + z_{grav} = \dfrac{1+z_{qu}}{1+z_g} = \dfrac{1+1.7}{1+0.039} = \dfrac{2.7}{1.039} = 2.60$. Using Equ.(4.3):

$$\frac{1}{1+z_{grav}} = \frac{1}{2.60} = e^{-a/R} = e^{-2a/2R} = e^{-R_S/2R}, \quad \text{hence,} \quad \mathbf{\frac{R_S}{2R} = \ln 2.60 = 0.955 \quad and \quad \underline{R = 0.524\, R_S}}.$$

This means the radius of the quasars is about half the Schwarzschild radius, $R_S$. However, even the highest concentration of mass does not cause the singularity of a Black Hole, and this is confirmed by the Clock Experiment of Hafele and Keating (1971), by the Gravitational Doppler Effect (1958), and now by the observations of Halton C.Arp. (See Chapters 1.1 and 1.2).

Each quasar in the Einstein Cross has collapsed to almost half the Schwarzschild radius $R_S$, which is defined as $R_S = 2a = 2GM/c^2$ (this means that $R_S$ is linearly proportional to the mass, M).

For the sun, $R_{S(sun)}$ ≅ 1.484 km. If each quasar has $10^9$ $M_{sun}$ ($M_{sun}$ = mass of sun), then its radius, R, is $0.524\cdot R_S = 0.524\cdot 10^9\cdot 1.484$ km $= 0.778\cdot 10^9$ km = approximately 5 times the radius of the earth's orbit.

The volume of one of these quasars would be = $4 R^3 \pi/3 = 2\ 10^{42}$ cm$^3$. If it is filled with $10^9$ times the mass of the sun ($10^9\ 2\cdot 10^{33}$g = $2\cdot 10^{42}$g), then the resulting mass density would be $= \dfrac{2\cdot 10^{42}}{2\cdot 10^{42}} = 1\,g/cm^3$.

At such densities, light-emitting atoms upon the surface can be imagined as being possible.

Another question is the stability of such a mass concentration. Atoms might not withstand the enormous pressure, but the pressure may be compensated by centrifugal forces. Many atoms or particles may be transformed into electromagnetic energy; however, if their angular momentum is retained at greater distances, then it could counteract the collapse by centrifugal force. However this is speculative.

We can calculate the radius of the quasar using the relative red shift,

see Equ.(4.2) $\frac{1}{1+z} = e^{-a/R}$; from that we obtain for the **radius of the quasar**: $\mathbf{R = \frac{GM}{c^2 \ln(1+z_{rel})}}$.

The velocity of the collapsing mass is $v = c\sqrt{1-e^{-2a/R}} = c\sqrt{1-e^{-R_S/R}} = c\sqrt{1-\left(\frac{1}{2{,}60}\right)^2} = 0.923c.$

The collapsing original mass, M, decreases because some of it is transformed into kinetic energy. If, for instance, it reaches the diameter 2R, the remaining potential mass and the mass of the kinetic energy are

$$\mathbf{M_{pot} = Me^{-a/R} = \frac{M}{2.60} = 0.384\,M. \qquad M_{kin} = M - M_{pot} = 0.616\,M.}$$

More than 61% of the total mass, M, is already kinetic energy and kinetic energy exerts no gravitation in the radial direction. It may be transformed into electromagnetic energy which can be radiated.

The distance of the **Einstein Cross** is determined by the associated galaxy having a red shift of 0.039.

If the density of the universe, $\rho$, = 4 H atoms/m$^3$, then we obtain for its distance, R

$$R = 2.19 \cdot 10^{28}\sqrt{\ln(1+0.039)} = 4.28 \cdot 10^{27}\ [\mathrm{cm}] \cong 4.5 \cdot 10^9 \text{ lightyears.}$$ (see **Equ. 4.5a, next Page)**

[1 lightyear = $0.946 \cdot 10^{18}$ cm; the mass of an H atom = $1.675 \cdot 10^{-24}$ g].

This calculation was made under Arp's assumption that the faint luminous bridge of "connecting material" to the quasar could be possible only if the distances from us to the central galaxy and to the four quasars are approximately equal.

**Interpretation 2:** Arp's critics deny even the mere existence of the bridge shown in the telescopes. Because they believe the universe *must* expand due to the red shift of remote galaxies, they declare that Arp's observation must be an error; the Einstein Cross can only be the effect of a Gravitational Lens. The massive central galaxy may be producing four images by deflecting the light of one and the same quasar behind the galaxy.

This is a classic illustration of how human stubbornness prevents open-minded scientific questioning. Since none of the arguments can be excluded, it is just destructive to discredit any of the observers; it reminds me of the ancient example of killing the messenger who brings bad news. The only fair way would be to make a decision on further scientific measurements, but this is exactly what the critics passionately try to prevent, even to the present day.

Most scientists including myself tend to make the same error: When we think of a gravitational lens, we unconsciously imagine a concentrated mass deflecting the light of a quasar located behind it. If that is correct, then Arp's argument is correct: that the four quasars should not be seen as small circles, but must appear as squeezed to long, tangential ovals. In the meantime, other images of the Einstein Cross exist which show the central mass in more detail as an extended cloud reaching far beyond where we see the four quasars. With this constellation, the hypotheses of Arp's critics could be, but do not necessarily be correct. Therefore, an objective decision cannot be made.

In this case, the material bridge observed by Arp may be a part of the galaxy in the foreground. Then there is no need for the assumption that this bridge is at a tremendous distance between the galaxy and a background quasar, or that it is a cloud which is by chance in the foreground (however for statistical reasons this is extremely unlikely, as shown by Arp). Still, his critics had to prove that the four images show one and the same background object. To do that, the critics would have to prove not only that the spectra of the four images are identical, they would also have to prove that the extremely rapid changes of the luminosity of the four objects follow exactly the same curve, as it should be if they were images of the same object, of course with different time lags of several years due to the different distances travelled.

In the meantime, such measurements have been made. The four quasars have different spectra and the rapid changes of the four images are entirely different from each other and cannot be matched by any time lag.

This is all the more important because, for other gravitational lenses, different images have been precisely matched with time lags of about two years. So Arp's measurements with his interpretation are confirmed.

Even if Arp's interpretation of the Einstein Cross where disproved, it would not effect his other meaurements. Especially his arguments with respect to the Quasar/Seyfert Object Makarian 205 cannot be disproved. This arguments can be realized in a combined x-ray and UV picture of at least three quasars, each showing a physical bridge to the central galaxy. However these quasars have extremely different red shifts, z, with 1.25, 0.63 and 0.46. If the red shift would indicate distances, then they cannot be the images of a single background object. Due to these material bridges between these quasars and the central galaxy, they belong to the same constellation having about the same distance from us. Hence their different red shifts can be explained not by different distances, but they can be explained by the "Gravitational Law with Energy Conservation".

I have used the Einstein Cross because it provides by a practical example an exceptionally simple instance to demonstrate how the Gravitational Law with Energy Conservation can be used.

## 4.4 Measurement of Galactic Distances

Next, we can calculate the distance, R, of a galaxy and associated quasars. The red shift of the galaxy is z. In this case we have to use Equ.(4.4) with the mass $M = 4R^3\pi\rho/3$ of the imagined sphere:

$e^{-a/R} = e^{-4GR^2\pi\rho/3c^2} = \frac{1}{1+z}$, or $\underline{e^{+a/R} = e^{+4GR^2\pi\rho/3c^2} = 1+z}$. If $z \ll 1$, then $z \cong \frac{4GR^2\pi\rho}{3c^2}$.

We define a new constant: $\mathbf{B} = \sqrt{\frac{\mathbf{3c^2}}{\mathbf{4G\pi}}} = 5.67 \cdot 10^{13}\ [\mathrm{cm}^{-1/2}\ \mathrm{g}^{1/2}]$. $(G = 6.67 \cdot 10^{-8}\ \mathrm{cm^3 g^{-1} s^{-2}})$.

From the underlined formula we obtain (ρ = mean density of the *universe* – not of the galaxy!):

$$\underline{\textbf{(4.5)}\quad \mathbf{R = 5{,}67 \cdot 10^{13}\sqrt{\frac{\ln(1+z)}{\rho}}}}\quad \mathbf{[cm].}$$ If $z \ll 1$ then $\ln(1+z) \cong z$, hence $\mathbf{R \cong 5{,}67 \cdot 10^{13}\sqrt{\frac{z}{\rho}}\ [cm].}$

If $\rho = 4$ hydrogen atoms/m$^3$ = $6.7 \cdot 10^{-30}$ g/cm$^3$, then $\frac{B}{\sqrt{\rho}} = 2.19 \cdot 10^{28}$ [cm] and

$$\underline{\textbf{(4.5a)}\quad \mathbf{R = 2{,}19 \cdot 10^{28}\sqrt{\ln(1+z)}}}\quad \mathbf{[cm].}$$ For $z \ll 1$ $$\underline{\mathbf{R \cong 2{,}19 \cdot 10^{28}\sqrt{z}\quad [cm].}}$$

## 4.5 Measuring the Density of the Universe

We can calculate ρ if the distance of only one galaxy can be found by other methods. With that value and the same formula we can calculate the distances of other galaxies, with the exception of quasars because these objects have additional a gravitational red shift which must be added.

## 4.6 Calculation of the Hubble Constant

With the formula $e^{-a/R} = e^{-4GR^2\pi\rho/3c^2}$ , squared and introduced into Equ.(3.6) (all in cgs units), we obtain

**(4.6) velocity** $v = c\sqrt{1-e^{-2a/R}} = c\sqrt{1-e^{-8GR^2\pi\rho/3c^2}} = c\sqrt{1-e^{-2R^2\rho/B^2}}$ . (Definition of B see Page. 64)
Solved for R:

R = R(v): $R = \frac{B}{\sqrt{\rho}}\sqrt{\ln\frac{1}{\sqrt{1-v^2/c^2}}} = \frac{5.67\cdot 10^{13}}{\sqrt{\rho}}\sqrt{\ln\frac{1}{\sqrt{1-v^2/c^2}}}$. For $v << c$: $\mathbf{R \cong \frac{4\cdot 10^3}{3\cdot\sqrt{\rho}}v}$.

The **Hubble Constant** was defined in the Big-Bang hypothese as a hypothetical velocity of expansion, $\mathbf{v_H}$, at the distance $R_H = 3.26\cdot 10^6$ lightyears = $10^6$ Parsec = $3.1\cdot 10^{24}$ cm. It should be remembered that this velocity has been defined as an abstract velocity just for indicating red shift. It may have been a real velocity only before a body has fallen from $R_\infty = \infty$ to R, for instance in a gravitational contracting universe. Of course, this can not be interpreted as verification of an expanding universe.

If we again assume $\rho$ = 4 H atoms/m$^3$, then $\frac{B}{\sqrt{\rho}} = 2.19\cdot 10^{28}$ [cm]. Then we get for the exponent of **e** in Equ.(4.6), $2R_H^2\rho/B^2 = 4\ 10^{-8}$. When x is small, then $e^{-x} \cong 1-x$. Inserted in the root and using 4H for $\rho$, we obtain the **Hubble Constant**, $\mathbf{v_H = c\sqrt{2R_H^2\rho/B^2} = c\sqrt{2}\frac{\sqrt{\rho}}{B}\cdot R_H = 2c\cdot 10^{-4}}$ **[cm/s] = 60 km/sMpc**, but

$$\textbf{(4.7)}\qquad \mathbf{v_H = c\sqrt{1-e^{-8\pi G\rho R^2/3c^2}} \underset{8\rho GR^2<<c^2}{\cong} 2R_H\sqrt{\frac{2}{3}G\pi\rho}} = \frac{R_H}{R_{universe}}c \quad \text{for density } \rho \quad \text{(B has been inserted).}$$

Since $\mathbf{v_H}$ is not a linear function of R, the Hubble "Constant" is not constant. But for distances where the exponent = $8GR^3\pi\rho/3c^2 << 1$, the function v = v(R) can be considered linear.

However it should be remembered: These velocity $v_H$ is only defined by the formula 4.7 for an abstract free fall from $R_\infty = \infty$ bis R. It can be used as an indicator of the red shift, but this is no proof of its real real existence. **It can not be interpreted as expansion of the universe.**

## 4.7 Velocity, v, as Function of the Red Shift, z

In the common theory, the red shift has been interpreted either by a receding velocity of remote galaxies or by an expansion of the universe. Now with energy-conserving gravitation, it is explained as the velocity of contraction relative to the observer when the universe is collapsing. The contraction is equivalent to the assumption of a velocity, v, when falling from infinity, according to Equ.(4.6):

In order to obtain v as function of z, we square the equation in the top of Chapter 4.4:

$e^{-2a/R} = e^{-8GR^2\pi\rho/3c^2} = \frac{1}{(1+z)^2}$ . Inserted into Equ.(4.6) and solved for v and for z, we obtain

**(4.8)** $\mathbf{v = c\sqrt{1-\frac{1}{(1+z)^2}}}$, or $\mathbf{z = \frac{1}{\sqrt{1-v^2/c^2}} - 1.}$ A few examples:

| | | | | | |
|---|---|---|---|---|---|
| z = | 0.039 (Einstein Cross) | 1 | 1.2 | 1.661 (Quasar) | 4.5 |
| v = | 0.271c | 0.866c | 0.891c | 0.927c | 0.983c. |

The calculation can be applied for the quasar of the Einstein Cross (first column), if, due to collisions of its masses, the velocity may have been slowed down long ago by dissipating the kinetic fall energy.

It should be mentioned that Equ.(4.2) shows the known proportionality between energy, E, and frequency, $\nu$:

**(4.9)** $\mathbf{1 + z = \nu_{R=\infty}/\nu_R} = h\nu_{R=\infty}/h\nu_R = \mathbf{E_{R=\infty}/E_R} = \mathbf{\frac{1}{\sqrt{1-v^2/c^2}}}$.

# 5. The Formula dE = vdP and its Derivation

From the *Lorentz Transformation*, the following equation for moving a mass can be derived:

**(5.1)** $\mathbf{dE = vdP = v_x dP_x + v_y dP_y + v_z dP_z = dE_{kin}}$ (E = total energy, **v** = velocity, **P** = momentum).

This formula, also valid in Classical Dynamics, will be proved in the next chapter. It shows the increase of the kinetic energy, **dE**, of a mass if its velocity, **v**, increases by applying a momentum, d**P**, upon it (and vice versa). If no gravitation is present, then, inversely, it is possible to deduce Special Relativity from this formula under the conditions of c = const. and $E = mc^2$. For instance, we can deduce the dependence of mass on velocity using the formula in the following way:

The kinetic energy of a mass, m, must be a function of momentum, **P**: $E = E(\mathbf{P}) = E(P_x, P_y, P_z)$.
By partial derivation, we obtain the change, dE, if the velocity, v, changes by applying a momentum, d**P**:

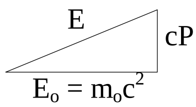
$$dE = \frac{\partial E}{\partial P_x} dP_x + \frac{\partial E}{\partial P_y} dP_y + \frac{\partial E}{\partial P_z} dP_z. \qquad \text{Comparison with (5.1) shows} \qquad v_x = \frac{\partial E}{\partial P_x},\ v_y = \frac{\partial E}{\partial P_y},\ v_z = \frac{\partial E}{\partial P_z}.$$

Because $E = mc^2$, the momentum is $\mathbf{P} = m\mathbf{v} = \frac{E}{c^2}\mathbf{v}$ or $\mathbf{v} = \frac{c^2}{E}\mathbf{P}$, this **v** inserted into (5.1):

$E dE = c^2 \mathbf{P} d\mathbf{P} = c^2(P_x dP_x + P_y dP_y + P_z dP_z) = \frac{1}{2} d(c^2\mathbf{P}^2)$ This is identical with $d(E^2) = d(c^2\mathbf{P}^2)$. Integrated

from $\mathbf{P} = 0$ to $\mathbf{P}$ we obtain $E^2 - E_o^2 = c^2P^2$, rearranged:

**(5.2)** $\mathbf{E = \sqrt{c^2P^2 + E_o^2}}$**,** this can be expressed by a diagram:




Because $\mathbf{v} = \left(\frac{\partial E}{\partial P_x}, \frac{\partial E}{\partial P_y}, \frac{\partial E}{\partial P_z}\right)$, the partial derivatives of (5.2) with respect to $P_x$, $P_y$, $P_z$ yield the velocity v:

$\mathbf{v} = \frac{c^2}{\sqrt{c^2P^2 + E_o^2}}\mathbf{P} = \frac{c^2}{E}\mathbf{P}$, that squared: $P^2 = \frac{E^2}{c^4}v^2$, and inserted into $E^2 - E_o^2 = c^2P^2$ yields

**(5.3)** $\mathbf{E = \frac{E_o}{\sqrt{1 - v^2/c^2}}}$, by division with $c^2$ we obtain $\mathbf{m = \frac{m_o}{\sqrt{1 - v^2/c^2}}}$.

Einstein completed the theory by introducing gravitation. However this causes a problem which could not be solved without Energy Conserving Gravitation. According to the clock experiment, a falling mass *decreases* by the mass of the emerging kinetic energy, but according to the Lorentz Transformation, it should *increase* by the mass of the emerging kinetic energy, $\Delta m_o = \frac{\mathbf{m_o}}{\sqrt{1 - v^2/c^2}} - \mathbf{m_o}$. Where does $\Delta m_o$, originate? Does it emerge from nothing? Or is $\Delta m_o c^2 = 0$? Such an exception would be a contradiction to the Lorentz Invariance. If $\Delta m_o c^2 \neq 0$, then such an inexhaustible reservoir of energy must be held in store by the space. Einstein was forced to postulate such a vacuum energy without any empirical evidence. Adopting the classical idea of a field which supplies the energy, he constructed a four-dimensional *curved* space with the strange capability of supplying the fall energy without having it. That is the genie in the bottle. Such a *postulate* violates the principle $E = mc^2$, because, if a mass, $\Delta m_o$, emerges from a field of zero mass by gravitation, it cannot be a physical entity. In order to avoid such an exception from Energy Conservation and the principle $E = mc^2$, Einstein inserted an additional term defining a field energy. This, he assumed, should not effect the Lorentz Invariance, however it should effect the course of time, which slows down if the distance to the gravitational center decreases. This, he concluded, could be correct, however he failed to realize that a decrease of the course of time is accompanied by an equivalent decrease of the mass due to the Lorentz Invariance.

In contrast, Energy-Conserving Gravitation is not contradictious to $E = mc^2$ but its *consequence*, resulting from the Lorentz Invariance. An energy-supplying field in the vacuum is not required, and all variables and operations used are within the Special Relativity. In that theory, the Lorentz Invariance is valid for each formula deduced from it and must remain valid. Moreover, the quality of a mass does not depend on its past or on the source of energy; and in the special case of gravitation the source is its own energy, $mc^2$. If a mass gains velocity, v, at the expense of *external* energy, then its momentary rest mass, $m_o$, (defined for v = 0) increases according to the formula, regardless of the value that mass would have at any other location, or whether it is the rest of a mass which has been decreased in the past by gravitation.

This can be expressed as follows:

**(A)** Equ.(5.1) was deduced from the Special Relativity Theory, however if we assume it is also true under the General Relativity Theory*, then a falling mass must *increase* by the factor $1\big/\sqrt{1-v^2/c^2}$ due to the velocity v of falling.

**(B)** If no additional term is assumed [shown on Page 69], then the Clock Experiment shows that simultaneous to that *increase*, the falling mass must *decrease* by the reciprocal factor, that is by $\sqrt{1-v^2/c^2}$.

**(C)** The product is = 1, hence the sum of kinetic and potential mass retains its value, $m_o$. However that follows from Equ.(5.1) only if the energy, dE (which is needed for increasing the momentum by d**P**) is *extracted* from its own energy, $m_oc^2$. This means that dE must be *subtracted* from its internal energy; hence, the sign of dE in Equ.(5.1) is negative:

**(5.4)** $$-\mathbf{dE = vdP = v_xdP_x + v_ydP_y + v_zdP_z = dE_{kin}}.$$

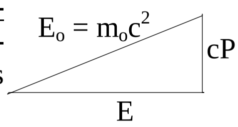
Now we proceed as above but with *negative* sign. The result of the integration is

**(5.5)** $E = \sqrt{E_o^2 - c^2P^2}$ if we observe that now $\mathbf{P} = m_o\mathbf{v} = E_o\mathbf{v}/c^2$. With this, we obtain

**(5.6)** $\underline{E = E_o\sqrt{\mathbf{1-v^2/c^2}}}$ , and after division by $c^2$, $\underline{m = m_o\sqrt{\mathbf{1-v^2/c^2}}}$ .

This is exactly the decreased "rest" mass as verified by the Clock Experiment.

Since the root is <1, the inner (potential) energy decreases by the emerging kinetic energy. That characterizes Energy-conserving Gravitation. The total energy remains constant and is now the hypotenuse. [The diagram is the same as in the Diagram 3.12 ("Well of the Time", Chapter 3.11).]




We can summarize:

**1. Positive sign of dE: (the Kinetic Energy of the mass is imported from outside)**

**(5.1)** $$+\mathbf{dE = vdP = v_xdP_x + v_ydP_y + v_zdP_z}.$$ Integrated:

**(5.3)** $$\mathbf{E = \frac{E_o}{\sqrt{1-v^2/c^2}}}.$$ This is the **Law of Inertia**. The energy *increases* by $\Delta E = E - E_o$.

The formula states: An energy input $\Delta E = E - E_o$ by applying a momentum, d**P**, causes an increase of the velocity v. That is called Inertia, because for a change of the velocity (b) of a mass (m) along a distance ($\Delta R$), an Energy ($\Delta E$) must be supplied. The "Energy supplied per unity of distance" is called Force (K). This can be expressed by the formula $K = dE/dR = mb$.

In Equ.(5.1), that is expressed by differentials: An increase, d**P**, of the momentum at the velocity **v** requires an energy input, dE.

* without the postulate of Equ.(5.7) for an additional hypothetical source of energy; as will be discussed on Page 69.

## 2. Negative sign of dE: (the kinetic energy is subtracted from its inner energy, $mc^2$).

Hitherto, an external energy source has been assumed. However a mass can accelerate *itself* at the expense of its inner energy, $mc^2$. Seen from any other mass, for instance in the Clock Experiment, a mass will accelerate in the direction toward other masses (via the point of gravity). This is called "Gravitation". Then, its inner energy *decreases* by dE whilst its own momentum *increases* by d**P**. Hence, dE must be negative:

**(5.4)** $\mathbf{-dE = v_x dP_x + v_y dP_y + v_z dP_z = v d\mathbf{P}}$. By integration of that equation we obtain

**(5.6)** $\mathbf{E = E_o\sqrt{1 - v^2/c^2}}$. This is called **Gravitation**. The *decrease* of its energy is $\Delta E = E_o - E$.

The only difference caused by the change of sign refer to the source of energy, i.e. whether the source of the driving energy is outside the driven mass or is the mass itself.

Equ.(5.4) not only confirms the Law of Gravitation with Energy Conservation *without an additional postulate, it* can even be deduced from it, as will be shown in the next chapter.

**Note: Nothing indicates a dependency on curvature of space** though the curvature may be an effect of gravitation.

Up to now, Equ.(5.1) could be deduced only from the Special Theory of Relativity, not from Einstein's General Theory. Because the equation is one of the physical principles which are indispensable in the General Theory, it has been *postulated* as an additional principle (however there exists no proof that this postulate leads to no inconsistencies). Of importance is especially Equ.(5.4) where the sign of dE is negative.

When the Gravitational Law is combined with Energy Conservation, then no additional axioms must be assumed, whereas for an energy-supplying field some additional axioms had to be postulated. I quote just some of them (the first two can be found in the books mentioned on Page 80):

- "... a general conservation law for energy and momentum does not exist in General Relativity."
- "... energy conservation can also be satisfied by debiting the *field* with an energy loss equal to the kinetic energy gained...";
- ... several billion years ago, the whole universe emerged in a Big Bang from a point (a "nutshell") where its density had been infinite (see Page 45).

If Energy Conserving Gravitation is accepted, then, without assuming such additional postulates, the Equ.(5.4) can be derived from it. This is possible by expressing K in two ways::

Equ. (1.9) Gravitational Force = $\mathbf{K} = -\mathbf{G}\dfrac{\mathbf{Mm_o}}{\mathbf{R^2}}\mathbf{e^{-a/R}}$, and **K** expressed by momentum: $\mathbf{K} = \dfrac{d}{dt}\mathbf{P}$.

Because the decreased mass is $E = c^2 m_o e^{-a/R}$, and $E_o = c^2 m_o$, hence $e^{-a/R} = E/E_o$.

From that: $-\dfrac{a}{R} = \ln\dfrac{E}{E_o}$ or $R = -\dfrac{a}{\ln(E/E_o)}$. $\ln^2\dfrac{E}{E_o} = \dfrac{a^2}{R^2}$.

Inserting $a = \dfrac{GM}{c^2}$ by using Equ.(1.9) we obtain:

$$v = \frac{dR}{dt} = \frac{dR}{dE}\frac{dE}{dt} = \frac{R^2}{aE}\frac{dE}{dt} = \frac{R^2}{aE}\frac{dE}{dP}\frac{dP}{dt} = \frac{R^2}{aE}\frac{dE}{dP}K = -\frac{R^2c^2}{GME}\frac{dE}{dP}G\frac{Mm}{R^2}e^{-a/R} = -\frac{dE}{dP}$$

(because $E = c^2 m_o e^{-a/R}$; $m_o$ was replaced by m.)

That is, as asserted, Equ.**(5.4)** $dE = -v d\mathbf{P}$.

Equ.(5.1) can only be derived from Special Rel.Theory, not from Einstein's General Theory. It is a consequence of the Energy Conserving Gravitational Law. Because Einstein realized that Equ.(5.1) is indispensable for the General Theory, he postulated it as an axiom, but without any empirical or theoreticel evidence, and only with the hope, that this will not lead to contradictions.

However, an axiom cannot reveal facts not defined in it. Such facts are the terms of higher power [>2, in Equ.(1.11) Page 7]. These terms can not be derived from Equ.(5.1.) which has been deduced under the condition that the energy is supplied from outside.

Equ.(5.1) follows from Equ.(5.4) if we insert proper values for dE. If, for instance, E remains unchanged, this means dE = 0 and $E = E_o$, then follows v = 0 from Equ.(5.4) and Equ.(5.6). This is the first axiom of Newton, the Law of Inertia, which states:

The velocity of a mass remains unchanged and rectilinear when no force acts upon it (K = dE/dR = 0).

If, however, the mass, $m_o$, is to remain unchanged in spite of a change of the movement, then dE must be zero. Because the energy for moving the mass is subtracted from $m_oc^2$, dE remains zero only when the subtracted energy is replaced by an equal energy input from outside. This is expressed by Equ.(5.1).

On the other hand, if there is no energy exchange with the environment, then only the mass itself can supply the gravitational energy and –dE< 0 (must be subtracted from it). By integration, we obtain for the energy $E = \sqrt{E_o^2 - c^2P^2}$ = constant = Equ.(5.5). This has not been recognized, because Equ.(5.2) $E = \sqrt{c^2P^2 + E_o^2}$ was also used in such cases where dE should be < 0. Because the *field* has wrongly been understood to be the source of energy, it was not possible to realize that Equ.(5.2) must be replaced by Equ.(5.5) when –dE< 0 In order to eliminate the effects of the incorrect Equ.(5.5), an *external* potential energy $E_{pot}$ was postulated and added to the root in Equ.(5.2). This $E_{pot}$ would have to be injected into the field when the mass, m, is lifted, and $E_{pot}$ was *defined* as a function of distance to the gravitational center. It must be zero when the distance $R = R_o$ where the lifting begins. Moreover, an additional Field Energy, $\mathcal{E}_o$, had to be invented***)**:

**(5.7)** $$E = \sqrt{E_o^2 + c^2P^2} + E_{pot}(\mathbf{R}) + (\mathcal{E}_o - E_o) = \text{const.} \quad (E_o = mc^2 \text{ is the intrinsic energy of the mass, m}).$$

To say the least, this formula is difficult to understand, but under the assumption that $E_{pot}(R_o) = 0$ at the distance $R_o$, it shows: If the velocity is also zero at $R_o$ (this means $\mathbf{P} = 0$), then with this definition and with Equ.(5.7) for the total energy, we obtain $E = \mathcal{E}_o$.

If we compare Equ.(5.7) with Equ.(5.5) [P.67] $E = \sqrt{E_o^2 - c^2P^2} = E_o\sqrt{1 - v^2/c^2} = E_{pot}$, then it is evident, why and to what extent the results of Equ.(5.7) can approach those of Equ.(5.5) because we can see:

$E_{pot}$ from Equ.(5.5) is almost identical with $E_{pot}$ in Equ.(5.7), *if* $(c\mathbf{P})^2 << (E_o)^2$ [wherein $E_o = mc^2$]. We can approximate the roots by $\sqrt{1 \pm c^2P^2/E_o^2} = 1 \pm c^2P^2/2E_o^2$. If these approximated roots of Equ.(5.5) are inserted into Equ.(5.7), then we obtain

$$\mathbf{E = E_o(1 + c^2P^2/2E_o^2) + E_o(1 - c^2P^2/2E_o^2) + (\boldsymbol{\mathcal{E}}_o - E_o) = (\boldsymbol{\mathcal{E}}_o + E_o) = const.}$$

Since the constant part of the energy has no effect upon the shape of the function $E_{pot}$, its shape must be almost identical in both formulas when $cP << E_o$, i.e. v << c. However, $cP << E_o$ is no longer true when R approaches $R_o$ (or zero). If, for instance, a mass falls toward a concentrated central mass, M, then its momentum P increases infinitely. Then the gravitation will never stop because [according Equ.(5.7)] when $R = R_o$, by definition, $E_{pot}(\mathbf{R_o}) = 0$, but P > 0, hence the root cannot be less than $E_o$. It never ceases to exert gravitation since $c^2P^2$ will never neutralize $E_o$ [in contrast to Equ.(5.5)].

In such a situation, only magic can help. The magic which has been invented is called "**Re-normalizing**". First, a hypothetical field must be assumed which, when required, can supply an unlimited amount of energy without having it. That "field energy" can not be localized or measured. Nevertheless, per definition, each falling mass at any point obtains without delay its fall energy from that field. The trick is to divide the distance to the gravitational center into an infinite number of stages. Each stage borrows a finite quantity of potential "space energy" from the vacuum, stores it and passes it over to any mass which is engaged in producing kinetic energy. When the falling mass has transformed the whole energy of a stage into kinetic energy, then it enters the next stage and the process is repeated. This is called "**Re-normalizing**". The idea is to cancel the consequence of the theories of Black Holes and Big Bang – where the field must be an inexhaustive source of energy (a "*variable* constant potential energy"). A re-normalized field supplies each mass with fall energy. The field defined in this way must be able to provide any energy required. I don't know whether anybody has checked the sum of the energy of all the stages, but I know that a lot of inventors have tried to build a machine for exploiting this "space energy". Years ago some have even announced having achieved this, this anouncement was the last report ever heard.

***)** Quoted from Falk & Ruppel "Mechanik, Relativität, Gravitation" 1983, Page 147

# 6. Newton's Cosmology by E. A. Milne

I sometimes receive a somewhat vague critic from competent cosmologists, stating the advance of the perihelion could not be taken as evidence for Energy-conserving Gravitation because it can also be deduced from the Classical Law of Gravitation. I pondered about this argument until I remembered an essay by the British cosmologists Edward A. Milne and William McCrea from 1934. To the surprise of the physical community, these scientists discovered that the results of General Relativity can also be derived from the Classical Theory. The very unexpected argument of these scientists can be found in the excellent "Cosmology" of **E. R. Harrison** (see Page 80). I will try to present it here in an abridged form.

Simplified but without essential changes, the idea of Milne and McCrea (**abbr. MM**) is as follows. If we consider the universe as a sphere, than its gravitational effect upon a mass upon the surface is the same as if the entire mass of this sphere would be located on its surface. The gravitation upon the mass, m, depends on the distance, R, to the center (proved on Page 35). Expansion of the universe implies that the radius, R, increases with the velocity, v. A mass, m, will escape the other cosmic masses, M, if its radial velocity, v, is at least equal to the classical speed of escape $v \geq |\sqrt{2GM/R}|$ (see Page 23), or, squared and written as equation, if $mv^2 = 2GMm/R$ + constant $k_1$. (In order to facilitate identification with known physical quantities, I have multiplied each term by m). The same equation results from the following setup if we designate with $\mathbf{k_1/2}$ the total energy of a mass: $\mathbf{k_1/2}$ = kinetic energy ($\mathbf{mv^2/2}$) + gravitational energy ($\mathbf{-GMm/R}$). If we assume that energy is conserved than the total energy remains constant. Multiplied by 2 and interchanging the sides:

**(6.1)** $\mathbf{mv^2 - 2GMm/R = k_1} = 2\times$ Total Energy. That is the **Setup of Milne & McCrea**.

In all calculations, only *changes* of potential energy are effective. Its initial value is unknown and cannot be identified because it has no effect on the result. For that reason, only its decreasing part is written. *Decreasing* means it is < 0. If $mv^2 < 2GMm/R$, then $k_1 < 0$. In this case, the kinetic energy cannot overcome the gravitational energy and reaches zero at a point $R_o < \infty$. Up from there the energy would reverse at an upward movement. If $k_1 \geq 0$, than there is no point of return and the universe would expand forever.

The loss of one kind of energy must always be the gain of the other. If precisely $mv^2 = 2GMm/R$, then the total energy = 0. In this case, kinetic energy and gravitational energy remain in equilibrium and the expansion will never stop. Any v greater than the escape velocity would never decline to zero even for $R \to \infty$.

If we replace m by the unity mass, m = 1, then Equ.(6.1) can be written as follows:

**(6.2)** $v^2 = 2GM/R - k$. (By convention, I have written the abbreviation $-k$ for $k_1/m$.)

$-k \leq 0$ implies permanent expansion, $-k > 0$ implies reversed expansion (the universe remain limited).

If we insert $4\pi R^3\rho/3$ for M, then we obtain

$$v^2 = \frac{8\pi G\rho R^2}{3} - k\,, \quad \text{and after division by } R^2\text{:}$$

**(6.3)** $$\frac{v^2}{R^2} = \frac{8\pi G\rho}{3} - \frac{k}{R^2}$$ ($\rho$ = mass density, G = gravitational constant)

This is identical with the equation Einstein had derived with the extremely sophisticated General Relativity Theory where $k/R^2$ stands for the *curvature* of space. The simple derivation of this formula from the Classical Gravitation Law (with elementary mathematics!) was very unexpected. In the controversy, whether the mathematically cumbersome four-dimensional space-time geometry might be a mere fiction, this result should be "impossible", consequently this was a strong argument against the General Theory.

According to the setup given above the constant $k_1$ or k represents the total energy. If the measuring unit for energy is properly defined, the constant can be made $|k| = 1$ or = 0. Then it is the criterion for the curvature of space. If $k = +1$, then the universe must be closed and finite. If $k = 0$, then its curvature is zero, the space is planar (Euclidean). If $k = -1$, then the universe is open and expands forever.

When k = 1, the radius, R, of the universe can be calculated by using that formula. At the reversing point, where v = 0, the radius is $R = \sqrt{\dfrac{3}{8\pi G\rho}}$, (if k = 1! The missing c is explained below).

So it turns out that it is possible to derive relativistic results from the classical law though in Einstein's proof this seemed to be "impossible" due to his other assumptions. With the setup of MM, we have obtained relativistic results from the Classical Theory. As can be shown, the same setup leads to the advance of the perihelion. In the context of this essay the question arises: Can these relativistic results also be an argument for Energy-conserving Gravitation? It can. We must only avoid some errors of the past and examine the implementation of energy conservation in its full consequence. First we have to remember that the basic assumption of MM is energy conservation. This is identical with the assumption of Energy-Conserving Gravitation, and it can be expressed by the same setup:

**(6.4)** Kinetic Energy + Potential Energy = Total Energy = constant.

Where is the difference? According to **Milne and McCrea** the unity mass ($m = 1$) is part of the cosmic masses, as such it is composed of two parts: (1) One part is kinetic energy, which has been transferred into the mass from outside by an initial momentum at the Big Bang, and (2) the other part is *potential energy* ($GMm/R$) as a function of its distance, $R$, from the center of gravity.

On the other hand, **Energy-conserving Gravitation** asserts that the *total energy* is the *intrinsic energy* of the masses $Mc^2+mc^2$. There is no outside, no energy outside, and the intrinsic energy itself cannot be zero. The velocity, $v$, is not the speed of *expansion* of the universe, not the result of a hypothetical momentum called Big Bang, it can only be the velocity a mass obtains when *falling* from $R=\infty$ (where the sign of $v$ was opposite), and the kinetic energy can only be *supplied by the* own intrinsic energy, $mc^2$, of the *mass itself*. However the *rate* of converting a mass into kinetic energy depends on distance, $R$, and the cosmic masses, $M$. An initial *external* energy for pushing the masses apart does not exist.

MM calculation leads to correct relativistic results from the assumption of *energy conservation*. However, in spite of this correct assumption, they could not discover Gravitation with Energy Conservation because they started their calculations on *expansion*. If only effects of *outside* directed movements are considered, then inconsistencies correlated with the singularities near the *center* could not be revealed because, when moving in outside direction, no singularities occur. If they had calculated the reverse of expansion (*collapsing* masses approach the center), then they would not have failed to come across the relativistic law of gravitation. If the mass falls from the turning point (the point of reversion, $v = 0$), then, due to *energy conservation*, the kinetic energy, $mv^2/2$, becomes gradually extracted from $mc^2$. However $v$ is not known, hence the decrease of $m$ cannot be calculated with the formula $m\sqrt{1-v^2/c^2}$. Only when $m$ falls from $R = \infty$ (the opposite of expansion), then $v$ can be *calculated* to be a function of $R$. It decreases with the factor $e^{-a/R}$ – the gravitation law.

This can be demonstrated easily by means of the formula used by MM if we begin with the setup of Equ.(6.1) $mv^2 - 2GMm/R = 2 \times \text{total energy} = k_1$.

The total energy of the falling mass is $mc^2$. This replaces $k_1$ and we obtain $mv^2 - 2GMm/R = 2mc^2$.

After inserting $4\pi R^3\rho/3$ for $M$ and dividing by $R^2$ and by $mc^2$ we obtain

**(6.5)** $$\frac{v^2}{c^2R^2}=\frac{8\pi G\rho}{3c^2}-\frac{k_1}{mc^2R^2} \qquad \text{that is with } k_1=2mc^2\text{:} \qquad \frac{v^2}{c^2R^2}=\frac{8\pi G\rho}{3c^2}-\frac{2}{R^2}\,.$$

For the radius of the turning point, where $v = 0$, we obtain

**(6.6)** $$R^2=\frac{3c^2}{2\cdot 8\pi G\rho} \qquad \text{or} \qquad \mathbf{R}=\frac{\mathbf{1}}{\sqrt{\mathbf{2}}}\sqrt{\frac{\mathbf{3c^2}}{\mathbf{8\pi G\rho}}}\,.$$

That radius is identical with Equ.(3.58) except for the factor $1/\sqrt{2}$. But such a factor has been expected because in the formula assumed we introduced kinetic and potential energies by their classic expressions. MM did not assume that the intrinsic energy, $mc^2$, of the masses is a possible source for the kinetic energy when acquiring the initial velocity, $v$. Hence, they defined "twice the total energy" not by $2mc^2$ but by $k_1 = mc^2$, so the factor $1/\sqrt{2}$ does not appear. [With the precise expressions for *kinetic* and *potential* energy, that is $mc^2(1-e^{-a/R})$ and $mc^2e^{-a/R}$ respectively, the distance, $R$, cannot be calculated although the sum is $mc^2$.] In any case, the calculated radius is identical with that based on Energy-Conserving Gravitation where it is defined differently, namely by the distance at which maximum gravitation occurs.

Equ.(6.5) can be written in the following form: Then, if $k_2 = 1$ and $v = 0$, we obtain: $R^2 = \frac{3c^2}{8\pi G\rho}$.

This agrees with the radius we obtained with Energy-conserving Gravitation [see Equ.(3.58), Page 38] Nevertheless, here we have defined this radius differently, that is for v = 0.

$\frac{v^2}{c^2R^2} = \frac{8\pi G\rho}{3c^2} - \frac{k_2}{R^2}$ if we write $k_2$ for $\frac{k_1}{mc^2}$.

If $v \neq 0$, then we obtain

**(6.7)** $\frac{k_2}{R^2} = \frac{8\pi G\rho}{3c^2} - \frac{v^2}{c^2R^2}$. ($k_2 = k_1/mc^2$) (Einstein often defines all the units so that c = 1.)

If, in an expanding universe, v increases *proportional* to R according to Hubble's Law, then the term $v^2/R^2$ is constant. For instance, a galaxy receding with twice the velocity will reach twice the distance if the Hubble *Constant* H = v/R remains unchanged. With this we can write (if we define c = 1) the

**(6.8) Equation of Einstein** $\frac{k}{R^2} = \frac{8\pi G\rho}{3} - H^2 + \frac{\Lambda}{3}$ (which he obtained by an entirely different theory).

However I have added Einstein's famous "Cosmological Constant", **Λ/3**, making allowance for a possible *decrease* of the Hubble Constant, –H, in the course of expansion (or *increase* when $\Lambda < 0$). Because Einstein derived this equation by integration, he could easily introduce Λ/3 as an integration constant. Later, he considered this constant to be his greatest error, but today some cosmologists, unhappy with the Gravitational Law, returned to that constant and even called it a brilliant idea (Milne). Why? Their arguments are: The customary theory explains neither the steady-state condition of the universe nor its expansion; moreover, additional hypotheses are needed for elimination some inconsistencies with energy conservation, and there was the looming threat of stars older than the universe. This he tried to banish by the cosmological constant.

However, the setup of MM turns out to be contradictory in itself. The Big Bang requires energy to provide the masses with initial velocities and momentum; energy is required also for gravitation. If energy is *conserved*, as assumed by MM, then that energy must originate somewhere. The mass of that energy belongs to the mass of the universe, because "universe" embraces everything: Since the universe has no "outside" the energy required cannot be imported. If there is no external energy source, then the total energy of all the masses of the universe must be identical with its intrinsic energy$(M+m)c^2$ of its own masses. However, which part of the gravitational mass supplies the initial kinetic energy? Because there cannot be two classes of mass, the "propertied" and "working" classes; their function must be distributed symmetrically. This means that the accelerating mass must supply its own kinetic energy. The mass exists as such only when $mc^2$ is not zero. Therefore, if the total energy, $k_2$, is $mc^2$ in the formula presumed by MM, then that formula turns out to be the Law of Gravitation with Energy Conservation.

Because the universe has been assumed to be a sphere, the center and rim are *distinguished* points. This does not contradict the principle of relativity because it just attributes to each observer *his own universe, his own world*. "Observation" implies to center the world around the observer. The "privilege" of the center point is just to be the center relativ to *itself*, that is: *the world observed from that point*. In that sense, *each* point is the center of all other masses, which are the "rim", whether they are near or remote. An analogy is: *different* observers looking at the *same* rainbow. Each observer sees himself sitting precisely and inescapably in the rainbow's center, which is an exact circle, though each observer sees its rainbow from different locations.

According to energy-conserving gravitation, Equ.(6.3) and (6.4) have not been obtained by *integration* from the start condition of the Big Bang (hence there is no indefinite constant). On the contrary, the equations have been *derived* by *differentiation* of the defined energy function. Moreover, there is neither a starting velocity of *expansion*, v, nor a mechanism postulated for preventing the universe from collapsing. So the constants H and Λ in Einstein's equation (6.8) are zero and the formula for the radius of the universe becomes identical with Equ.(3.58) (Page 38) as derived with energy conservation.

However, the factor $c^2$ in the equations must be explained. Implicitly, the factor $c^2$ is also present in Einstein's equation (6.8), because k replaces $k_2c^2$. So we have $k = k_2c^2 = k_1/m = mc^2/m = c^2$ (see above). Equ.(6.8) corresponds with Equ.(3.58) if $c^2$ is shifted to the other side of the equation. The confusing variety of constants is the result of different definitions of c and m by the authors of relativistic papers. Often c and m are defined to be = 1 in order to make the *appearance* of the formulas more "elegant".

So we must be careful when comparing the formulas, because by defining c = 1, Einstein often uses an unconventional measuring system. Then the factor $c^2$ is concealed within the number 1. Of course, we can say that Einstein just uses another unit for length, i.e. 300,000 km instead of 1 cm, and this is only a division by the constant velocity, c, of light. This however changes the entire measuring system. It gives c the status of a fundamental unit and precludes the use of cm as unit for length. Consider Equ.(5.2), $E = \sqrt{E_o^2 + c^2P^2}$ (P. 66). It seems that for c = 1, the dimension of the momentum P and of energy E would be the same, a very common fallacy. In reality, we obtained the quantity P from cP by division by c. In the result, $\frac{E}{c} = \sqrt{\frac{E_o^2}{c^2} + P^2}$, all energies, E, are replaced by fictitious quantities, E/c, having the dimension of momentum. So *each* energy (or *its mass*) appears replaced by an equivalent abstract momentum. A momentum is not an entity in it self, it must be *applied* – applied to what? It can only be applied upon a mass, not applied to nothing. How will anything come into existence just by "applying"? Even Baron v. Münchhausen was a more realistic physicist when he pulled himself out of the swamp by the hair. Not only have the masses to catapult themselves apart, they must even *create themselves* by such a miracle. That is the one possibility. The other is that we must be careful when we use such an unusual measuring system in which c = 1, and "length" is no longer a fundamental quantity: it is not sufficient to assure the reader by a marginal comment, that replacing v by v/c would restore the original system, since *each* quantity in the formula must be transformed from the one system (cgs) into the other, or vice versa.

(1) How velocity is applicable as a fundamental measuring unit (when regarding the special addition theorem of velocities), that has to be proved;

(2) it must also be shown, how the new fundamental quantities inserted can be defined *empirically*.

If c = 1, then the sum, $E_o^2 + P^2$, appearing in Equ.(5.2), does not make sense if the different dimensions of the two terms added are not transformed according a precise definded instruction.

Certainly, Einstein had the correct transformation in mind when translating the result into conventional physics, but it remains up to the reader to decipher the measuring system for each term in a formula, otherwise a dialog will be an illusion. Whenever a physical quantity is used, e.g. "Force" or "Energy", the argument arises how these quantities are defined in the relativistic terminology. If "force" is defined as "energy transport along a path of one unit of length", then any logical discussion is impossible if "energy" does not correlate with a *relativistic* quantity or when energy is added to momentum. So everything leads to a question of faith when the arguments are based a) on different definitions and b) the arguments are refuted because incompatible with "the current state of science", occupied by each party having a different religion.

It should be added that later (1948), Edward A. Milne published a theory in which the universe is thought to be a cloud of galaxies and that it expands at nearly the velocity of light. According to his calculation, the density of the galaxies increases limitlessly when the distance increases, whereas the gravitation of the masses upon the inner masses remains finite. I will not try to explain his ideas here; I only want to demonstrate that the concept of expansion of the universe is inconsistant with energy-conserving gravitation.

Had Milne considered the inverse procedure, that is, a collapsing universe starting with a *limited* mass, then certainly he would have discovered the Energy-conserving Gravitational Law, because, implicitly, his theory contains *the transformation of the falling mass* into kinetic energy. Then, for R = 0, he would have realized that the gravitational mass disappears. When reaching R = 0, then the velocity, v, would be c.

If however only expansion is considered, then we must define an *initial condition*. Next, we have to proceed by integrating over time and space. But we cannot start with an initial cosmic mass m = 0, because m = 0 is nothing. In order to make a calculation possible, Milne had to start with a mass > 0, but then the integral would diverge, hence Milne obtained infinite masses when the distance approaches the "rim" of the universe. Nevertheless, he was correct when he realized (perhaps as the first scientist) the very important fact that gravitation is subject to Special Relativity and to its effects.

As far as I know, it has never been realized that the derivation of relativistic results from the classical theory by Milne and McCrea reveals an inconsistency in their mathematical logic. According to classical gravitation, planets can move only on elliptical orbits. In contrast, MM obtained *rosette*-shaped orbits, though they have used only the classical law. In a rosette shaped orbit is the perihelion advancing!

Such a mathematical inconsistency allows only one conclusion: the implementation of Energy Conservation by MM must have *transformed* the Classical Law into a different theory. This however is difficult to recognize on the formulas, at least not on those preferred by most of the sharp-witted mathematicians.The formulas used are horribly abstract. It seems that this have involved their minds in a sophisticated cycle where they have lost the thread for 63 years. If we are climbing down the ladder of abstract mathematics to human beings – which do not think with formulas, but with the brain – then we will return to the realm of *measurable* quantities. Then we may state:

(1) Newton and Einstein have assumed that the space is an inexhaustible reservoir of energy.
(2) In contrast, MM assumed *energy conservation* – and this modifies Newton's Law in its foundations.

Until 1905, it was unthinkable that the "potential" in Newton's Law was not inherently a quality of space or the "field". Even today it is difficult to present a measurement if it shows that the "potential" is the very mass itself. It is less difficult to stick aloft in a rigid position then to defend a challenged opinion in a dialog.

If MM had just suspected that the Classical Law could be transformed into another theory, then they had probably discovered the "other theory", because Energy Conservation allows only an unambiguous solution.

My own professors never had any doubt that the Classical Law of Gravitation is not consistent with Energy Conservation. All the more I was surprised when many years later I was sharply criticized by an other professor for the statement that the relativistic graviational law violates the Principle of Energy Conservation:

"*It sounds somewhat strange when, in a paper which claims to criticize the Theory of Relativity fundamentally, not a single equation of the theory appears. That may be a strong indication that the relatively ambitious mathematical structure of Einstein's equations has not been understood.*" My reply: If you expect a criticism of the mathematical structure of Einstein's equations, then you miss the essential point of my paper. There exists no criticism of Einstein or his"ambitious mathematics". Critic is not my intention. In this paper I am concerned with *assumptions* made <u>before</u> mathematics can be applied. Mathematical correctness is the pre-condition for any physical theory – including Einstein's Equation – but that is not the crucial point for correctness in my physical argumentation. It is the <u>assumption</u> which is crucial. Einstein's equations are *mathematically <u>correct</u>*, however they make sense only *if his assumptions* agree with reality, especially the assumption that the field supplies the gravitational energy. Such an energy supplying field has been disproved by a measurement suggested by Einstein himself and was first performed in 1971 by the clock experiment of Hafele and Keating's (see Page 1).

A measurement cannot be invalidated by applying the most consistent mathematical logic if the assumption contradicts that very measurement. If the result does not agree with the measurement, then one must question *the* correctness of the *theory* – in this case: are the assumptions correct upon which the theory is based?

The objective of this essay is to disclose the assumptions of the measurements and its consequences. However, without any additional hypotheses, it reveals even more, that is:

We are confronted with two contradictory statements:

(1) Planetary orbits must be ellipses (the mathematical consequence of Classical Gravitation).
(2) MM drew just the opposite conclusion from the same law: The planetary orbits are *rosette*-shaped.

If a mathematician is faced with such a contradiction then all his alarm bells should ring – but the didn't. For 63 years, two contradictory results from one and the same law have not disturbed the physicists. Can that be justified with the critic's claim "I had not understood *the relatively ambitious mathematical structure of Einstein's equations*"? Could it be that the majority of scientists remained silent because they are convinced that they understand the *ambitious mathematical structure of Einstein's equations*? Is that structure of the same kind as the "Emperor's New Clothes"? The cleverly woven *ambitious structures* have the marvelous property of making them "invisible for those who are either stupid or unfit for the office they hold".

# 7. Gravitation – Generalized Perspective

Sitting at the window, you look along a straight road skirted by houses. In the perspective the sidewalks, gutters and facades with their parallel lines are converging to the vanishing point. Parallel lines just do not appear to be parallel. Moreover, distant houses appear smaller than near ones. Is this distorted space perhaps not Euclidean? But you don't have any such doubts: You know that the distortion is just the result of your reference point. However, there *aren't any* reference points from which these lines will seen parallel. Are parallel lines an illusion? You *know* the lines *are* parallel, you *know* the space is *not* distorted. Really? You know this to be true in an abstract sense for *theoretical* reasons, and the theory is reliable because it has been confirmed by long experience.

Why does the world appear distorted? You have an explanation. The cause is the *rectilinear propagation of light* in empty space. From this the theory of the perspective has been deduced. It explains why a visitor, who a short time ago was full-sized, – now, when seen through the window whilst departing – looks much smaller. He appears reduced by exactly the same rate as the houses he passes. You would be right if you say: "Human beings shrink (contract) as the distance increases." You can even calculate the rate of contraction. Of course, you would add, in reality it is not a contraction because, if you follow the visitor and measures his size, no change will be detected. However, what does that measurement mean if your measuring device, the gauge, contracts at the same rate? Are far-away human beings smaller, or not? Actually, when the gauge is subjected to the same contraction, no simple method exists to answer this question. Hence, you cannot know the *absolute* size of human beings or physical objects, you can only judge the objects you see *in relation* to your own measuring units, and that, of course, is always the view from your location. If a distortion affects only the image you see of a remote object but does not effect the local *relationship* of the objects, then Euclidean geometry is confirmed.

If you are in a rapidly moving vehicle, then another understandable distortion occurs due to the *limited* velocity of light. What will you see from this vehicle? The limited velocity of light changes the appearance of the world: the houses in the street must look shortened because length is defined by the transit time of light. for covering the distances from *different* measuring points to the observer. The light needs time in both directions due to the movement whilst the light travels. However, no such length contraction is observed when each distance is measured *directly* at the object by applying a measuring stick. Again, the geometry is confirmed to be Euclidean. It is independent of the distorted view from different observation points.

However, length contraction is also determined by a *third distortion* which too is caused by a quality of light, and this is the strangest of all. It is the *invariability* of the velocity of light regardless of movements of observer and light source. Difficult to understand it is related to the *time dilatation which applies to a moving object* viewed by an observer at rest. We may call it *Time Perspective*. This distortion is also relativistic, since it does not exist for an observer located on the moving object itself. So once again, the geometry turns out to meet the definition of Euclidean geometry, but there is a difference.

Seen by an observer at rest, the rate of a moving clock slows down by the same rate as length decreases. However, the invariance of the velocity of light produces an additional effect which can *not* be deduced from the source-free field in the customary theory: the gravitationally active *mass* of a body *decreases* when it approaches the center of gravitation. *Perspective* does not only effect length, It effects also *mass* and *time*: This leads to a generalization of Euclidean geometry. In the generalized perspective, not only parallel *lines* converge to a vanishing point, two other parameters approach also to zero: length and clock rate, – and *the mass* at the same rate as shown in Chapt.1.3. This makes physics invariable, that is, independent of location and time, a characteristic feature of **General Relativity**. This is the Lorentz Invariance. It could be called the Generalized Parallel Axiom.

Einstein recognized a new realm of thinking, but a small gap was left without a bridge to reach it. He was convinced that modern mathematics could provide these bridge by the Potential Theory of Classical Physics. The tempting but misleading idea of the Potential Theory was the postulate that a central force *must* have its energy source *in the field*. Even for many astronomers of today it seems to be evident that no alternative to a field energy can be imagined. Can we find an open-minded scientist who is ready to discuss the opposite?

Even Einstein was hypnotized of the classical Potential Theory when he assumed the field as the only conceivable source of energy. Although it was he himself who had discovered the alternative, he continued his search for the best mathematical theory like the man who puts on his glasses in order to find them. Instead of trusting the alternative he already had, he relied on theories about central forces developed by the most gifted mathematicians (though in their theories the Principle of Energy Conservation is violated). While inventing obscure and exotic energy sources for the kinetic energy of free fall, the *known* energy, $mc^2$, of the falling mass itself, visible for everyone, remained unnoticed. Have you ever heard that $mc^2$ might be the source? Of course, the classical Potential Theory could not anticipate the identity $E = mc^2$. Many scientists had the qualification for checking whether $mc^2$ might be the source of the gavitational energy. Just the idea did not occur to them. Nobody expected that a *physical* theorem, even if it is the equivalence of mass and energy, could disprove the "obvious" *mathematical* logic that the kinetic energy of free fall must originate in the space.Is it possible that a dependency of mass on distance had never been imagined? I remember my own surprise when I obtained some results of the General Relativity just by introducing Energy Conservation into the masses of Newton's Law of Gravitation! For me, just as for all other physicists, this was the last I expected. First I did not believe the results and suspected myself to be a victim of my own miscalculations.

Of course, the physical community of today cannot afford to be as slow as I was. However if it is realized that the falling mass itself *may be* the source of the kinetic energy, than no serious scientist can ignore that this option must be investigated.

After having realized that gravitation becomes consistent with energy conservation simply by accepting the identity $E = mc^2$, then it is difficult to understand why the opposite (and disproved) *hypothesis* has been preferred, that is: the source of kinetic energy would be the space and not the *known* intrinsic energy, $mc^2$.

Not until recent times some physists realized (though do not take into account), that the intrinsic energy, $mc^2$, of a mass decreases precisely by the same amount as it acquires kinetic fall energy. This is a fundamental principle of physics, explained in many text books. It is also true for any kind of binding energy in an atomic nucleus of a chemical compound, shown by (1) **Marcus Chown** in his recommendable essay "The Magic Furnace", 1999, Page 80-83) and (2) **Harald Lesch** in his TV-serie BR "Alpha-Centauri" 2008, 4, 13. The autors accept the mass as the source of the gravitational fall energy, but without being aware of the disastrous effects of this relativistic principle upon their own "standard theories" (hence Big Bang and Black Holes remained omnipresent spectre in Lesch's TV-serie). Already years prior to Einstein the ingenious visionary **Ludwig Boltzmann** has recognized that the decrease of mass by the energy of free fall is one of the basic principles of physics (1896, see insert on Page 83).

**Essential is the consequence: a mass can never collapse into a Black Hole, because by falling the mass transforms itself completely into kinetic energy. Kinetic energy can be radiated.**

As already (**Page 69**) explained, the following **axiomatic equation** with two energy sources $\mathcal{E}_o$ and $E_{pot}(\mathbf{R})$ have been postulated for implementing Special Relativity into General Relativity Theory:

**Equ.(5.7)** $$E = \sqrt{c^2P^2 + E_o^2} + E_{pot}(\mathbf{R}) + (\mathcal{E}_o - E_o) = \text{const.} \quad (m_o = m).$$

With these postulates the field was endowed with two hypothetical (almost mystical) sources $E_{pot}(\mathbf{R})$ and $(\mathcal{E}_o - E_o)$ in order to *adapt the formula* to the Classical Potential Theory. In the Classical Potential Theory energy conservation was not conceivable because the energy-mass equivalence $E_o = m_oc^2$ was not known at this time. Today however, physics is not conceivable if we ignore the relativistic source $mc^2$. Though this source is a gigantic reservoir, its capacity is limited to be $m_oc^2$ in the formula.

It must be emphasized that any increase or decrease of energy exists *only* relative, that is, for observation from a mass at rest. Hence it is zero if the observer is located upon the moving mass itself, where $v = 0$. Astronauts inside a free-falling space vehicle will *not* notice a conversion of their own mass into the kinetic energy of free fall. However, an observer sitting in the gravitational center can measure the energy extracted from the collapsing (falling) mass. If that "observer at rest" tries to verify the change of the falling mass due to that energy conversion, then he can measure it by braking, that is slowing down the velocity of free fall and extract the kinetic energy from the falling mass by converting it into heat, which can be measured. However no kinetic energy appears if the observer is located (fixed) upon the falling mass. (Of course, energy can be imported from a source outside, e.g. if we heat the mass, but that would alter the structure of the falling mass.) The situation is the same as it is for a passenger in a moving train who will not notice having kinetic energy because it is a measurable quantity only for an observer "at rest" outside the moving train. What is an "observer at rest"? It can be an observer in another train or standing on the ground. For each observer having a different relative velocity, the kinetic energy (and mass) of the *same* body is different, and an energy increase *does appear only by accelerating it to a relative velocity*.

Of course, if the observer is upon the central mass then he can gather information about the falling mass by measurements, for instance, of the Doppler shift of the spectrum if the light if its source is located on the falling mass. He can also measure the time Dilatation (of the calibration frequency of the frequency meter – defining the gate time for counting the number of cycles). The Relativity Principle is valid in any mass (for instance, the mass of a person in a moving train). It states that the mass does *not* change for an observer moving with the mass (v = 0), but it changes for an observer moving *relative* to the mass. A mass appears to be different for different observers, but it is constant for an observer moving with the same velocity.

Originally, Euclidean geometry was defined by constant distances between parallel lines. Now that definition is generalized by applying the concept “parallel” to both variables, to the mass as well as to time intervals. For an observer moving *with* the mass, both – the mass and the time intervals – are constant, that is “parallel”, however in the view of an other observer both are changing by the same factor.

The "standard" interpretation of General Relativity states, that the source of the fall-energy is the "space", but this is inconsistent not only with energy conservation but also with a general principle of physics which states: A physical system tends to assume the **State of Least Energy,** that is the “most stable state” possible. This principle accounts for the stability of chemical compounds. For instance, 2 hydrogen atoms and 1 oxygen atom combine to water, $H_2O$. The water atom has less energy (mass) then the sum of the three solitary atoms. Hence, when the molecules combine then remains an excess energy which is released as heat. Inversely, the atoms can be *separated* only when the emitted energy is restored. Another instance is the radiation an atom emanate when it falls from an *excited* to a lower energy level. As for any binding energy the same principle is working for gravitational movements: Due to energy conservation the intrinsic energy (= $mc^2$) of a falling mass decreases by exactly that part which transformes into kinetic energy. Kinetic energy is external energy. As such it can transform into radiation. According to Boltzmann this is true for any kind of atomic force acting between atoms. However in the erroneous standard interpretation of gravitation the opposite has been assumed, though being incompatible with the fundamental principles of physics: If it would be possible that a mass can fall without consuming its mass, then its kinetic energy should increase limitless. This contradicts Energy Conservation and is the opposite to the “most stable state”, it would be the most unstable state and can not be true. Now the main principles of General Relativity have been discussed.

# 8. Gravitational Waves Discovered?

When impressed by the results deduced from Gravitation with Energy Conservation, we should not forget the following question: Do **Gravitational Waves** exist? In any case, when photons are emitted then energy is emitted. The equivalent mass of the photons must excert gravitation. Light is a special type of electromagnetic waves. It would be strange if two kinds of gravitational waves would exist, the first being light, the second another kind of wave. According to all known observations, the whole *kinetic* energy is supplied by the the inner energy of the falling mass, nothing by a hypothetical "energy of the field”. The field is not a source of energy, it controls only the rate of supply, but does not even transmit it. “Attraction” is relative. It can only be defined relative to a reference point, the observer. If the observer is located upon the central mass, then (for him) the gravitationally attractive central mass is at rest and remains unaffected. However the observer can interchange the locations. He can change from the *central mass* to the *falling mass*. Only a change of the relative velocity – by acceleration, retardation or collision of the masses – determines where and how much kinetic energy will be released. If masses are colliding then energy transfer may occur until the central region is reached, for instance by fusion of atoms in the sun or by extraction of kinetic energy from moving water. In short: no indication exists that a field can produce gravitational waves.

The discovery of "gravitational waves" was sometimes reported, e.g. by observations of J. H. Taylor and R. A. Hulse et al, of the Pulsar PSR1913+16 [“Pulsars”, W.H. Freemann & Comp. 1977, *Spektrum der Wissenschaft*, 12/1981 and 12/1993 (Nobel prize)]. The report relates to the rare case of a Pulsar in a narrow binary star system. From the Doppler shift of the radio frequency and the period of pulsation, the authors were able to calculate very accurately the parameters of the two orbits. Due to the enormous concentration of the masses within the small dimension of the orbits relativistic effects are very pronounced. One of these effects is an observable decrease of the orbit’s diameter, indicated by a continuous decrease of the orbit’s period. The authors pointed out that such a decrease can be explained by an energy loss due to "gravitational waves". The discrepancy between theory and measurement was only 0.3% within 20 years.

Without commenting this calculation, I will direct the attention to the fact that Gravitation with Energy Conservation leads also to a change of the orbit's diameter. It is well known that the diameter of the orbit decreases only by extracting kinetic energy from the planet's orbital movement (the effect is used by the space shuttle for landing). When calculating the Gravitation with Energy Conservation, we would obtain an incorrect result if we would base it on the simple assumption of a collapsing central mass where the emerging kinetic energy were transformed into heat and radiated. That would cause an *increase* of the orbit's diameter.

In order to discuss the observed *decrease* of the diameter we must carefully follow the Law of Gravitation with Energy Conservation. The energy of free fall must be subtracted from the falling mass. The decrease of the orbit's diameter indicates a decrease in the kinetic energy of the orbiting mass. According to the formulas of Einstein, the loss of energy can be explained by gravitational waves emerging from such a constellation, however that is just a possibility and doesn't exclude effects other than hypothetical gravitational waves, for instance: radiation of electromagnetic waves or tides in the central mass. Even an increase of the central mass by a mass transfer from the orbit into the central mass cannot be excluded. The measured spiral orbit indicates an increase in the relation of central mass to orbiting mass, whatever its cause may be. Our knowledge about all possible causes is limited. Moreover, a mathematical examination is difficult because some neglected effects in the derivation of Equ.(3.34) for the relativistic orbits can not be neglected in a system with such an enormous mass concentration. The loss of energy due to tides and other effects can hardly be estimated. Most likely, no closed solution of the differential equation exists. Perhaps some reader of this paper will find an approximate solution explaining that pulsar.

In the customary theory, an energy-producing vacuum has been postulated, but that would require an entirely unknown kind of physics. With **proper quantum** **effects** (or other), such a vacuum should function as an energy reservoir. I cannot comment on ideas of this kind because I cannot accept such arguments as being sufficiently conclusive for sacrificing a principle which is so fundamental as energy conservation, or that new theories of gravitation have to be invented.

# 9. Future and Age of the Universe

The hypothesis of a Big Bang is disproved, however the question remains: Does the universe change as time passes? Will the universe always look the same? Clearly, it may contracting, but if the units of all the fundamental physical quantities are "contracting" by the same factor in such a way that the physical laws remain unaffected, then the universe can (but must not necessarily) maintain its present structure forever. Thus, the question of its "beginning" or of its "purpose" loses its importance. Then the answer is life itself, which as such, is a revelation due to its obvious existence. Each living being is "co-creator of the universe", each living being gives it a "purpose".

These considerations may raise another question if we refer to the problem that we do not have the faintest idea "what a mass is". The only thing we know about "mass" is its ability to effect another mass, thereby identifying itself and the existence of other masses. Our own existence is a secret, but it is a fact. Each living being is a mass. Mass is not explainable, all we know is: life cannot be separated from mass. Why? Try to imagine a world *without* any living being – a being which can be aware of anything. If no being exists which can be aware of itself or of anything else, then neither you nor your awareness exists. What is the criterion for "existence" if no kind of awareness exists? This means: Life is precluded. Is "being dead" possible? Is "being dead" a possible category of "being"?

Whether life on earth has been imported from somewhere else or has developed from "dead matter" is a controversy between metaphysicists who are convinced that they know what "matter" or "dead matter" is.
However, the logic may be the opposite: *matter* is not the "material" out of which living beings develop, but the inverse may be the case: *life* is the "material" for matter. Of course, living organisms can be defined as the opposite of chaos; however, is this not also a quality of "matter" and even of "being dead"?

Cosmology can be thought as a forum for new theories, for example the theory that gravitation can reverse the Law of Entropy (see Chap. 1.8 on P. 10). **Galaxies** are not only birth places for stars, they are also gigantic "machines" for *recycling* the stars and their planets. The planets may have life "on board", but they must pay for it if they fall (with their suns) toward the galactic center where they may transform into primordial material for new stars and planets, places for new generations of life.

May be that the universe is *many times older* than is normally assumed. If no limit exists for its age, then the problem of “stars which seem to be older than the universe" disappears. It is immaterial because then they have sufficient time to reach a state similar to their present state. By gathering intergalactic material from the enormous space around a galaxy, the accretion of primordial matter becomes concentrated in the disk of each galaxy. Inside these disk, many small accretion disks could form and evolve into planetary systems. "Friction" (mutual interaction) between those small disks in their fringes may act like a brake, slowing down their orbits. Whilst their masses are spiraling toward the galactic center their constant angular momentum is transferred into the outer fringes of each galaxy. We may summarize:

1. There was no Big Bang (see Page 2), hence **there is no indication of a limited age of the universe.** Up to now, an age has been "calculated" by a special interpretation of the **Hubble Constant**.
2. With relativistic logic, we must abandon the idea of absolute units of length, time, and mass.
3. Only if the relativity theory where not true then we could conclude that the world had emerged from a Big Bang at a time, $\mathbf{T_o}$, and an expansion velocity, **v**. This is just a an interpretation of the red shift. If $\mathbf{R_H}$ is the distance of a galaxy to us, then we get with this assumption $\mathbf{v = R_H/T_o = HR_H}$. $\mathbf{H = v/R_H = 1/T_o}$, calculated from the distance **R** and the escape velocity **v**. (**R** caluclated from the luminosity of "standard" stars of a known galaxy, and, due to **v,** a Doppler-shift occurs).
4. If we would assume a Big Bang at the time $\mathbf{T_o = 1/H}$ then we get in conflict with the Special Relativity Theory. In the chapters 1 and 2 we have proved: If the Special Rel. Theory is true then the average structure of the universe at the time $T_o$ has been the same as it is today. As long as nothing indicates that the age of the universe is limited, an astronomer need not to be afraid if he discovers a star “older than the universe”.

# 10. Approximate Equation for Gravitation

**Fig. 3.1** on Page 21 shows a dotted curve which approximates Energy-conserving Gravitation by shifting the graph (Fig.1.6, P.6) of Newton’s Law by a/2 to the left, that is, by substituting R+a/2 for R. This eliminates the singularity because the maximum force remains finite even when R = 0. If we extend $e^{-a/R}$ in an exponential series, we obtain a formula which reveals that the accuracy of the approximation is ½ the second term:

$$\frac{e^{-a/R}}{R^2} = \frac{1}{R^2 e^{a/R}} = \frac{1}{R^2(1 + a/R + a^2/2R^2 + \cdots)} \cong \frac{1}{(R + a/2)^2}.$$

With this, we obtain approximately:

$$\mathbf{K} \cong \frac{\mathbf{GMm}}{(\mathbf{R} + \mathbf{a}/2)^2},$$

(no singularity because R ≥ 0. $K_{max}$ at R = 0). Integrated from a/2 to R:

$$E_{pot} = \int_{a/2}^{R} K dR = \int_{a/2}^{R} \frac{GMm}{(R + a/2)^2} dR = \frac{GMm}{a} \cdot \frac{R - a/2}{R + a/2} = c^2 m \cdot \frac{R - a/2}{R + a/2}, \quad (R \geq a/2).$$

**Note 1 to the Pages 3, 19 and 98**

If the Photon had a gravitational field whose velocity $c_{grav}$ becomes added to to the velosity of light $c_{light}$ = c,

($c_{grav}$= $c_{Licht}$ = c), then the addition theorem must be applied: $\mathbf{v} = \frac{\mathbf{c_{light} \pm c_{grav}}}{\mathbf{1 \pm c_{light} c_{grav} / c^2}} = \mathbf{c_{light}} \frac{\mathbf{1 \pm c_{grav} / c_{light}}}{\mathbf{1 \pm c_{grav} / c_{light}}} = \mathbf{c_{light}}.$

This means: A „Field of the Photon“ can neither hurry ahead the photon nor remain behind. It sticks to the photon because nothing can be added to the velocity of light and nothing subtracted from it.

# 11. Assumptions in Current Publictions

The following quotations are examples. Comparable **interpretations** can be found in almost any textbook and in many other texts. They represent the current status of understanding, that is: the gravitational energy is a quality of the *field* or *vacuum*. As already shown, such concepts do not agree with the results of Hafele und Keating's Clock Experiment (predicted by Einstein), and not with Boltzmann's Law. The idea of field energy could easily be, but was not recognized as an error. As far as I know, until recently it has not been realized that the field does not provide any energy. If Einstein's theorem $E = mc^2$ is taken into account, then – in a gravitational field – time dilatation as well as the gravitational Doppler shift rule out the *field* or *vacuum* as a source of gravitational energy.

A correct "**interpretation of the red shift in a static gravitational field**" I found in February 2000 in the Am. J. Phys. 68 (2), © 2000 American Association of Physics Teachers. This article is an exception. The authors are L. B. Okun and K. G. Selivanov (ITEP, Moscow, 117218 Russia) and V. L. Telegdi (EP Division, Cern, CH 1211 Geneva 23, Switzerland). The common interpretations are different, e.g.:

**1. Albert Einstein, "Grundzüge der Relativitätstheorie"**, Akad.-Verl 7058 ES 18 B1, Pergamon, Vieweg:
My translation: "It must be considered that apart from the energy density of matter, there must also exist an energy density of the gravitational field. Hence, there can be no question of a conserving principle for energy (or momentum) of *matter alone*." (Emphasized with italics by Einstein; see explanation on Pages 16 –18).

**2. W. Rindler / "Essential Relativity"**, 2nd edition, 1979, Springer, Page 83:

"One kind of energy that does *not* contribute to mass is *potential* energy of position. In classical mechanics, a particle moving in an electromagnetic (or gravitational) field is often said to possess potential energy, so that the sum of its kinetic and potential energies remains constant. This is a useful "book-keeping" device, but energy conservation can also be satisfied by debiting the *field* with an energy loss equal to the kinetic energy gained by the particle. In relativity there are good reasons for adopting the second alternative, though the first can be used as an occasional shortcut: the "real" location of any part of the energy is no longer a mere convention, since energy – as mass – gravitates."

[Here, an exception to $mc^2$ is postulated, may be in order to avoid inconsistency with Energy Conservation. This seemed possible due to the belief that the "field" could obtain the non-existent potential energy by "debiting" the vacuum. That idea has been adopted by some non-physicists in order to exploit "space energy". They even claim to have already built this new kind of *perpetuum mobile*, and they assert that it does function. The question remains: why in the millions of years of biological evolution has nature not used this simple idea?]

**3. N. Straumann "General Relativity and Relativistic Astrophysics"**, 2nd Print, 1991, Springer, Page 146:

"In Special Relativity, the conservation laws for energy and momentum of a closed system are a consequence of the invariance with respect to translation in time and space. In general, translations are not symmetry transformations of a Lorentz manifold and for this reason a general conservation law for energy and momentum does not exist in General Relativity*. This has been disturbing to many people, but one will simply have to get used to this fact. If one tries to find an "energy-momentum tensor for the gravitational field", one is on the wrong track. This is also clear since the gravitational field ( $\Gamma^{\mu}_{\alpha\beta}$ ) can be transformed away at any point. If there is no field, there is no energy and no momentum."

*["…for this reason a general conservation law for energy and momentum does not exist". Note by R.K.:This is not true: the energy is not in the field (the location) but it is in the mass which is falling.]

**4. Edward R. Harrison "Kosmologie"**, 2nd ed., 1984, Darmstädter Blätter, Page 432: (Retranslated)

"The Law of Energy Conservation is a help in all natural sciences except cosmology. In regions not participating in expansion of the universe and (compared with the average in the universe) the density is high, we can prove the flow and interaction of energy in its various forms and state that it is conserved. However in the universe as a whole, it is not conserved. The total energy decreases in an expanding universe and increases when the universe collapses. The answer to questions of where the energy in an expanding universe goes and where it comes from in a collapsing universe is – nowhere, because in this one case, the energy is not conserved."

**5.** Only in recent time some authors accept the mass as source of gravitational energy. See insert page **102.**

# 12. Divergence

In order to approach the Classical Theory under boundary conditions, Einstein adopted from that theory the concept of a source-free gravitational field (see Page 16). The boundary conditions are not specified explicitly. “Source-free” means that the kinetic energy, $E_{kin}$, of free fall emerges from “empty space”, or the “field”. This is inconsistent with energy conservation. Another consequence of the Potential Theory is that the sum of potential + kinetic energy $(E_{pot} + E_{kin})$ is constant, as can be seen with any falling mass. Therefore somewhere a source must exist. Nevertheless, Einstein was following the classical hypothesis of a source-free field. By merging energy and momentum into a single physical entity, he created a source-free field where energy is “not localizable”. So the field seemed to be reconciled with energy conservation just by making its energy absent until it is needed in the form of potential energy.

The mathematical expression of a source is “divergence”. Where the divergence is zero, the field is free of sources. If, however, the energy, $mc^2$, of the falling mass is recognized as being the source, then Einstein’s assumption of zero divergence cannot be maintained. Approaching the boundary condition, Einstein’s definition of divergence must converge into the classical expression of divergence, derived as follows:

From $R=\sqrt{x^2+y^2+z^2}$ we obtain $\frac{\partial R}{\partial x}=\frac{x}{R}$, $\frac{\partial R}{\partial y}=\frac{y}{R}$ and $\frac{\partial R}{\partial z}=\frac{z}{R}$

**(12.1)**
$$\left.\begin{aligned}\frac{\partial^2 R}{\partial x^2}&=\frac{R-x^2/R}{R^2}=\frac{\mathbf{1}}{R}-\frac{x^2}{R^3}\\ \frac{\partial^2 R}{\partial y^2}&=\cdots=\frac{\mathbf{1}}{R}-\frac{y^2}{R^3}\\ \frac{\partial^2 R}{\partial z^2}&=\cdots=\frac{\mathbf{1}}{R}-\frac{z^2}{R^3}\end{aligned}\right\}\quad \text{sum}=\frac{\mathbf{3}}{R}-\frac{\mathbf{1}}{R}=\frac{\mathbf{2}}{R}.$$

From **Equ.(9)** $K=\frac{dE}{dR}=\frac{GMm}{R^2}\cdot e^{-a/R}$ follows

**(12.2)**
$$\frac{d^2E}{dR^2}=\left(-\frac{2GMm}{R^3}+\frac{GMm}{R^4}a\right)\cdot e^{-a/R}=\frac{GMm}{R^3}\left(\frac{a}{R}-2\right)\cdot e^{-a/R}.$$

**<u>Divergence defined by the Potential Theory</u>** $\operatorname{div}\overline{K}=\frac{\partial^2E}{\partial x^2}+\frac{\partial^2E}{\partial y^2}+\frac{\partial^2E}{\partial z^2}$, e.g. $\frac{\partial E}{\partial x}=\frac{dE}{dR}\cdot\frac{\partial R}{\partial x}$, hence

**(12.3)**
$$\frac{\partial^2E}{\partial x^2}=\frac{d^2E}{dR^2}\left(\frac{\partial R}{\partial x}\right)^2+\frac{dE}{dR}\cdot\frac{\partial^2R}{\partial x^2},\ \text{analogous}$$
$$\frac{\partial^2E}{\partial y^2}=\frac{d^2E}{dR^2}\left(\frac{\partial R}{\partial y}\right)^2+\frac{dE}{dR}\cdot\frac{\partial^2R}{\partial y^2}\quad\text{and}$$
$$\frac{\partial^2E}{\partial z^2}=\frac{d^2E}{dR^2}\left(\frac{\partial R}{\partial z}\right)^2+\frac{dE}{dR}\cdot\frac{\partial^2R}{\partial z^2}.\ \text{The sum of that is:}$$

**(12.4)**
$$\operatorname{div}\overline{K}=\underbrace{\frac{d^2E}{dR^2}}_{\text{Equ.(12.2)}}\underbrace{\left[\left(\frac{\partial R}{\partial x}\right)^2+\left(\frac{\partial R}{\partial y}\right)^2+\left(\frac{\partial R}{\partial z}\right)^2\right]}_{=1}+\underbrace{\frac{dE}{dR}}_{\text{Equ.(1.3) \& (1.9)}}\underbrace{\left(\frac{\partial^2R}{\partial x^2}+\frac{\partial^2R}{\partial y^2}+\frac{\partial^2R}{\partial z^2}\right)}_{=2/R\text{ see Equ.(12.1)}}.\quad\text{with Equ.(1.9):}$$

$$\operatorname{div}\overline{K}=\frac{GMm}{R^3}\left(\frac{a}{R}-2\right)\cdot e^{-a/R}+\frac{2GMm}{R^3}\cdot e^{-a/R}=\frac{GMma}{R^4}\cdot e^{-a/R},\qquad\text{or}$$

**(12.5)**
$$\underline{\mathbf{div}\overline{\mathbf{K}}=\left(\frac{\mathbf{GMm}}{\mathbf{R^2}}\right)^2\frac{\mathbf{e^{-a/R}}}{\mathbf{c^2m}}\ \mathbf{or}=\mathbf{c^2m}\cdot\frac{\mathbf{a^2}}{\mathbf{R^4}}\cdot\mathbf{e^{-a/R}}.}$$

This is **zero only when**
**R = 0 or R = ∞ or if c = ∞**
(maximum for R = a/4).

Now Einstein’s “boundary conditions in the Classical Law” can be defined. The condition $v\rightarrow 0$ implies $R\rightarrow\infty$, which makes no sense. For real distances $R<\infty$, the classical requirement $\operatorname{div}\overline{K}=0$ can be met only when $c=\infty$ according to Equ.(12.5). However $c=\infty$ is inconsistent with Einstein’s Theory. This means:

No theory exists which is consistent with itself except the Energy-conserving Gravitation Law.

# 13. Vector Representation of the Gravitational Force

With the equation **(3.29)** $\mathbf{m\ddot{R} - mR\dot{\varphi}^2 = -\frac{GMm}{R^2} - 3\frac{GMmF^2}{c^2R^4}}$ as the first component, the gravitational force can be expressed as a vector with the cylindrical coordinates R, φ, z. The mathematical setup is identical to the setup in classical textbooks, however the relativistic term, $3GMmF^2/c^2R^4$, must be added:

$$\vec{K} = \begin{pmatrix} k_1 \\ k_2 \\ k_3 \end{pmatrix} = \underbrace{\begin{pmatrix} m(\ddot{R} - R\dot{\varphi}^2) \\ m(R\ddot{\varphi} + 2\dot{R}\dot{\varphi}) \\ m\ddot{z} \end{pmatrix}}_{\text{(Classical expression)}} = \begin{pmatrix} -\frac{GMm}{R^2} - 3\frac{GMmF^2}{c^2R^4} \\ 0 \\ 0 \end{pmatrix}$$

($\vec{K}$ *has* the direction $\frac{\vec{R}}{|R|}$ of the component $k_1$.)

**1.**The relativistic term, $\mathbf{3GMF^2/c^2R^4}$, is the attractive force of the kinetic energy due to the transverse movement. The term will be calculated below.

**2.** The two components $k_2$ and $k_3$ (*orthogonal* to $\vec{R}$) are zero because the force of gravitation is a central force (= $\vec{K}$, or written not as a vector but as boundary condition for the 1st component). Integration of the 2nd component, $\mathbf{R\ddot{\varphi} + 2\dot{R}\dot{\varphi} = 0,}$ results in $\mathbf{R^2\dot{\varphi} = F = const. = vR,}$ that is, twice the area swept by the radius R per unit of time. It is a constant, discovered by Kepler (Law of Equal Areas, explained by Newton).

**3.** The 3rd component, $m\ddot{z} = 0$, is the condition that the trajectory is in the R-φ-plane (when $\dot{z} = 0$) orthogonal to the z direction. The equation for $k_1$ is true also for the deflection of light by a large mass, but for light is the rest mass = m = 0, hence the term for the attractive force does not exist, $GMm/R^2 = 0$.

However, in this classical setup, the mass, m, in the component $k_2$ is not correct. It must be replaced by its *relativistic* equivalence which can be found in the following way: First, we know that the classical condition of a moving *constant* mass is $R^2\dot{\varphi} = F = const. = vR$, or, multiplied by m: **mF = mvR**. Therein, mv is the momentum, P, of the movement orthogonal to R, hence PR is the angular momentum. The law "constant area F = const." expresses conservation of angular momentum. Because this is also true in Special Relativity, its relativistic equivalent can be written directly by using the relativistic mass, $\mathbf{m_{transv} = me^{+a/R}}$, of the transverse movement (see "Dependence of Mass on Direction", **P. 24**). The result is the *relativistic* Law of Constant Area (≡ Law of conservation of angular momentum):

$mF = m_{transv} \cdot v_{transv} R = me^{+a/R} \cdot R\dot{\varphi} \cdot R = m R^2\dot{\varphi} e^{+a/R} = const.$ The initial mass, m, can be cancelled:

$\mathbf{F = R^2\dot{\varphi}\, e^{+a/R} = const.}$ Its derivative is $\frac{dF}{dt} = \left(2R\dot{R}\dot{\varphi} + R^2\ddot{\varphi} + \dot{\varphi}a\dot{R}\right)e^{+a/R} = 0.$

After division by $Re^{a/R}$ and because $a = GM/c^2$, we obtain $\mathbf{R\ddot{\varphi}m + 2\dot{R}\dot{\varphi}\left(m + \frac{GMm}{2Rc^2}\right) = 0}$.

By comparison with the component $k_2$ we see: in the relativistic equation, the mass, m, in the second term (that is the Coriolis force) must be supplemented by half the mass GMm/R of the potential energy. The mass, m, is defined as the initial mass (when R = ∞). The deviation from the classical equation is extremely small, nevertheless it is not neglected in the following calculation.

According to Energy-conserving Gravitation, the change of mass will always occur when the distance, R, changes, independent of whether subsequently the fall energy becomes transformed into kinetic energy or any other form of energy. This means: instead of being expressed by the velocity, it can be expressed by R according to the equation $\sqrt{1 - v^2/c^2} = e^{-a/R}$ or $m/\sqrt{1 - v^2/c^2} = me^{+a/R}$:

$F = R^2\dot{\varphi}e^{+a/R} = v_{transv}\, Re^{+a/R}$, hence $v_{transv} = \frac{F}{R}e^{-a/R}$. With this and because v << c for $E_{kin/transv}$ we obtain

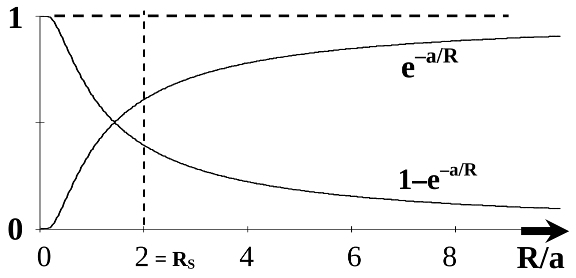
$E = \frac{mv_{transv}^2}{2} = \frac{mF^2}{2R^2}e^{-2a/R}$. The mass of this kinetic energy is $m_{transv} = \frac{E_{kin/transv}}{c^2} = \frac{mF^2}{2c^2R^2}e^{-2a/R}$.

The mass $m_{transv}$ causes *additional* gravitation, but transverse to $v_{transv}$ and therefore twice as much (true for any kinetic energy, see P. 17). Because the factor is $e^{-a/R} \cong 1$, we can use the classical formula for that very small gravitational potential. We obtain what we had introduced into the formula at the start of this chapter:

$$E_{pot/transv} = \frac{GM \cdot 2m_{transv}}{R} = \frac{GMmF^2e^{-2a/R}}{c^2R^3}, \quad \text{from that,} \quad \mathbf{K_{additive} = \frac{dE_{pot/transv}}{dR} = \frac{3GMmF^2}{c^2R^4}\Big(\underbrace{e^{-2a/R} + \frac{2a}{3R}}_{\cong 1}\Big).}$$

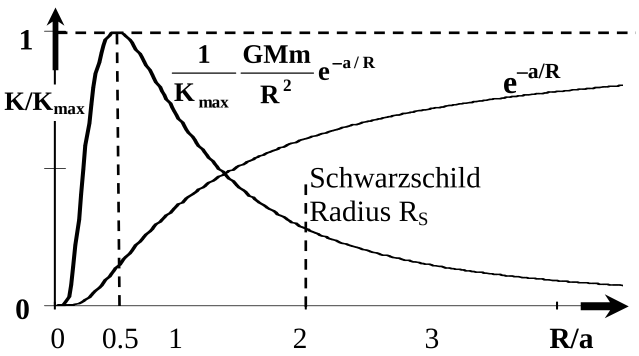
# 14. Details to Some Functions

**Fig 14.1 The functions $e^{-a/R}$ and $(1-e^{-a/R})$**




By expansion in a series (with $a = GM/c^2$)
$\mathbf{e^{-a/R} = 1 - a/R + a^2/2R^2 - a^3/6R^3 +-}$
it can be realized that for large R, the function $\mathbf{1-e^{-a/R}}$ approaches the **hyperbola a/R** becaus there, the terms with higher power disappear. If R is small, then the terms a/R with an exponent of 2 and higher dominate.

**Bild 14.2 (1) Gravitational force of the Star M** (normalized to $K/K_{max}$) **and (2) the factor $e^{-a/R}$**




Notice that $\mathbf{e^{-a/R}}$ almost disappears when R is close to 0.

The gravitational force has its maximum at the point of inflection for $e^{-a/R}$ (because it is its derivative).

**Note to Page 6:** 

## Boltzmann's Law

(→Boltzmann 1896, Vorlesungen über Gastheorie, I.Teil, Van der Waals / Gase mit zusammengesetzen Molekülen)

If the attractive force between two masses depends only on their distance, then energy conservation must be true. Already in the 19th century, about ten years prior to Einstein's Spez.Rel.Theory, **Ludwig Boltzmann** proved that for the potential of any central force the following law must be true, for instance for gravitation:

**(1)** $\mathbf{n = n_0 e^{-E_{pot}/E_0}}$ = **Boltzmann's Law** (see Feynman Vorlesungen über Physik, Bd.1)

$\mathbf{n_0}$ = number of energy-units composing the mass $m_0$ at distance $\mathbf{R_0}$. | $\mathbf{E_0}$ = classical potential energy at the distance $\mathbf{R_0}$. = ∞
**n** = energy-units between **R** and $\mathbf{R_0}$ = $E_{pot}$ | $\mathbf{E_{pot}}$ = potential energy at R (at R it is less then it is at $R_0 = \infty$)

This can be compared with the **Energy Conserving Gravitation Law (Equ.1.6,** but note: $\mathbf{m = m_0}$ if $\mathbf{R_0 = \infty}$**):**

**(2)** $\mathbf{m = m_0 e^{-a/R}}$, hence it must be $\mathbf{n = m}$, $\mathbf{n_0 = m_0}$. For $a = GM/c^2$ and $\mathbf{E_{pot/classical} = GMm/R}$ we get

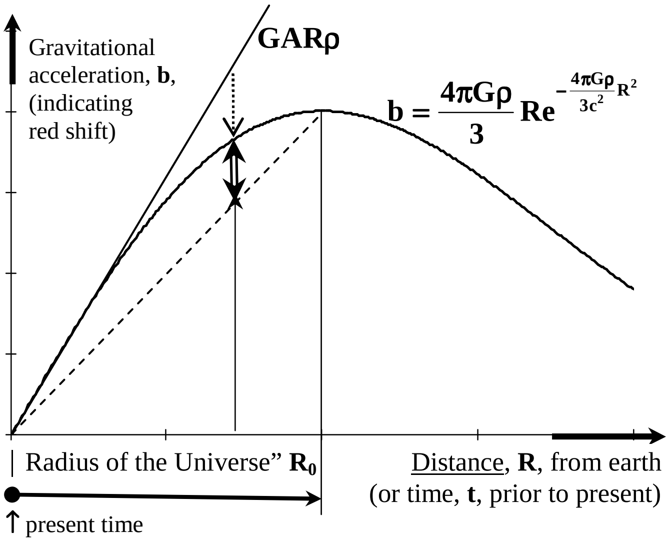
for the Exponent $-\dfrac{\mathbf{a}}{\mathbf{R}} = -\dfrac{\mathbf{GM}}{\mathbf{c^2R}} = -\dfrac{\mathbf{GMm}}{\mathbf{R\,mc^2}} = -\dfrac{\mathbf{E_{pot(classical)}}}{\mathbf{E}}$ . Multiplying Equ.(2) by $c^2$, $\mathbf{mc^2 = m_0c^2\, e^{-a/R}}$, and if we insert $\mathbf{mc^2 = E_{pot}}$ and $\mathbf{m_0c^2 = E_0}$, we get Equ.(1)

**(3)** $\mathbf{E = E_0 e^{-E_{pot(classical)}/E}}$ The other way: Multiplying $\mathbf{n_0}$ and **n** in Equ.(1) by a unit of mass (or energy) produces Equ..(2) resp. (3). Boltzmann used as unit of mass the energy of a monatomic molecule. Equ.(2) and (3) show, how a mass $\mathbf{m_0}$ resp. its energy $\mathbf{E_0}$ transforms into **m** resp. **E** when subjected to a central force. The transformation is possible in two ways: [**A**] by changing the number of molecules from $\mathbf{n_0}$ to **n**, or [**B**] by changing the inner energy of each molecule in such a way that the equation is obyed. When Boltzmann explained this equation in the theory of heat he expressed the masses by the number of monatomic muleculs, that is: not in Newtons gravitational mass units. So in this visionary view the equivalence of mass and energy has been anticipated – for the first time and implicitly, long before the Special Relativity Theory was known. So in Boltzmanns vision a mass can change either by changing the number of molcules or by changing its intrinsical value.

If the number of atoms of a body is constant, e.g. if the body is a planet, then only its mass can change: It changes with the distance to the central mass. This shows once more Boltzmann's visionary view. Had he discovered the relativity principle if he had lived longer? I remember a word from him: "It is almost regrettable that we must die before the next great discoveries of science are made." He just had to wait with dying a few years.

In any case Boltzmann's Law, together with Maxwells Equations, could lead, in principle, to Special Relativity, because these equation are already relativistic.

**Fig. 14.3** **Gravitational acceleration at a distance, R, from our viewing point, the earth.**




Equ.**(3.56)** on **P. 37** expresses the **gravitational acceleration**, **b**, upon a galaxy at the distance **R**. The acceleration b is caused by all the masses within (or less) the distances **R**:

$$\mathbf{b} = \frac{\mathbf{GM}}{\mathbf{R}^2}\mathbf{e}^{-\mathbf{a/R}} = \mathbf{GAR\rho e}^{-\frac{G}{c^2}\mathbf{AR^2\rho}}.$$

$A = 4\pi/3$ $\quad$ $[\mathbf{M = 4R^3\pi\rho/3}]$

$\rho$ = density of the universe

G = gravitational constant

$a = GM/c^2 = 4\pi G\, R^3\rho/3c^2$

Initially, the gravitation increases almost linearly with **R** along the **straight line** = **GARρ** until approx. $\mathbf{R_0/3}$, because at such "small" distances, the factor $\mathbf{e^{-a/R}}$ is close to 1. If, however, the light sources are more distant than $\mathbf{R_0/3}$, then the gravitational acceleration, **b**, is less (by the value of the **dotted arrow**, ⇣ ) than it would be if it followed the straight line **GARρ.**

The **red shift** of fossil light is a function of **b**: On the left of $R_0$ it is less when **b** is less. Advocates of the Big-Bang hypothesis interpret the red shift as an effect of expansion of the universe. If this interpretation were correct and if we were to observe a light source having a distance **R** (less than $\mathbf{R_0}$) and if **b** remains *proportional* to **R** – then, if we go from $\mathbf{R_0}$ to **R** – the acceleration, **b,** would decrease along the **dashed line** (which expresses a *linear* decrease of **R** relative to $\mathbf{R_0}$, this is the graph of the function of *constant* expansion). However, the *actual* (measured) value of **b** at $\mathbf{R < R_0}$ exceeds the linear function by the **double arrow**⇕. This means: **b** is not a *linear* function of **R**. The same applies to the **red shift**: it is too large for all objects of less age at distances $\mathbf{R < R_0}$. This excessive red shift at distances less than $\mathbf{R_0}$ has been *misinterpreted* as an effect of an *increasing* expansion velocity of the universe.

So we have to conclude that these measurements do not confirm an increasing velocity of expansion of the universe, but – as a consequence of Energy-Conserving Gravitation – they just reveal the *non-linear* characteristic of the gravitational acceleration, **b**, when the distance, **R**, changes, as shown in the graph above.

On the other hand: If **R** exceeds the so-called "radius of the universe", $\mathbf{R > R_0}$, then **b** will no longer increase, it would decrease when the distance increases (right branch of the curve). The acceleration decreases until it asmptotically approaches zero in spite of the fact that the number of cosmic objects may increase limitlessly.

This solves an old problem called "**Olbers' Paradox**", stated by Heinrich W. Olbers in 1826, but also realized long before by Johannes Kepler and others: **Why is the sky dark at night?** The common answer runs as follows:

By each increase of the distance, **dR**, the *number* of light-emitting sources in the sky per unit of area inside a solid angle, **Ω,** increases exactly as much as the energy of radiation decreases. Hence, in an unlimited space, each area should be bright – but it is dark! Why? The problem seemed to be solved by the **assumption of a Big Bang**, because, due to the limited age of the universe, the number of light-emitting sources is also limited and cannot be added infinitely: *If we could look far enough into the past, we would see remote region where no stars exist.*

**Energy-Conservation Gravitation** solves Olbers' paradox simply by the fact that at very large distances, the gravitational effect of Equ.3.56 (as shown by the red shift of the emitted light) asymptotically approaches zero (right branch of the curve). (There the factor $1/R^2$ in Equ.3.56 is intensified by $e^{-a/R}$.)

*The "**Radius of the Universe**" is defined in the same way as we define, for instance, the "Radius of the Sun" or other gaseous stars, that is by that "distance from the center of gravitation where the gravitation has its maximum". However if we define a sphere within the universe by this distance then this does not mean that we consider the universe to be a sphere with this radius, because for the universe no surface exist.

# 15. Gravitation Within a Mass, $M_o$

**(a) <u>Given</u>:** Equ.(1.5) $\mathbf{f(R) = e^{-a/R}}$, where $\mathbf{a = GM/c^2}$, Equ.(1.6) $\mathbf{E_{pot} = E_{grav} = (M + me^{-a/R})c^2}$.

$\mathbf{E_{total} = E_{grav} + E_{kin} + E_{neutral} =}$ **constant** ($\mathbf{E_{neutral}}$ is the inner energy of the gravitationally <u>in</u>active shell.)

**<u>Outside</u>** the central mass, $\mathbf{M_o}$ (radius $\mathbf{R_o}$), no mass exists, hence $\mathbf{E_{neutral} = 0.}$

If a mass, **m**, falls from $\mathbf{R = \infty}$ to the surface of the central mass, $\mathbf{M_o}$, then **m** decreases by exactly the mass equivalent of the emerging kinetic energy (which can dissipate into the environment). The remaining potential energy is $\mathbf{mc^2e^{-a/R}}$. The quantity **a** (= $\mathbf{GM/c^2}$) is constant only outside $\mathbf{M_o}$ (there, $\mathbf{M = M_o}$ is a constant).

**<u>Within</u>** $\mathbf{M_o}$ only that part of **M** is gravitationally active which is within the **radius** $\mathbf{R < R_o}$, (hence $\mathbf{E_{neutral} > 0}$).

We define $\mathbf{A = 4\pi\rho/3}$. $\mathbf{M = 4R^3\pi\rho/3 = AR^3}$ and $\mathbf{a/R = GM/Rc^2 = G4R^2\pi\rho/3c^2 = GAR^2/c^2}$. We get

**(b)** $\mathbf{E_{grav} = (M + me^{-a/R})c^2 = c^2AR^3 + mc^2e^{-GAR^2/c^2}}$, from that, because **M** is within $\mathbf{M_o}$, we obtain

**(c)** $\mathbf{\dfrac{dE_{grav}}{dR} = 3c^2AR^2 - 2GAm\,Re^{-GAR^2/c^2}}$ = <u>change</u> of $\mathbf{E_{pot}}$ due to change of **R**, or expressed by **M** (< $\mathbf{M_o}$):

$$\mathbf{\frac{dE_{grav}}{dR} = \frac{3c^2M}{R} - \underline{\frac{2GMm}{R^2}e^{-GM/Rc^2}} = P - 2K > 0}$$ [Symbol $\mathbf{P = d(c^2AR^3)/dR}$].

**P** = symbol for the first term = **surface** of the central mass × $\mathbf{\rho \times c^2}$ [**dR** = thickness of the surface layer], hence **PdR** = **surface** × **dR** × $\mathbf{\rho}$ × $\mathbf{c^2}$ = mass of the surface layer × $\mathbf{c^2}$. The <u>underlined</u> term is twice the negative gravitational force, $\mathbf{-2K = 2GMme^{-a/R}/R^2}$, at the distance **R**. The negative sign indicates that –**2K** is directed away from **m**, this means: lifting by the distance **dR** effects not only **m,** it also moves the spherical layer **PdR** away from **m** (since this layer must remain concentric to **M)**. (The negative sign of this term is the original negative sign of the exponent.)

Generally a mass increases if we we apply a force to it, hence we may expect that the falling test mass **m** ***<u>in</u>****creases* (it should be raised to the energy equivalent to force times distance). However Equ.**(c)** shows that **m** is ***<u>de</u>****creased* by the factor $\mathbf{e^{-a/R}}$ , why? Because it moves opposite to the force. The force **K** can only compensate half of the negative force, **–2K** (–2K is directed away from **m)**. This can be recognized if we multiply **Equ.(c)** (expressing forces) by **dR**. We obtain the energy for shifting along the path **dR**:

**(d)** $$\mathbf{dE_{grav} = \frac{3c^2M}{R}dR - 2\frac{GMm}{R^2}e^{-GM/Rc^2}dR}$$ (Therein $\mathbf{K = \dfrac{GMm}{R^2}e^{-GM/Rc^2}}$ = gravitational force.)

Although the first term, $\mathbf{3c^2M/R}$, (abbreviated called = **P**), has the dimension of a force, but **PdR** it is not a force. It is the <u>energy</u> equivalence of the surface layer. It is added to the central mass, **M,** when this layer is lifted by its thickness, **dR**, away from the center (and also away from **m**!).

This energy is, as mentioned above, = **surface** × **dR** × $\mathbf{\rho}$ × $\mathbf{c^2}$.

The second term shows: lifting by **dR** produces a *negative* force **–2K**. This corresponds to an energy *decrease* by **–2KdR**. In other words: If (within $\mathbf{M_o}$) the radius **R** of the gravitationally active sphere, **M,** were constant, then the energy required to lift **m** would have to be applied against a *constant* gravitational force, **K**, and would be +**KdR**. However, within $\mathbf{M_o}$, the radius **R** of **M** *<u>in</u>creases* by **dR**, thereby consuming the energy –**2KdR**. The sum is –**2KdR+KdR** = –**KdR**. Hence the energy **+KdR** inserted cannot compensate the whole of –**2KdR**. The remaining potential energy is still reduced by **–KdR**. We must conclude:

If we lift a mass, **m**, in the upward direction, this is from the center to the surface, then along each (positive) increment **dR** its intrinsic energy, $\mathbf{mc^2}$, <u>de</u>creases by **–KdR** because the applied energy is <u>added to the mass</u>, **m**. This, however, is only half of the energy, $\mathbf{-2(GMm/R^2)\cdot e^{-GAR^2/c^2}}$ **dR,** which, at the distance **R**, was consumed for lifting the surface layer of the central mass by the increment **dR**.

This is true until the surface of $\mathbf{M_o}$ is reached. There, the mass $\mathbf{me^{-GAR^2/c^2}}$ reaches its lowest value because, if the lifting is continued *outside* the central mass, the effect of the negative exponent is not counteracted by the energy required to build up the central mass (the first term, **PdR**). Only at infinite distance (∞) (or when **R** = **0**), does the mass (and with it its energy equivalent) reach its original value, $\mathbf{mc^2}$.

For $\mathbf{R < R_o}$ we can summarize:

If the potential energy of the gravitationally active system is $\mathbf{E_{grav}}$, and if a test mass is lifted by **dR**, then the energy for lifting, **+KdR**, must be added to $\mathbf{dE_{grav} = (P–2K)dR}$**,** Equ.(c).

The resulting energy change is **–2KdR+KdR = –KdR**. Though the energy **KdR** has been added, the sum remains negative. That means: For any radius $\mathbf{R < R_o}$ the potential energy appears decreased by **–KdR**.

We can consider this the other way round: At the start in the center, the energy was $\mathbf{mc^2}$, at the distance **R** it is decreased to $\mathbf{mc^2} - \int \mathbf{KdR}$. This corresponds to a fall, however from center toward the surface. The factor for decrease at the distance **R** is $-\mathbf{e^{-a/R}}$.

Although energy must be applied for lifting against the gravitational force,
this is (force × distance) $= \mathbf{(GMm/R^2)\cdot e^{-GAR^2/c^2}\ dR}$,
it is only half of the energy decrease of $-\mathbf{2(GMm/R^2)\cdot e^{-GAR^2/c^2}\ dR}$ of Equ.(d).
It remains $-\mathbf{(GMm/R^2)\cdot e^{-GAR^2/c^2}}$. The mass decrease is a function of **R**.

## Next let us consider the change of the time scale:

The less the mass, **m**, of an atom, the less – by the same factor – are all its quantified energy levels and their differences.
According to Special Relativity, these frequencies are ideal clock frequencies because they define the course of time. This means:
By approaching a gravitational center, the falling mass and the course of time decrease by the same factor. Time proceeds slowest at the surface of the central mass.

### This can be tested:

The condition that the mass falls from *outside* toward a central mass, **M**, has been measured by Pound & Rebka (1960) (see Page **3**, Chapt.**1.2**, **The Gravitational Doppler Effect**). The measurement has confirmed the factor $\mathbf{(1+\Delta\varphi/c^2)}$ by which the course of time decreases when the potential $\boldsymbol{\varphi}$ increases.

However, if the falling mass is inside the central mass (e.g. within the earth, for instance **in a pit, a tunnel or a submarine**), then the measurement will confirm that the course of time **in**creases when the distance to the center **de**creases. In the center it must be the same as it was at infinite distance, that is $\mathbf{t_o/(1+\Delta\varphi/c^2)}$ (note: relative to the surface of the earth where we have defined the designations: the interval $\mathbf{t_o}$ and the potential $\boldsymbol{\varphi}$). $\boldsymbol{\Delta\varphi}$ is the increase of the potential relative to the earth. In order to avoid unjustified critique, the test should be made at a great distance from inhomogeneous densities of the earth – in an ocean or within a great continental plain. Would a tunnel also be an adequate location?

The formula $\mathbf{K = \dfrac{GMm}{R^2} e^{GM/Rc^2}}$ in Equ.**(c)** or **(d)** has already been used when calculating the diameter of the universe. Dividing **K** by **m** yields the gravitational acceleration **b** at the distance **R** from the center of the mass, **M**. In Chapt.**(3.10)** that formula has been applied to the mass, **M** (which is within a gigantic sphere around us in the universe) when **M** is expressed by its volume multiplied by the density, **ρ**, that is $\mathbf{M = 4R^3\pi\rho/3}$. The result is the gravitational acceleration as function of the distance, **R,** shown by the diagram on **Page 84**, always relative to an observer in the center (that is **R** = 0):

$$\mathbf{b = \frac{4\pi G\rho}{3} R e^{-\frac{4\pi G\rho}{3c^2} R^2}}\ .$$

For $\mathbf{R < R_S/3}$ the curve is almost linear because there the exponent is ≈ 0, $e^{-\text{exponent}} = 1$ ($R_S$ is the Schwarzschild radius).

When R increases, then, beginning at about $R > R_S/3$, the steepness of the curve decreases until it reaches a maximum at $2R_S$. The distance to that maximum can be defined as the "Radius of the universe". Of course, this is no edge of the universe, there is no change of the mean density of the universe.

# 16 Relativistic Dynamics

In General Relativity, the concept of “force” as a basic quantity, has sometimes been abandoned. However, most physicists are still thinking in terms of force, are speaking of the “fundamental forces of nature” and that the gravitational force belongs to the most fundamental ones. Because the concept of “force” can easily be imagined as “weight” or as “tractive force”, or “compressive force”, it seemed logical to use it when explaining the three principles of Newton:

☀ “**inertia**”, ☀ “**actio = reactio**”, and ☀ “**gravitation**”.

These principles can also be formulated as following:

1. A body moves *uniformly* and *rectilinearly* (or on a *geodetic line)* if no external **force** is applied, that means, masses are “inert”.
2. Any *change* of movement is proportional (a) to the force acting upon it and (b) to a characteristic quantity for each body, designated by Newton as “inertial mass”.
3. Any two **masses** attract mutually by a force which is proportional to each mass and the square of their reciprocal distance (“gravitational mass”).

However, some skepticism remains: the “reality” might be missed by such a mere axiomatic “explanation”, especially in the case of mass attraction where the gravitational force acts over a distance, that is, without a material bridge in empty space. Moreover, by the same principle, the condition “actio” = “reactio” must be met. The General Theory of Relativity tries to answer such skepticism by the principle of the "proximity theory" and with the assumption that space is curved.

Without engaging myself in a controversy, I will just mention a remarkable possibility: With Energy-conserving Gravitation, a completely different view of physics can be imagined where neither Newton’s dynamics nor Einstein’s idea of curved space must be defined. Instead of postulating the axiom of inertia – that is, that the movement of a mass can change only by applying an external force to it – the opposite can be assumed as well. Then, a mass *itself* decides about its own movement. In other words: The mass may behave like a migratory bird which does not fly from Europe to Africa due to an “attractive force of Africa” or due to “curvature of space”, but because of the bird’s own decision to fly this route.

If a mass is inside a “field” which has only one function, namely to inform the other masses about its existence, this is about its location and its amount, then Newton’s principles could be replaced by a different principle, stating that “each mass tries to unite with other masses”. Without assuming a force which counteracts a hypothetical inertia of the mass, the mass itself accelerates in *that* direction in which it can most effectively unite with other masses. In this case, no attractive “force” acting from outside compels the mass to move, inertia must not and does not exist.

If a mass enters a “field” of another mass and the field has only the function to provide the entering mass with information about its existence, its location and its amount, then Newton’s principles could be replaced by a different principle, stating that “each mass inherently tends to unite with other masses”. Without assuming a force which counteracts an hypothetical inertia of the mass, the mass itself accelerates in *that* direction which allows it to unite with the other mass most effectively. In this case, no attractive “force” acting from outside compels the mass to move, inertia does not exist.

To be sure: It is not my intention to disprove any of the common theories, especially not those of Einstein or Newton. I have no new theory to proclaim, I just want to draw your attention to how questionable our knowledge is, especially when it seems to be self-evident. Sometimes, the self-evident is a habit-forming drug. Because we are used to and even familiar with Newton’s marvellous dynamics, we may be led astray if we are not aware that mass might display the same behavior even if it had no inertia. If this were true, its behavior would have to be correlated to another axiom, that is, one defining the inherent tendency of a mass to unite with other masses.

In other words: We don’t know why nature “moves” at all. If we wish to uncover her secret – a secret which our mind can understand – then first we must also consider other possibilities which up to now have been excluded too hastily because they were “unthinkable”.

Perhaps we find new worlds when we realize that our thoughts must not habitually stick in the same groove. We have seen that the law of inertia follows from Energy-conserving Gravitation. If *every* movement can be explained by Energy-conserving Gravitation, then it is possible that “inertia” and “gravitation” are the same phenomenon, or even more, that Dynamics constitute an intrinsic part of gravitation.

# 17 Orbital Velocity, v, in Galactic Disks

It may be expected that the orbits of the stars in the spiral galaxies obey Kepler's Laws. Hence the orbital velocities of the stars should be the less the farther away they are from the center. The center is the nucleous mass, $\mathbf{M_z}$, plus the sum $\mathbf{M}$ of the disk stars: $\mathbf{M_z + M}$, within the distance $\mathbf{R}$. The attractive force of each mass $\mathbf{m}$ is

$$\mathbf{K = \frac{G(M_Z + M)m}{R^2}},$$ $\mathbf{R}$ = distance from center (less than the outer radius of the disk = $\mathbf{R_0}$).

For simplification we can think the mass $\mathbf{M_z}$ to be included in $\mathbf{M}$ and that the orbit of each star is a circle.
If the orbital radius $\mathbf{R}$ is less than the radius of the disk, $\mathbf{R_0}$, ($\mathbf{R \le R_0}$), then the central mass consists only of stars within the radius $\mathbf{R}$. Stars between $\mathbf{R}$ and $\mathbf{R_0}$ belong to the outer environment of the orbit, hence they have no effect on the attractive force and the orbital velocity (explained on the pages **1+2**, **Fig. 1.1**).

Centrifugal force ($\mathbf{mv^2/R}$) and gravitational force ($\mathbf{K = GMm/R^2}$) are in balance. If the masses, $\mathbf{M}$, within $\mathbf{R}$ are constant then the orbital velocity should be the less the greater the distance to the center. The actual measurement however is in contrast to this calculation: up from a certain distance, $\mathbf{R_X}$, the orbital velocity is approximately *constant*.

This is explainable only if we assume that the orbits of the outer stars are not in an empty space but within the masses of the galactic disk at large distances. The space in the disc is the domain of stars. Their distances are so great that the stars can move without colliding. Outside the disc the matter is also extreme thinned. It is composed of nebula, remnants of exploded stars, material which has been ejected from galactic centers, radiated particles and light. The masses inside a planetary orbit constitute (for this orbit) the central mass, $\mathbf{M}$.

The farther away a star is from the center the greater is (for this star) the central mass, which constitute the balancing force against the opposing centrifugal force. We can ask: At which distribution or density $\rho$ of matter becomes the measured orbital velocity independent of the distance from center?

We have assumed that the mass of the nucleous, $\mathbf{M_z}$, is included in the mass of the disk, $\mathbf{M = 4R^3\pi\rho/3.}$

Centrifugal force, $\mathbf{mv^2/R,}$ and gravitational force, $\mathbf{K = GMm/R^2}$, are in balance:

**(17.1)** $$\mathbf{\frac{mv^2}{R} = \frac{GMm}{R^2} = \frac{4\pi G}{3} R\rho m,} \quad \text{from that} \quad \mathbf{v^2 = \frac{4\pi G}{3} R^2\rho}.$$ The following has been measured:

Up from a distance $\mathbf{R_X}$ remains $\mathbf{v}$ constant, hence the derivation of $\mathbf{v}$ with respect to $\mathbf{R}$ must be zero: d$\mathbf{v}$/d$\mathbf{R}$ = 0:

$$\mathbf{2v\frac{dv}{dR} = \frac{4\pi G}{3}\left(2R\rho + R^2\frac{d\rho}{dR}\right) = 0}, \quad \text{hence} \quad \mathbf{2p + R\frac{d\rho}{dR} = 0,} \quad \mathbf{or} \quad \mathbf{\frac{d\rho/dR}{\rho} = -\frac{2}{R}};$$

**(17.2)** $$\rho = \rho_X \frac{\mathbf{R_X^2}}{\mathbf{R^2}}$$ is the solution of this equation for integration up from $\mathbf{R_X}$.

If we expand the fraction by $\mathbf{\pi d/\pi d}$ (or $\mathbf{4\pi d/4\pi d}$) then we see: up from $\mathbf{R_X}$ the mass of each layer of the surface of same thickness $\mathbf{d}$ has always the same value: $\mathbf{\rho R^2\pi d = \rho_X R_X^2 \pi d}$. ($\mathbf{R_X}$ = distance from the galactic center)

The formula says: Because the orbital velocity has been measured being constant for distances greater than $\mathbf{R_X}$, the density, $\rho$, decreases for $\mathbf{R} > \mathbf{R_X}$ invers to each spherical surface $\mathbf{R^2\pi}$.

According to this formula we can conclude: There exists a gigantic, but constant stream of matter whose density, $\rho$, is the less the greater the distance. The density decreases with the square of the distance.

Goes this stream (like the heat of a hot body) outwards into the space? No, due to gravitation this is a stream of masses falling into the galaxis. This means: The matter, which, aeons ago in the past, has been ejected by galaxies will now "feed" other galaxies thereby constituting the material for new generations of stars.

This will be true also when the masses are not distributed in a spherical symmetry or when additional relativistic effects are present. Such an effect is the gravitation of the kinetice energy due to orbital velocities of stars at small distances. For instance stars moving parallel will be attracted slightly by the gravitational force of the mass equivalent of its *kinetic* energy (see **Page 24**). So the gravitation between parallel moving masses (stars) causes a concentration in the plane of a disc (and an increase of gravitation in the direction to the center).

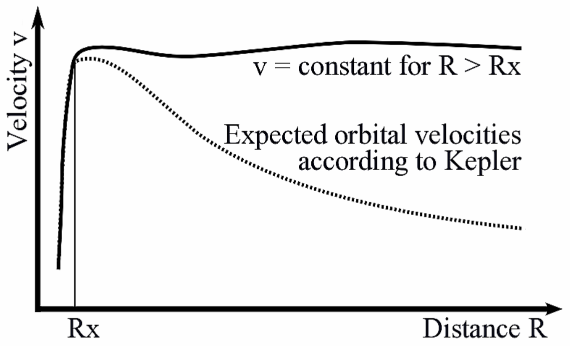
The orbits of circulating stars in the galactic disk approach slowly the center due to the decrease of momentum when its kinetic energy decreases by mutual interaction with other masses and by radiation.

Though the density of matter in the enormous galactic space is extremely thin, its sum is gigantic, and it is **dark**.

However this has nothing to do with the much greater "**Dark Matter**" which has been postulated in the Big-Bang hypothese in order to explain the decrease of the universal expansion. Their mutual gravitation has often been assumed to converge at least to zero or it should explain Hubble's red shift of distant galaxies. However Hubble has not observed a "red shift of distant galaxies", because the galaxies seen from the earth have emitted this light far in the past, millions or milliards of years ago, hence it cannot indicate an expansion of today. As pointed out in this essay no expansion is possible und the assumed dark matter does not exist.

## Diagram of the Orbital Velocity v of the Stars in Galaxies

The diagram shows the measured orbital velocities of stars and, dotted, the same velocities calculated on the assumption that the central mass is concentrated in the galactic nucleus. The measurements are most reliable if we look into the rim of the galaxtic disk. Surprisingly, up from a certain distance, $\mathbf{R_X}$, from the center the orbital velocity remains almost constant when **R** is increasing. As shown in the preceding page this could be explained by an input stream of gravitational matter from the environment when the inflow of matter, summarized over the whole surface, is constant (similar a water flow into the sink of a bath-tub). Such an input stream of mass from the intergalactic space has its counterpart in the fountain ejected by many galaxis from their centers into the interglactic space. Then Fred Hoyle's idea of creation of new matter could reach an unexpected new meaning: It must not be a "creation of new matter", it may be explained as recycling the ejected matter of stars. If this is true then each galaxy acts like a gigantic vacuum cleaner within very thinned clowds of kosmic dust and gas. Each galaxy is acting by its gravitation, its suction pipe is its surface, where the matter streames into the galaxies. The total flow is the same (constant) in each distance from the galactic center, as calculated on the preceding page.




# 18 Dark Mass (resp. Energy) in the Universe

According to this diagram and its calculation a Galaxy behaves like a vacuum cleaner in the intergalactic space. However instead by suction it acts by gravitation. Its force attracts an extremely thinned cloud of dust and gas. If we think the galaxy enclosed by spherical surfaces, then the same material stream (falls) through each of these concentric spheres towards the galactic center, calculated above.

Each galaxis is enveloped by a halo of masses, which – long ago in the past – have been ejected from the centers of other galaxies. Due to the attractive force of the galaxis the density of the cloud increases when approaching the galaxis, beginning from almost zero in the intergalactic space until it reaches the densitiy of the galaxy at $\mathbf{R_X}$. At that distance the masses begins collapsing into radiating stars which are moving on orbits around the glactic center. But at the same time these orbital movements are very slowly retarded by a small amount of friction due to mutual interaction of the stars, e.g. by tidal effects and radiation. Though the decrease of the orbital velocities is very small, it leads to a decrease of the distance to the center. With the distance the gravitational force become less, because masses outrun by the falling masses have no longer a gravitational effect upon it. The masses of this halo are dark and they are added to the galactic mass, hence the total mass of a galaxy is much greater than the sum of the visible stars, which are inside $\mathbf{R_X}$.

With other words: Because the visible components of each galactic disk constitute only a fraction of its total mass, the density of the remaining intergalactic space is almost zero and consequently it is transparent for light and other waves. If in a cosmological theory the density of the universe would be assumed to be the same as it was at $\mathbf{R_X}$ then its sum would amount to be far greater then it actually is.

The decrease of the orbital velocity of the stars in the galactic disk has the effect that the centrifugal forces upon them also decrease and with it their distances to the center. Ultimately they fall into the center and from there they are ejected along the galaxtic axis seen as impressive fountains into the intergalactic space.

Prior to a research of the structur of the universe its invariable fundamental parameters must be determined, otherwise hypotheses about expansion of the universe or the escape velocity of its masses makes no sense. In any case the conservation priciples for energy and others must be included and the Law of Gravitation must be adapted to the Special Relativity Theory.

Some gifted Cosmologists have constructed genial models for the universe, but if there very impressive work invested in many years of their life should not be for nothing then the same Cosmologist are now challenged to eliminate some cardinal errors in their models. These errors are arising from the mistake that the red shift of the light of distant galaxies would be an effect of a recession velocity of the space. This light However has been emitted many millions years ago and cannot tell anything about the *present* movement of these galaxis. This fundmental mistake must be replaced by a model where the Energy Conservation Law is restored, even if this requires to repeat most of the former calculations of the cosmological models.

# 18 Big Bang on Test

In 1929, Edwin Hubble discovered that the spectral lines of distant galaxies are red-shifted – proportional to their distances. At first, the red shift was interpreted as Doppler shift due to an assumed escape velocity of remote galaxies. Since that time, the universe has been thought to be expanding though Hubble himself never beliefed on expansion. The observed proportionality between red shift and distance was expressed by the **Hubble Constant, H**. Moreover he universe has been assumed to be **homogeneous** and **isotropic**, this means that there is no special point or direction the universe could emerge (or fall), and if it expands then, due to **isotropy,** in any direction *simultaneously* by the same rate per unit of time. An expanding universe must begin with a start, which Fred Hoyle ironically called **“Big Bang”**. Based on this assumptions, **1/H** should be proportional to the age of the universe. From this assumption the age was calculated to be between 12.5 and 20 billion years. *However – is expansion a confirmed knowledge?*

**What did Hubble really measure?** Clearly, Hubble measured the red shift of distant galaxies. However he warned against accepting “expansion” as the only possible explanation for the red shift.

Due to the mutual gravitation of all its masses, the universe should not expand but *contract*. If it contracts, then the present distances of all its masses would be less relative to the distances they had when their light was emitted. Obviously, this is inconsistent with the Big Bang hypothesis.

If the Big Bang is assumed to be the cause of the red shift, then we must assume that the universe is expanding because, in an expanding space, the wavelength of light should become lengthened, and this is inconsistent with contraction. Many cosmologists are convinced of the Big Bang and that the universe must be the outcome of an expanding “primordial soup”. This horrible soup must have started from an extremely dense primordial point. Up from there space and also the mass of the whole universe should continually “explode”, may be in steps of different speeds. According to some very shrewd cosmologists, "this soup had adjusted itself", with a few knobs, that is adjusting their own natural laws (inclusive the time) in such a way that the mess will run forever. At this point of the story I dare to interfere with an infuriating surprise:

**In reality, Hubble discovered that the universe is not expanding, and there was no Big Bang!**

Fact is only the *conviction* of cosmologists that the observed red shift of remote galaxies is a compelling evidence for expansion of the universe. What did Hubble actually observe? He saw that the light of remote galaxies is red-shifted. This is not evidence of expansion because it only indicates that, the fossil light had been *emitted* with that red shift millions or billions of years ago, relative to present galaxies. Hence the light observed by Hubble is only a witness of what happens long ago – **T years** prior to present.

However, if we look at a source which had emitted its light **T/2 years** ago, then we see **half** of this red shift, and if the sources were **T/10** years in the past, then the red shift was **1/10** (relative to **T**). The less the elapsed time, the less is the red shift. This contradicts expansion, it must be correlated with contraction. Light emitted **today** is not red-shifted (if we neglect effects of local masses), regardless of the distance it had at the time of its emission.

If we believe that the universe is expanding (since the time of Big Bang), then we must expect that light will be seen red-shifted – either by a Doppler shift or due to expansion of space. If we believe in expansion, we must conclude (and could even calculate) that the universe is emerging from a Big Bang (although it is not possible to deduce, from this assumption, its mass and its velocity). At least we must recognize that we have ignored the most-important fact that we cannot see the light a distant galaxy is emitting *today*. Since it takes millions of years to reach us, the light can only tell us the past – *and that the measured red shift is proportional to the time elapsed since the light was emitted*.

Of course, expansion of the universe can be disproved only by presenting scientific arguments and by interpreting it correctly – especially the red shift measured by Hubble. However, many editors of astronomical journals refuse to do this. Convinced that their interpretation cannot be a mistake, they insist that the red shift can only be an effect of expansion. Reports in which **the red shift is proved to be an effect of the universe’s contraction** have almost no chance of being published. The editors do not even tolerate a hint that the red-shifted galaxies we see are not identical with the galaxies as they are today (which cannot be seen).

Hence, the red shift of remote galaxies does *not* confirm the expansion of the universe; on the contrary, it confirms that it is contracting! Only uncritical editors and authors insist on the wrong interpretation. Here are the proofs:

**(Proof 1)** We see a remote galaxy with the red shift it had retained since the time when its light was emitted. For the sake of argument let us assume that it was emitted a billion years ago. We compare its spectrum with the spectrum of the same elements today. If the *red shift* is interpreted as *expansion* of the universe, then the farther back we look into the past, the larger the universe within this distance should be. However, time does not run backwards, it proceeds from an age of greater red shift to the present age, where it is less red shifted. Hence, the less time elapsed until the light reaches us, the less is the red shift, and it is zero when the transit time to the present is zero.

This however means: **the universe is contracting**, because, after the transit time the wavelength of light is less – it is the wavelength it had retained since the day when it was emitted. This was measured by Hubble.

**(<u>Proof 2</u>)** The same can be proved in another way if we start with the *opposite assumption*. What would be the result if – contrary to the Big Bang hypothesis – we *assume* that the **<u>universe is contracting</u>**, say by 10% every billion years. Let's assume <u>that 1 billion years ago</u>, a galaxy had emitted precisely that spectral frequency of the caesium atom which is used for calibrating the second. This light arrives us today *unchanged*, because – according to Special Relativity – **<u>for light</u>**, the time between emission and absorption is zero.

However, **<u>viewed by an observer</u>**, the *transit* time for this light wave may be one billion years. If in this time the *universe* has contracted by 10%, then the light wave appears *elongated* by 10% relative to the wave of the caesium atom <u>today</u> on earth. Therefore – in a *contracting* universe – light emitted in the past is seen **red-shifted.**

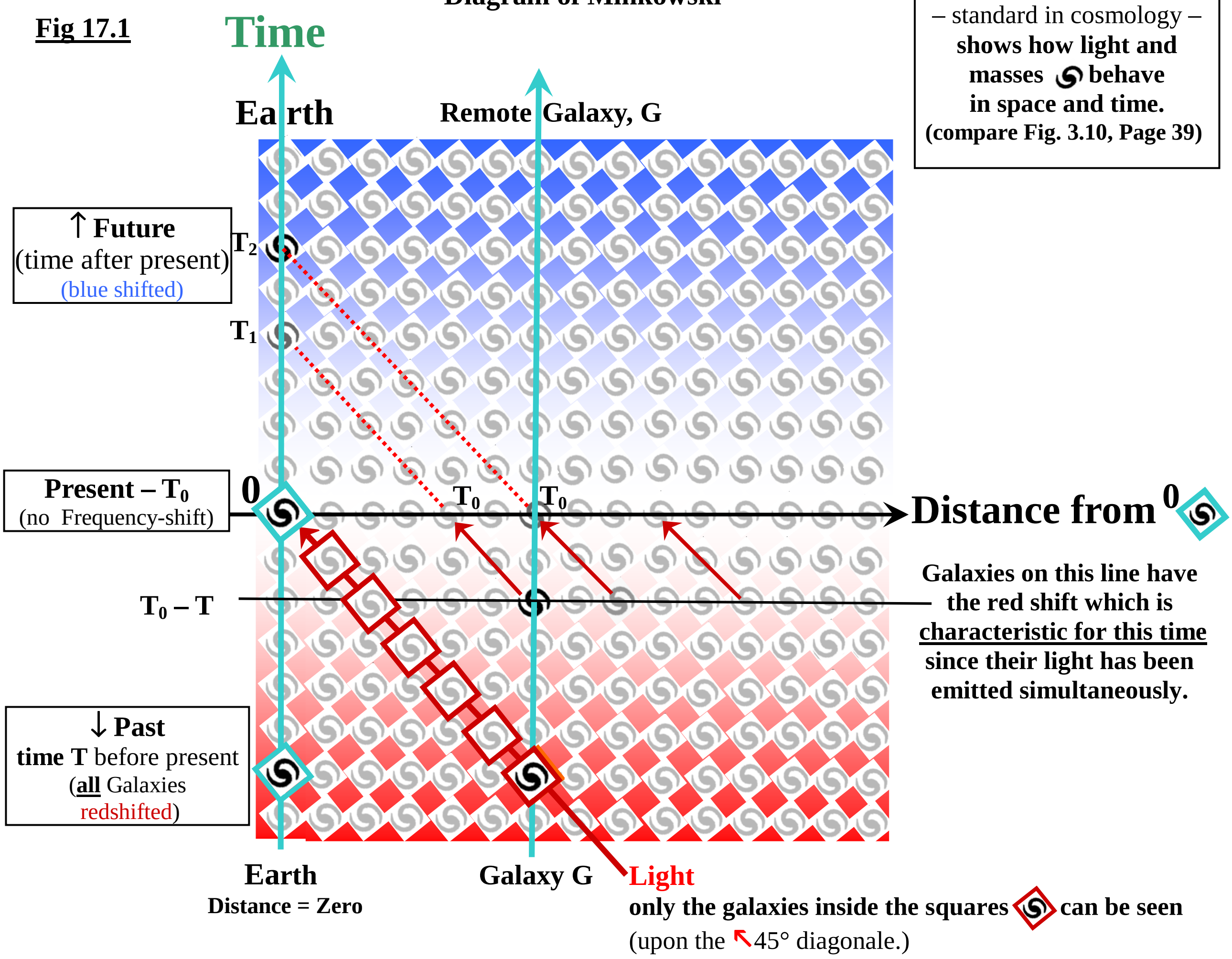
**Conclusion: The red shift indicates that the universe is <u>contracting</u>.**

Generations of physicists since 1929 have not been aware of this. Most astronomers of ancient times, even Archimedes, rejected the idea that the sun would be at rest. Their argument: This connot be questioned because everyone can *see* the sun circling around the earth. Just as it was difficult to prove that Archimedes was wrong, it is similarly difficult to convince some **physicists of today** (even if they are more gifted than Archimedes – for instance, editors of scientific journals), that the red shift of a distant galaxy indicates that the universe is *contracting*. How carefully does any "normal" person think about it when spontaneously affirming that the red shift cannot be an effect of contraction. Now we have proved what "most scientists" consider to be impossible.

## <u>Hubble's Measurement</u>

**Diagram of Minkowski**

**<u>Fig 17.1</u>**



**1.** Each point in the Minkowski-Diagram is defined by two coordinates: (1) **distance from the observer** (direction to right→), and (2) **time** relative to present (direction upwards↑). For an observer on **earth**, time and distance are zero (**0**). This is at the point 0. Distances and time are drawn in the same measuring units (e. g. billions of light years); hence, a light ray has a slope of 45°.

**2.** Each symbol, presents galaxies having same distance and velocity. This means each symbol stands for the characteristic **red shift** of a galaxy, **G ,** having those coordinates. Hubble found that the spectra of remote galaxies are the more red-shifted the farther these galaxies are **in the past** – of course, relative to the spectra measured on earth for the same chemical elements. This can be seen the other way round: The red shift is the less, the less the time is between the past and the present.

**3.** The measurable decrease of the red shift for a decrease of the time-distance means, there the light's wave length is smaller. This means **the universe is shrinking**. The widespread conclusion that the universe is expanding is wrong.

**4.** A **horizontal** line in the diagram represents galaxies at the same time, hence the symbols in that line represent the **same** red shift (regardless of distance!). This expresses Einstein's principle of "Isotropy of the Universe". It states: at the same time, *the same* physics apply at each point. In other words: No point is distinguishable from any other point. However, from all the galaxies in this line, we see only the spectra of those which are within the squares on the red diagonal because only the light of these galaxies has reached zero distance from us at the present time ($T_0$)

**5.** The present state of galaxies at the *right* of the red diagonal line can neither be seen nor measured. The state of galaxies *left* of this diagonal line could have been measured in the past, but this is not identical with their *present* state. We see only that light of a galaxies when it was emitted on the red diagonal line, because only this light reaches at present the point **0** where we are.

**6.** Although the universe is shrinking, in our (in its inhabitants) view it does not shrink because their measuring units shrink by the same factor (relativistic, that is, proportional). This is explained on Page 3.

*"Plausible" explanations are tempting. In this case, it is the highly plausible but incorrect interpretation of the red shift of distant galaxies, caused by an erroneous sign of the time vector. We may wonder why a error in sign could escape the attention of all physicists since 1929. The wrong sign has been used by many cosmologists in their theories, without critical questions. Have they not checked their theories?*

**Deriving the red shift of remote galaxies when using only confirmed theories.**

The more distant a galaxy, the greater is its red shift." – we find this statement in textbooks and in scientific journals – but this is true only if we understand "distance" as the *time*-distance which has elapsed since the light was emitted. This truth however is expressed in such a manner that the reader falls into the illusion that the red shift of a galaxy would depend on its *spatial* distance from us, whereas in reality, instead of being a function of **spatial** distance, the red shift is a function of the transit **time, T**, this is the time between emission and reception, regardless of the *spatial* distance *from us*. When we "see" a galaxy, we see the light which has been in transit for a time equal to the distance of that galaxy from us in lightyears. We see the light only because the spatial distance from the emitting galaxy and the transit time of the light for covering the distance from us, are equal. When this is not the case – when the spatial distance from the emitting galaxy and the transit time of the light to cover the distance are NOT equal – then we cannot see the light. *Spatial distance* and *transit time* should not be confused!

**Isotropy of the Universe** means that all galaxies (at any location) have the same red shift at a given time. Galaxies having identical state (red shift) at the same time are in the diagram in the same (horizontal) line, but we *see* only those which are on the red diagonal line. At time $\mathbf{T}_0$, the light of the other galaxies on that line will reach the heads of the small red arrows ↖ which do not coincide with the observer's location.

Up from the very moment a light ray is emitted, nothing can influence this light any more. Because no higher velocity than that of light is possible, no field can change the light's characteristic energy and frequency. Either the light will continue to be what it was at the start – forever – or it will cease to exist when the energy is absorbed by measurement. The ultimate reason that light is the most durable entity in the universe is the fact that **time** does not exist for light. Because the time between emission and receiving is zero, even the greatest distances in the universe is zero – for light.

After emitting a light ray the universe continues to contract. Its caesium atoms and the related wavelength also contract – due to isotropy, and this happens simultaneously at each point in the universe. If eventually the emitted light ray reaches a spectrometer, then its original (unshortened) wavelength will be compared with the shortened wavelength the caesium atom has today. Then the Big Bang fans announce to the world: We have proved the expansion of the universe because the light of the distant galaxy is red-shifted!

This can be expressed in a different way: The greater the time interval between emission and reception of the light of a galaxy, the more time had the universe to contract. Now, if we resume *scientific* research, we need a large wastebasket for many discarded theories.

**The shorter the time-distance of a galaxy from the present** (the time it takes for light from a distant object to reach us)**, the less is its light red-shifted**.

This is also assumed in the Big Bang hypothesis, but with a small difference: In the Big Bang hypothesis we are looking back in time, we look into the past. The farther we look back into the past of a galaxy – that means going in the reversed direction of time – the greater is its red shift. Due to ignoring this, many physicists have drawn a wrong conclusion: They assumed that the galaxies would recede from us. Precisely this is not the case: we see a galaxy in the state it had long ago, but this does not tell us whether its distance is increasing or decreasing in the present.

In the course of time, the red shift decreases until present – where it reaches zero. In contrast to the Big Bang hypothesis, time can not run in the reverse direction as in a film running backward. The galaxis always proceeds into the future. In a hypothetical voyage into the past, the time-distance from the present increases, but this can only be understood the other way round, that is, in the direction in which time actually passes. Then, the time-distance *to the present* decreases – the universe is contracting. Based on this observed and measured contraction, the crucial argument in favor of the Big Bang hypothesis is incorrect.

Why have most physicists not realized that they have inverted the direction of time in their theories? Why is there no dialog on this at universities? Science is impossible if in all institutions and relevant journals critical voices to the Big Bang hypothesis are excluded from the dialog. The advocates of Big Bang try to justify this censorship by referring to an anonymous "majority of astronomers" who had *somewhere* disproved all the critics. Have you ever seen where *somewhere* is or have you ever seen a paper in which, for instance, the inversion of time has even been discussed? This censorship is called Peer Review!

All this reminds me of Andersen's fairy tale in which a majority of simpletons pretend to see the "invisible" – non-existent – clothes of the naked emperor. In which hole will the censors hide when an innocent child unmasks them with the simple remark: "But we are not going back into the past".

Some theoretical physicists have developed extremely "demanding" mathematical models of the universe based on an expanding universe. However, because they have not noticed the inherent error relating to the sign for 'time' in their theories (concerning the red shift discovered by Hubble in 1929), we must ask how much credit we should give their incomprehensible models of the universe. The erroneous sign in time may not be their only mistake. Many – if not all of these models – may contain many similar errors which haven't been noticed.

We never see a galaxy in its present state, we see its past, where its light has been emitted. Many physicists have ignored the fact that we are always looking backwards in time when we look at distant objects, that is, looking opposite to the course of time. This can be ignored when dealing with the short distances of everyday life. Events between emission and reception of light occur in reversed order as in a film played backwards: We see a distant galaxy red-shifted, but this red shift refers to the light relative to that location which the galaxy had before, when the time-distance to us was *greater*.

In the past, (1) the wavelength of light was longer and (2) the universe was larger.

## The state of science until 1993

In the 20th century, some astronomers designed a model for the universe and bestowed it with the nimbus of truth just by calling it "***standard***" **model of cosmology**. They assumed some unprovable postulates to be self-evident, especially that the universe had evolved itself from an extremely hot and dense point, which Fred Hoyle *ironically* called **Big Bang** because he did not believe such a nonsense. In order to make the model consistent with many of the phenomona observed they *postulated* the following list of assumptions.

However these list of wrong assumptions is not complete. Some entries are skipped because in this essay they have already been discussed or disproved. Especially criticism of the Big Bang and correlated events must not be repeated.

1. **Abundance of elements:** In the *Nucleosynthesis* shortly after the Big Bang ($10^{-2}$ sec), the universe was so hot that matter was broken up into quarks and gluons. During expansion and cooling of the universe, protons and neutrons appeared. After approximately one second, protons and neutrons fused to nuclides of light elements (Deuterium, $^3$He, $^4$He, $^7$Li). This process lasted about three minutes; within this time and prior to formation of the first stars, the relative abundance of the elements occurred.
2. **Cosmic microwave background radiation:** As a result of the Big Bang (note, shown above, the presumed Big Bang never happened), George Gamov assumed a background radiation. This radiation was discovered in 1964 by Arno Penzias und Robert Wilson – but with a mean temperature of 2.73K which is different from the temperature predicted by Gamov. It was argued that this radiation appeared during the period up to approx. 300,000 years after the Big Bang, when the universe was assumed to be about 1/1000 of its present size – the moment where the universe became transparent. Before that, it was an opaque, ionized gas.
(Ref.: Measurements by COBE, BALOON, MAP).
3. **Expansion of the Universe:** (Again: In this essay "Expansion" has already been disproved, see above.)
Edwin Hubble discovered the red shift of the spectrum of remote galaxies in 1929. The red shift is the greater, the greater the distance to the emitting galaxy. It has been explained either by a "Doppler Effect" or by "expansion of the universe". The factor of proportionality is the Hubble Constant, H, which has been assumed to be between 50 and 80. "Expansion" should not be understood as having a special starting point, but rather that the space of an isotropic universe expanded everywhere at the same time and rate. By calculating the expansion back to its origin, we could find the *age of the universe* (Hubble time = 1/H). If H is a constant, then the age of the universe would be between 12.5 and 20 billion years. (The question, whether the rate of expansion of the universe increases or remains uniform or decreases, remained open).

According to **this** "Standard" model based on the Big Bang, a history of the universe was constructed:

| | |
|---|---|
| Planck era; | 0–$10^{-43}$sec: all four forces were still united; |
| Inflation Phase; | ends afterr $10^{-23}$-$10^{-30}$s; extrem expansion by the factor between $10^{30}$ and $10^{50}$; |
| Quark era; | up to $10^{-7}$sec: inflationary phase; quarks, leptons and protons appeared; |
| Hadron era; | up to $10^{-4}$sec: protons, neutrons and their antiparticles appeared; moreover, myons, electrons, positrons, neutrinos und photons; |
| Lepton era; | up to 10sec: myons decay, electrons and positrons are annihilated; |
| Radiation era; | ca. 300,000 yrs: H, He, Li emerge; |
| Matter era; | up to present: the universe becomes transparent, galaxies develop. |

(Important research instruments: in satellites: Hubble Space Telescope, ROSAT and Hipparcos, MAP.)

## Since 1993, however, the state of science has changed:

In 1993, the assumptions mentioned above and their verification were carefully checked. One type of "evidence", which is never absent in hypotheses to the postulate of Big Bang, is the assertion that these hypothesis had been approved by the "majority of astronomers" etc. Is "approved by the majority" a sort of physical evidence? If so, then this would open an interesting aspect, because then, according to the opinion of a "majority since antiquity " – the world would have remained a disk upon a turtle swimming in an ocean. Critique in detail:

- **Abundance of elements:** There is no evidence that the observed abundance of elements could *only* result under the condition of the Big Bang and not by some other (not less-extreme) process, for instance in the cores of galaxies or in collapsing stars, all the more so, since the time needed for such a scenario is not limited. Moreover, the abundance of hydrogen and helium has been chosen arbitrarily in order to obtain the result needed for a Big Bang (making the data fit for the desired result). This was emphasized in "A Different Approach to Cosmology" by Fred Hoyle, Geoffrey Burbidge and Jayant Narlikar.
- **Cosmic background radiation.** [Re-translation of a text of Geofrey Burbidge:] *"If the measured abundance of He/H in our galaxy is generally true for the baryonic matter with the same numeric value throughout the entire universe, then the density of the energy released by synthesizing helium corresponds almost exactly with the black-body microwave radiation at 2.73K. Hoyle mentioned this in a paper published in 1967 together with Robert V. Wagoner and W. Fowler. It allows the supposition that perhaps (in a former stage of evolving galaxies) all the helium in space could have been created by hydrogen burning inside hot stars, where the released UV radiation could – through absorption by dust and re-emission in the form of thermal radiation – produce the observed microwave radiation, which therefore, cannot be used as evidence for the early universe. Of course, because such a concept must be unpleasant for advocates of the Big Bang idea, they have ignored this paper."* [The texts on the preceding page are quoted and were translated from the German text in *Sterne & Weltraum*, Vol. 1-3/2003. There is also a note in that issue that the background radiation had already been discovered in 1941 by Andrew McKellar - prior to Penzias and Wilson.]

- **Expansion des Universums**: Edwin Hubble has not measured an expansion of the universe, he measured the red shift of the spectral lines of remote galaxies. He found that the red shift is the greater the greater the distance from us, but he emphasized that this should not be explained by a Doppler Shift due to an expansion of the universe. Moreover Halton C. Arp has presented large telescope measurments which are incompatible with an expansion of the universe (“Seeing Red – Red Shifts, Cosmoloy and Academic Science“ by H. C. Arp).

Two important measurements for disproving the theory of an expanding universe have been predicted by Einstein:

## 1. Measurement of **H**afele & **K**eating **(H&K)** 1971 and by the Global Positioning System, GPS:

Einstein has predicted: A clock at a lower location runs slower than an identical clock at a higher location because the course of time depends on the local gravitational acceleration. In the mean time this has been confirmed by many measurements (e.g. by the GPS). Einsteins prediction: The greater the gravitational acceleration, the slower the course of time – by the factor $1/(1+\Delta\varphi/c^2)$. ($\Delta\varphi$ is the increase of the field due to a shift to a lower position.)

The most-precise time measurement is possible if the clock is defined by an atomic resonant frequency which is emittted at a transition from a higher to a lower atomic energy level. The energy emitted represents a mass according the relativistic equivalence of energy and mass. This means: The slower course of time at the lower level indicates that the mass of each atom has been decreased by the same factor. Conclusion:

**A falling mass decreases. The mass may be the mass of a clock. It decreases by exactly the amount of energy (mass) which it gains as kinetic energy (and vice versa). Due to energy conservation the total energy is retained.** This measurement, predicted by Einstein, is the evidence that the kinetic energy, which appears in a falling mass, is not caused by the gravitational field (e.g. the earth) but by the falling mass itself – but note: in the view of an observer *at rest*. If however the observer (and the clock) moves *with* the falling mass, then no change of the the intrinsic (internal) mass appears when falling. If the kinetic energy is dissipated into the environment, e.g. by colliding with an object or decelerated by another cause, then its mass remains decreased by the mass-equivalent of the energy which appears by braking (decelerating). In the view of an external oberver at rest, the mass decreases whilst falling. Because only the remaining smaller mass is gravitationally active in the direction it falls, the kinetic energy itself has no gravitation in that direction. In the view of an external (a resting) oberver the gravitation acting upon the remaining mass is reduced – *in the direction it falls* – because the falling mass is reduced by the same factor.

## 2. Measurement of **P**ound, **R**epka & **S**nider **(PRS)** 1960:

Using the Mössbauer effect, these authors have measured the frequency change of light in a gravitational field.
The measurement confirmed Einstein’s prediction that the *frequency* of gamma rays (“light”), emitted at the base of a tall building, will be decreased by the factor $1/(1+\Delta\varphi/c^2)$ when ray reaches the top.
(c = velocity of light; $\Delta\varphi$ is the difference in energy between base and top.)

According to textbooks, the photons have lost energy because the photons need this energy for ‘climbing up’ the gravitational field. However this explanation is incorrect.

The photons need no energy because photons do not sense the graviational force in the direction in which they propagate. The correct explanation is the following:

“Frequency” is defined as the “number of oscillations per second”. According to the measurement of **H&K,** one second at the base lasts longer by the factor $(1+\Delta\varphi/c^2)$ relative to the second at the top. Hence – if its oscillations are counted in the *lengthened* second at the base using the instrument at the top, then the number of oscillations *during the longer* second at the base is greater by the same factor $(1+\Delta\varphi/c^2)$. *This has been measured*. **Consequently, all theories which are affected by the course of time (including the Big Bang hypothesis) must be incorrect if the change of time in a gravitational field is ignored.** (It is essential that measurements can only be compared when they are made in the same reference system, with the same instruments, and under the same conditions).

A change of distance between masses causes a change of both, the gravitational mass and the course of time. If this is not taken into account then the theory becomes contradictional in itself and renders all “proofs” of **Big Bang** and **Black Holes** to be invalid (not to mention that these two strange consequences are defined in such a way that a direct observation is not possible, not even theoretically). In order to rescue the hypotheses of **Big Bang** and **Black Holes** many additional hypotheses have been invented, each designed for eliminating a wrong contradiction – and then, in a *vicious circle*, each has been considered as an additional and independent *verification* of the hypotheses of Big Bang and Black Holes.

As shown above, all additional hypotheses have been disproved – and even more: they are not independent, because they emerge from the same error – the wrong sign for the course of time. Contradictions can't be eliminated by defining exceptions from the fundamental principles of physics, e.g. exeptions from energy conservation and momentum, or by “renormalizing” the field on each location, or by the invention of vacuum energy, of superstrings and so on.

# Appendix
# Gravitation of Kinetic Energy and Light

An often-misunderstood result of the relativistic formulas presented in standard textbooks is the dependence of mass in the direction it moves. We have seen that a mass *decreases* when falling because it acquires kinetic energy at the *expense* of its inner energy, $mc^2$. If, on the other hand, we accelerate a mass by a force from *outside*, then the mass *increases* because in that case energy is imported, its mass equivalent must be added. So the mass equivalent of the kinetic energy is either subtracted from or added to the rest mass. Since the early days of the Relativity Theory, it has been recognized that (1) when energy is supplied, the mass increases in the direction in which it is accelerated, and (2) the mass increases three times as much orthogonal to the direction of movement. That means: two masses have been added. These are called longitudinal mass (radial) and transverse mass (orthogonal to movement). (See **Max Born, "Einstein's Theory of Relativity"**). The mass increase and its dependence on the direction of movement is one of the best-verified facts in Special Relativity. However, one crucial problem has not even been noticed: Is the longitudinal or the transversal mass responsible for gravitation? The answer is simple: Only the mass which can be recognized by the falling mass (from its point of view) can be responsible for gravitation. This has been investigated in Chapters 3.4 and 3.5 with the following result:

If a mass is falling, then it acquires kinetic energy *at the expense* of its own mass; hence, its gravitational mass must decrease. A "decrease in gravitation" means that the kinetic energy has no gravitation in the direction the mass moves because it is the equivalent of precisely that mass which has been subtracted from the falling mass. Gravitation is a quality of mass which, due to energy conservation, can never become separated from it. When it disappears in the direction of movement, then – because it is retained – it must be added in the other, the orthogonal direction. (See note on **Page 79**).

Today it may appear unbelievable that this simple conclusion had not been realized before, but this may be explained as an effect of a new speculation which hypnotized the physicists around the year 1900: This is the assumption that gravitation may be caused by the curvature of space. It seems that the fascination of this idea has diverted many scientists from testing also other effects, especially the effects when Special Relativity is inserted into the Classical Law of Gravitation. Nevertheless it remains difficult to understand why Special Relativity has never been implemented in Newton's Law of Gravitation, although the idea of relativity has been applied to the other quantities which are essential in Classical Physics, may be interpreted in a very different view.

If gravitation is ignored then any attempt to implement Special Relativity into Classical Physics must fail because the relativistic and the classical definition of mass are not compatible. Einstein recognized this very clearly when he criticized that the mass has been defined twice, first by inertia and then by gravitation. Physicists often wondered about the identity of inertial and gravitational masses, because they are defined so differently. In order to combine Classical Physics with Special Relativity, the first requirement must be a mass definition by gravitation, however that is precisely what not even Einstein did. He, too, assumed the attractive mass as a characteristic quality of a body. As such is should be *constant*. In his equation, the two definitions of mass exist simultaneously, as gravitational "rest mass" and as the equivalent of energy. The consequence is that it is impossible to combine Classical Physics with Gravitation because the "rest mass" cannot be both: to be a *constant* and – at the same time – the source of the gravitational energy, which changes precisely by this energ.

We have seen that a falling mass continually transforms into kinetic energy. The kinetic energy exerts also gravitation, but orthogonal to the direction it is falling. By adding the gravitation reaches twice the value it had before. Why not three times the value when accelerating to the center, as mentioned above? The factor 3 results when the mass has been accelerated by an energy *input* from outside since then the mass of the imported energy must also be added to the falling mass (its gravitation is active in both directions, radial *and* orthogonal). In this case, the orthogonally active mass is three times as much as the mass added in the radial direction, and this has been measured with high precision.

# Change of Mass by Gravitation – (Measured 2003 on **Pioneer 10 and 11**)

In Chapter 1, it has been proved that a mass decreases when the distance to the gravitational center decreases and vice versa. This could be verified for the first time with the space probes Pioneer P10 and P11 (1993). Their distances could be determined with extreme accuracy (reference below). Today, thirty years after launch, the distances of the space probes are far beyond the planets. Radio signals from Pioneer 10 were received until January 2003 and used for measuring their distance. (In the meantime, P11 ceased transmission). To the surprise of the astronomers, the distance is a small amount less than explained by any known theory. This "strange" result has left the astronomers helpless. It looks as if a very small *additional* gravitational force would act in the direction toward the sun. Does this indicate a new kind of gravitational force? No, It does not, it just verifies the increase of mass if we apply the "Law of Gravitation with Energy Conservation" according to the Special Relativity (SRT):

This is consistent with all empirical facts. As shown in Chapter 1, a mass, m, when falling from $R_\infty = \infty$ to R, **de**creases from m to $m_0 = me^{-a/R}$, i.e. it decreases by exactly that small fraction of its own mass which becomes transformed into kinetic energy. When, conversely, the mass is raised, then the same amount of the applied kinetic energy is transformed back into mass according to the reciprocal factor, $e^{+a/R}$. As the distance **in**creases, the mass increases from the lower value, $m_0$, to $m_0e^{+a/R}$. In other words: In order to increase its distance from the sun, Pioneer 10 needs energy. The source of this energy is its own kinetic energy, which decreases – by that amount – when it is transformed back into mass. Since the increased mass has a greater weight in the sun's field, it is raised slightly less from the sun than it would with a constant mass, $m_0$, hence, Pioneer 10 did not rise from the sun as far as expected.

In reality, the effect is comparable great because the space probes gained much additional kinetic energy when they were dragged along Jupiter's orbit. The energy came from the kinetic energy of Jupiter's *orbital* velocity (not from Jupiter's *gravitational* energy). After the swing-by on Jupiter this kinetic energy transforms into mass because up from there it is moving away from the sun. Since the mass is increased, it has a greater weight in the sun's gravitational field and becomes lifted slightly less than it has been calculated with a constant mass, $m_0$.

With $a = GM/c^2$, we calculate this with the formulas derived in Chapter 1:

$M_{Sun} = 2\cdot10^{33}$ g, $c^2 = 9\cdot10^{20}$ cm$^2$/s$^2$, $G = 6.67\ 10^{-8}$cm$^2$/g s$^2$, distance $R_{Earth\text{-}Sun} = 1.5\ 10^{13}$ cm. We obtain

$\mathbf{\frac{GM}{c^2R_{Earth/Sun}} = 10^{-8}}$. Hence $\mathbf{e^{+a/R} \cong 1+1\times10^{-8}}$. That means the mass of Pioneer 10 (and its attraction by the sun = its "weight") at that distance is greater than it would be under classical law – due to the addition of the mass equivalent of that energy which is subtracted from the kinetic energy when increasing the distance to the sun.

However, the *measured* change of mass is 8.74 times greater (than $\mathbf{1\times10^{-8}}$) in the factor $\mathbf{1+(8.74\pm1.25)\cdot10^{-8}}$. Why? It includes the energy added to P10 on its encounter with Jupiter on Dec. 4, 1973. They got even much more energy from Jupiter's orbital energy as needed for escaping the solar system. The dragging by a planet is common use for catapulting space probes to greater distances from the sun. See **Chapt. 3.4**. [Reference:

**1.** "Die Pioneer-Anomalie" by Hansjörg Dittus & Claus Lämmerzahl in Physik Journal Jan. 2006 and

**2.** "The Strange Acceleration of Pioneer 10 and 11" by John D. Anderson, Philip A. Laing, Eunice L. Lau, Michael Martin Nieto, and Slava G. Turyshev in "The Planetary Report", November/December 2001.

The change of gravitational mass proportional to the distance is also responsible for the advance of the perihelion of planetary orbits. In order to evaluate the measurements, many additional effects must be taken into consideration: solar wind, influence of planets, radiation (for instance, radiation of heat and radio signals), the gravitation of kinetic energy, etc.

# Nobel Laureates Outwitted by a Pupil who Disproves Black Holes

In discussions with teenagers about gravitation, a pupil reported one day about his difficulties to enter into a dialog with physicists of highest reputation. With just a very simple mental experiment, he provoked almost unbelievably irrational answers. Some physicists pretended that his question was too fuzzy to be worthwhile answering, others beat around the bush. The reader may judge for himself, that young man's idea:

Let's assume a star observed from a rocket approaching it: its mass is too small and its diameter too large for collapsing to the Schwarzschild Radius or less, hence this star is not a Black Hole. If, however, the observer accelerates his rocket relative to the star until it reaches nearly the velocity of light; then (according to the theory of these physicists), the mass he observes must **in**crease relativistically until it collapses to a Black Hole (all the more so since its radius must decrease relativistically). After having checked that the star has imploded into a Black Hole (indicated by the increased orbital velocity of the star's planets), the observer reduces his rocket's velocity and returns to earth, where such a great achievement would surely be awarded the Nobel Prize. However, a problem remains: this contradicts physics.

A Black Hole can never become reversed into the same star it was before, hence the Black Hole created just *by watching a star* from a fast-moving rocket would be the greatest sensation of the century.

I do not know what would happen with the Nobel Committee and the observer when they realized that the star has recovered from becoming a Black Hole. If the question is too fuzzy for an answer by these physicists, then the dialog with teenagers having such questions will just have to wait until they have died out.

However, another option exists: Because stars cannot become transformed into Black Holes just by watching them from a fast-moving mass, we must conclude that Black Holes cannot exist at all. Some scientists may argue that such a fast-moving rocket is not feasible, hence such a mental experiment is not permissible. However, (1) an experiment is not disproved just because it may be not feasible; moreover, (2), in *that* case it doesn't matter, since the experiment *has* already been made. Particles in some accelerators have reached velocities just a few cm/s less than the velocity of light. Like any other mass, these particles are *observers*. Relative to these particles, *all* the stars of the universe must be Black Holes, but this contradicts the fact that – relative to us – they are not Black Holes.

## Einstein's Interval

Comment on Chapter 2.5, **Page 16**, "Einstein's Hypothetical Space"

Some readers may wish to compare Einstein's formula quoted on **Page 16** with the following original formula of Einstein, where, for light, ds must be zero, and $\sigma$ is the density of mass:

$$ds^2 = -\left(1 + \frac{\kappa}{4\pi}\int\frac{\sigma dV_o}{r}\right)\left(dx_1^2 + dx_2^2 + dx_3^2\right) + \left(1 - \frac{\kappa}{4\pi}\int\frac{\sigma dV_o}{r}\right)(cdt)^2 = \mathbf{0}.$$

The brackets are the factors for the change of length and time respectively. Instead of the gravitational constant, G, Einstein prefers – without explanation – the expression $\kappa = \frac{8\pi G}{c^2}\cdot$ For spherical masses, $\int_\infty^R \frac{\sigma dV_o}{r} = \frac{M}{R}$ (see **Page 35**), hence, when $\kappa$ is inserted, the second term inside each bracket is $\frac{2GM}{c^2R}$.

With this, we obtain the same factor for time dilatation as on Page 16 in Equations (A) and (B).

In each reference system, the velocity of light must be a constant, expressible by

$c = \lambda/\tau$ = wavelength divided by the duration of a period.

With Einstein's formula, the velocity of light – viewed from any reference system – can be calculated. Please note that Einstein often uses an approximation for the root of the brackets. For light, ds = 0; then the left term in this equation is equal the right term, and the roots must also be equal.

Einstein was convinced that Black Holes do not exist, hence he often assumed $v \ll c$.

That means $2GM/Rc^2 = v^2/c^2 = \varepsilon \ll 1$. For such a very small $\varepsilon$, he can use the approximation

$\sqrt{1-\varepsilon} \cong (1-\varepsilon/2)$, and $1/(1-\varepsilon/2) \cong (1+\varepsilon/2)$.

# Is the Redshift of Remote Galaxis a Doppler-Shift?

"Doppler shift" means the change of frequency due to the velocity of a light source relative to the observer. The same effect is known for the frequency of a sound. The frequency increases when we move towards the source of the sound, and is lowered when we move away. Christian Doppler predicted the same effect for light (1842), but this prediction had the effect that 1852 his lectorship was dispensed – for teaching such a nonsense. More then 100 years later the astronomer Halton Arp was dispensed for the opposite, that is, he measured a red shift on remote galaxies which is not explainable as a Doppler shift of an expanding universe. Once more we are confronted with the same question: Is it a good idea, to prove or disprove the laws of natue by excluding astronomes from the dialogue if there finding do not agree with an established opinion?

**1. Is the red shift of a galaxy a Doppler shift?** Is a correct conclusion also correct if we reverse the logic?

**A.** If a galaxy moves away from us then we see its light red shifted.
**B.** We see a remote galaxies red shifted – hence it moves away from us.

This conclusion is wrong. Why? In **A** the Galaxy moves away from us now (in this moment). **B** could be the reverse of **A** only if we would see the light in that very moment where it is emitted. This is impossible. The fossil light we see is the light emitted millions oder billions years ago. Because $c < \infty$ it has been emitted many years ago. That means:

**2. Its red shift can not be an effect of velocity.** Three proofs:

**a**: Statement **B** contradics itself. It would be correct only, if the red shift of the distant galaxy would be the same to day as it was in the past. However this is impossible if we assume a Doppler shift. Then the increase depends on both, the velocity of expansion and the distance. This would be zero at zero distance, but must be the greater the greater the time since emission.

**b**: If the velocity of expansion would be proportional to the distance then the galaxies had the highest expansion velocity at present. When the galaxies proceed from past (from where they are coming) they must even reach a velocity greater than light, relative to the past. It was not realized that Galaxies, if the expanding velocity is proportional to distance, must reach the maximal expansion velocity **now** (today), not in the past, where they had emitted the red shifted (fossil) light. This shows the standard mistake of the logic in anstronomy: The time was given a wrong sign, "*looking into the past time*" was considered as *"expansion"*! It is the inverse of expansion.

**c**: "Proof by contradiction": Assumed, the red shift is a Doppler shift due to an expansion velocity proportional to distance. A galaxy at a distance of 2 **BLY** (2 **b**illion **l**ight **ye**ars) from us, has, due to this velocity, **v,** at this distance a red shift **z**. Five times farther back, that is **10 billions of years**, the red shift was **5z** due to the greater *expansion* velocity **5v**. However each Galaxy emitted at any time light – also 8 *billion Jahre later*, when the time distance to present have been only 2 **BLY** (*from 10 to 2 = 8 billion years*). During the time where they where approaching and the universe expanding, the distances should have stretched (beginning with **5z**, at least with **z**). The distance of **2 BLY** (the galaxies have today), should be, at the same time, stretched more than **2 BLY**. Hence, the assumption that the red shift is an effect of expansion, is disproved. The red shift cannot be a Doppler shift.

Conclusion: ***All*** theories constructed on the condition of expansion of the universe contradict the logic.

According to the Spez.Rel. of Einstein the red shift of distant galaxies is a consequence of the gravitation **of** the masses in the universe (proved on Pages **1-3**), however the masses are defined by its intrinsic energy. The same results can be derived from the law of Ludwig Boltzmann (see Page 83).

These are the mathematical consequences of the Special Relativity Theory if no additional hypotheses or assumption are assumed. With this many problems not answered before have been solved.

- The red shift of distant galaxies measured by Hubble and others;
- The universe does not expand.
- The up to now not explained *delayed* Pioneer-probes 10 and 11 (and others);
- The twofold light deflection by large masses;
- The advance of the Perihel of planets.

# Einstein-Machine and Gravitation (http://www.rudolf-kiesslinger.de/)

When exploring the law of free fall Galileo applied a simple trick. He reduced the velocity of the fall by using small balls of different weight simultaneous rolling down a slightly inclined groove. Due to the slowed movement he could notice the position of the balls at any time. Of course, this trick was possible thousands of years before – but nobody had the idea. Galileo found what prior to him only crack-brains had realized by logic: *The velocity of the free fall is the same for all bodies.*

So he disproved a scientific "**Standard**"-Theory of his time ("standard" is often used synonymous with ultimate truth) – in opposition to "the majority of scientists", to authorities like Aristotle, Ptolemy, and to all who believed that god reveals himself by "self-evident facts", for instance "heavy bodies are falling faster".

In order to demonstrate the relativistic change of **mass** when the distance to the gravitational center changes we apply the trick of retarding the free fall (analogous to Galileo's trick of slowing-down).

As far as I know all "Standard" hypotheses – Expansion of the Universe, Big Bang, Black Holes, etc. – have been derived under the **supposition that the mass remains constant – particularly when its distance to the gravitational center changes**.

Remains a mass constant when falling? Will we get a millenium result like that of Galileo's?

Accidentally I found a machine by which cosmological theories can be tested far more precisely than Galileo could measure the free fall. With this machine gravitational effects can be checked in steps, each step deals with only one relativistic principle. So the summarized relativistic behavier can be revealed by taking into account each effect separately. Of course, as before we have to reveal how the masses interact, the machine will not do it for us. I call the machine "**Einstein-Maschine**". It works similar a tower-clock, where
a) we *wind-up* a heavy mass by using a crank, b) we let the mass sink, however, in contrast to a clock, controlled not by a pendulum but by a centrifugal regulator actuating a friction brake via a gear. An ingenious constructed control loop allowes an extremely precise adjustment of the dropping *velocity* – or to stop it. Up to now the machine was used for steering a telescope to follow the "moving stars". We use the machine for an entirely other application: Because the mass in the machine and the masses in the universe are governed by the same laws, we use the machine for simulating a mass in the *universe* by a mass *inside* the machine.

**The identity of the law inside and outside the machine allowes to test some kosmological hypotheses.**

We make use of the fact that the machine obeys Einstein's **S**pecial **R**elativity-**T**heory (**SRT**). This is possible because **mass and energy are equivalent**. Mass represents energy, and conversely, energy – stored or not – represents mass, expressed by Einstein's famous identity $\mathbf{E= mc^2}$.

The **S**pez. **R**elativity **T**heory remains true if we use as criterion for mass its *gravitation* (or its weight). This is inherently different from Newton's dynamics where mass is defind by *inertia*. If "mass" is defined as the essential cause of gravitation than inertia must be a consequence of this definition. This can be assumed to be known, but because not all physicists had realized this it will be proved on top of **Page 103**.

From the equivalence of mass and energy (**SRT**) follows that the weight of a clock increases when its spring becomes wound up. It increases proportional to the mass equivalent Energy $\mathbf{E = m\,c^2}$, stored in the spring.

The mass equivalent of the spring's energy is far too less for being measurable. However when atoms in a large accelerator reach a velocity near that of light then their weight increases many times. [You may calcu late it: The weight increases with the mass: $\mathbf{m = m_0 \big/ \sqrt{1 - v^2/c^2}}$. (**v** = velocity of the atoms, **c** = velocity of light)].
The energy of the mass of a 2-Euro-Coin could lift the Lake Constance (600 km$^2$, 90m deep) by more than 1 meter.

By raising the driving-weight of the Einstein-Machine we insert energy, **E**, into this weight.
According to **SRT** this energy, $\mathbf{E = mc^2}$, represents a mass $\mathbf{m = E/c^2}$, by which the weight increases.

If we release the force upon the braking shoe then the weight sinks. Then the energy supplied before "flows" from the weight into brake and bearings – where it transformes to friction heat.
In case of free fall over the same distance this energy transformes into kinetic energy ($\mathbf{= mv^2/2}$).

Here we should notice: The "standard"-hypotheses (Expanding Universe, Black Holes, Big Bang) ignore the increase of weight by lifting, because the mass is assumed to remain constant in the gravitational field.

In reality however the following happens: If an assistant winds-up the driving-weight then energy "flows" from his muscles via a crank into the weight, thereby increases the mass of the weight by the energy inserted (due to SRT). (Accordingly the assistant's weight decreases due to the energy-flow from his muscles into the crank.)

If we allow the weight to sink then its mass decreases – because the energy inserted before by lifting changes into friction heat. Please note: The energy flowing out from the dropping weight has been a part of the mass of this weight. It was not in another place in the field of the earth or the "space".

This can be expressed as a law: Potential energy + Kinetic Energy = constant. The idea of potential energy makes no sense if (as in the "standard"-hypotheses) the energy is assumed to be a quality of the "field", because then the energy (with gravitation!) would be stored not in the weight, but in the field (even simultaneously with all other masses of the universe) – it had to find its way into the brake *on demand* via the weight.

The flow of energy obeys **Special Relativity** (this means: the theory will not contradict itself).

With other words: If **mass m** is lifted in a gravitational field then it ***increases***. It increases precisely by the mass-equivalent of the energy needed for raising it (this is $\mathbf{E = mc^2}$ = weight × height).

The inverse is more informative: A dropping mass (also its weight) *decreases* because it aquires kinetic energy at the expense *of its mass* (not of the field – a field cannot have an output if there is no input).

A mass can fall until it is used up. Can it become "used up"? If so, then its gravitation has vanished, the kinetic energy has its maximum – however mass must be conserved! **Where** goes the mass when it "vanishes" and becomes conserved at the same time?

You see, that simple machine leads us to the last questions of physics, for instance: What happens if the dropping of the mass would not be stopped, that is, if our star – the earth – had such an enourmous mass that it would, by gravitation, collapse into a point? (Is the driving weight of the machine whithin this "point"?)

The collapsing atoms produce heat due to mutual pushing. If at least the atoms itself will collapse, then the mass transformes completely into kinetic energy. The temperature must increase until the whole mass is converted into light, and light is kinetic energy only. This cannot produce a **Black Hole** because, instead of *accumulating* in the center, the mass *transformes* into light which is radiated. Energy in form of light cannot excert gravitation in the direction it propagates.

At the end only light was produced. Then the whole kinetic energy has been transformed into radiation.

A Black Hole cannot result. Falling masses will not *accumulate* in the center, because they disappear by transforming into light. Nevertheless light is kinetic energy (with an equivalent mass) whose gravitation had vanished in the direction it propagates. There does not exist any evidence for a supposed "field energy".

The mass of the falling weight can be imagined composed of two parts: A longitudinal part: this is that mass which causes gravitation in the direction it moves; and a part which acts transverse to it. The kinetic energy has its source in the longitudinal part, hence it becomes subtracted from the longitudinal mass, and at the same extent the gravitation in longitudinal direction must decrease. However – first realized by Einstein – in the transverse direction this gravitation is *added*. Because this is *orthogonal* to the direction of falling it does not effect the fall, still in the other direction it effects interaction with other masses, measured by Eddington as deflection of the stars' light when passing near the large mass of the sun.

A part of the mass becomes transformed into kinetic energy. According to Einstein's equation $\mathbf{E = mc^2}$ it must be conserved in spite of being transformed – since it cannot vanish, its gravitation must also keep on. It has no gravitational effect in the direction it moves. Especially for light remains a question about the equivalent mass of the light's energy? Where is the gravitation of that mass acting?

It should be emphasized: The question can be (and has been) answered only by non-"standard"-Theories. Consider a falling mass. Of course, it transforms itself into kinetic energy, and this to that extent as it disappeares as "gravitational mass in the *direction* it moves" and appeares as kinetic energy (Note the contrast to Newton's dynamics where the "gravitational mass" is a *constant*, defined by inertia). Because the gravitational quality (the attractive force!) disappears in the direction of the moving mass, this quality must (and can) appeare only in the direction orthogonal to this – as a quality of the mass-equivalent of the kinetic energy (due to energy conservation). In classical physics the force – in the direction of movement – has been defined by inertia, now, orthogonal to that direction, it is defined by attraction, which is *added* to gravitation. This is also true for light (having no gravitation in the direction it propagates). What light does not have in the direction where it propagates, that is added orthogonal to this direction. That means:

**Orthogonal to spreading its gravitation is twice.** Though this has been correctly calculated by Einstein it is often ignored. Being a consequence of energy conservation, it is generally true for any kind of kinetic energy. In other words: **Kinetic energy exerts gravitation, however only orthogonal to the movement. There it is**

**added, hence for light the force becomes doubled.** It would be a wrong conclusion that a sufficiently large concentration of mass would produce a Black Hole from which **"not even light can escape"**).

**From the mere fact that light has no graviation in the direction it propagates, it must be concluded that light can escape even *the greatest gravitational field without being effected*.**

According to **SRT** light does not exert gravitation in that direction where it is approaching us (because – due to the addition theorem – the spreading velocity of gravitation cannot be greater than that of light).

**!** Though this can not be questioned, some standard texts persist on the wrong conclusion that "*from a Black Hole not even light can escape since the escape velocity 'is' greater than that of light." (Literal!)*

For the same argument a Black Hole can not even be formed because the amount of both – the *falling* and the *escaping* – velocity, must be the same, each must be less than the speed of light.

And an additional argument: According to **SRT** the time between *emission* of a photon in a galaxy and its arriving our telescope is zero, and in zero time nothing can change.

So the Einstein machine turns out to be a demonstration device for solving – without sophisticated mathematics – a lot of problems which up to now could not be solved even by most competent theoreticans. We can even encourage any student to crack these problems just by the knowledge acquired by reading the preceding two pages.

Consider, for instance, the trajectory of the **space probes pioneer 10 und 11**, launched 1972 and 1973. Today these probes have reached a distance fare beyond the most remote planet.

[Ref: **1.** "*Die Pioneer-Anomalie*" by Hansjörg Dittus & Claus Lämmerzahl in Physik Journal Jan. 2006. **2.**„The *Strange Acceleration* of Pioneer 10 and 11“ by John D. Anderson, Philip A. Laing, Eunice L. Lau, Michael Martin Nieto, Slava G. Turyshev in „The Planetary Report“ Nov./Dec. 2001.]

The distance of Pioneer 10 could be measured until 2002 – extremely precise. The "strange" result was quite unexpected. It perplexed many astronomers by the fact that the measured distance of the probes is slightly less than calculated. It looks as if a very small additive (even growing) force *towards the sun* would exist. A force of this kind could not be explained by any known theory. On the other hand it turns out that it cannot be an indication of a new gravitational theory (as sometimes has been suspected), because the measurement confirms what now we can explain with the Einstein machine. Let us consider the whole problem:

After launch from the earth each probe was navigated to follow Jupiter on its orbit. According to some reports the probe has acquired kinetic energy from the gravitational energy of the Jupiter, but this is an error. The gravitation of the Jupiter has only be used like a tow rope to drag the probe along the planet's orbit. Of course, whilst dragging the probe was falling to the Jupiter, however before colliding it was manoeuvred out of his orbit in a direction away from both – Jupiter and sun. The energy for climbing up the sun's field is supplied by the kinetic energy (acquired when the probe was dragged to follow Jupiter on his orbit). *Within the dragging time* the probe had acquired additional kinetic energy from Jupiter's *orbital* velocity – about 8-times the energy by which the probe has been launched. Due to *this* energy the probe could escape the sun.

The energy aquired from the Jupiter's orbital movement is kinetic. As such it exert no gravitation in the direction of movement, but orthogonal, when "climbing up" the sun's field, this energy has been transformed into potential energy in the sun's field, thereby increasing the weight of the probe with respect to the sun by the mass equivalent of this energy. This is the "strange" force which has been thought to be "not explainable by any known theory".

These arguments are a consequence of the principle that the falling energy is supplied by the intrinsic energy of the falling mass, not by a hypothetical "space-energy" and not by the even more mysterious "source-free field". This principle is by no means a mere hypothesis, it is one of the most precise measurements in physics (1971, called "clock experiment"). It proves a prediction of Einstein, that in the field of the earth the time proceeds the faster, the less the strength of the field. This means:

The **run of time** increases when we rise in the field of the earth. A time interval can be defined most precisely by a quantum jump, and a quantum jump is proportional to the atomic mass, hence the mass must increase when the distance to the gravitational center increases. This means: **Mass** and **the run of time** increase by the same factor:

**The source of the gravitational energy is the intrinsinc energy of the mass itself – not the "field", not the "space"**. Though this is a simple fact, it appear to be difficult to realize by advocates of "standard" theories. Some of them *begin* to accept it, though not realizing the *mathematical implications* (these are also simple), for instance **Harald Lesch** (2008.4.13, 20h, Bayrisches FS, Alpha-Centauri); **Marcus Chown** (1999 in "The Magic Furnace" Page 80+81) i.a.

The **identity of gravitational and inert mass** can also be confirmed by the Einstein-Machine. For this we wind up the driving weight of the machine by a defined distance. The mass of this weight increases by the inserted lifting energy. If the weight falls back the same distance, it reaches the velocity **v**. The kinetic energy of the mass at this velocity **v** is precisely equal the energy acquired for winding it up. Of course, this energy could also be inserted from the outside into the mass by accelerating it horizontally until the same velocity **v** is reached. In both cases the mass increases by the same amount of energy because in both cases they have got the same velocity **v**, regardless, whether the mass has been lifted against gravitation or accelerated horizontally against inertia.
Hence a *gravitationl force cannot be distinguished from an inertial force*. This had to be proved

## Disproof of "Standard-Theories":

Galilei realized that *the velocity of free fall is the same for all bodies*. This he demonstrated by small spheres rolling down a slightly inclined groove. In order to explain energy transfers we use another device, the **Einstein machine**. With this device it is easy to realize that in a gravitational field *the source* for the energy of fall is the dropping mass itself (**mc²**) – not the "field", not the "space", in contrast to standard-theories.

This has been confirmed by measurements predicted by Einstein. However Einsteins arguments remained unnoticed, may be because they are hidden in sophisticated mathematics (see the box on preceding **Page**). If Einstein's mesaurements are accepted then the consequence is far reaching because then not only the movements of celestical bodies become simplified, it also eliminates the contradictions to energy conservation in the vicinity of **singularities** (singularities are the mass concentrations called Black Holes where the gravitation has been assumed to become unlimited). (Some of the contradictions are quoted on **Page 80**).

Einstein realized that the gravitation of light *transverse to its propagation* is doubled. Though many autors followed his arguments, as far as I know non of them realized that in *the other direction – the direction where light propagates,* the gravitation is zero, and this is true not only for light but also for the mass equivalent of any kinetic energy – that is along the tangent of the trajectory. Transverse to the tangent it is doubled.

When Einstein inserted **Poissons equation** into the General Theory of Relativity then even he did not realize that the mass changes when it is moved in the field. Poissons equation however has been derived under the assumption that the mass remains constant. Ignoring the change of mass when applying Poissons equation leads to inconsistencies with energy conservation (and to energy transports in the Einstein machine).

If light is directed upwards a field then its frequency (measured by the clock at the bottom) decreases. This has often been misinterpreted as a decrease of the light's energy. However light needs no energy for "climbing up a field" – because light does not sense the gravitation in the direction it propagates. The lower frequency measured at a higher point does not indicate a loss of its energy due to rising, it indicates the decrease of time at the higher point (this means: 1 second is shorter). The *same* instrument (at the base!) counts for the upper point less cycles per second – not *in spite* but *because* the frequency does not change.

All contradictions of the relativitic gravitation can easily be solved if we take into account: 1st that the source of any energy is always a mass, and 2nd that energy represents a weight. An instance is the advance of the perihelion of the planet mercury which can be calculated as follows: When a planet approaches the sun then it gains a fall velocity. Because this velocity is turned into the orbital direction, it increases the kinetic energy of the orbital movement. In this direction the kinetic energy corresponds to an equivalent gravitational mass. The attractive force of the sun acts upon any "kinetic mass" twice as much (compared with a bodily mass). Hence the orbit around the sun contracts, causing the planet to advance a slightly greater angle around the sun. The calculation in this book is similar to that of Einstein. (Compare this with the calculation used above for the pioneer probe when explaining why its distance to the sun is less than expected.)

The following **Page 105** demonstrates by simple mathematics that the **red shift of distant galaxies** is an effect of gravitation of the mass density of the universe. This disproves the hypothetical expansion of the universe. By the same calculation many problems are solved, e.g. ☀Why is the sky dark at night? (**Pages 84, 100**), ☀Why does the universe not expand? ☀All simplifications of the mathematical representation of the celestial mechanics and its effects are basically a consequence of elimination the erroneous assumption that in the Gravitational Law the mass would be a constant.

In the Einstein machine the energy is conserved without postulating any new hypotheses. Now a surprize:

This has already been proved ahead of Einstein by **Ludwig Boltzmann** at the time, where **E = mc²** was not known.
(1896 Vorlesungen über Gastheorie, I. Teil, Van der Waals/Gase mit zusammengesetzen Molekülen). More on **P. 83.**

One of my readers was disillusioned from the Einstein machine because – in his words – it reveals nothing "what I did not already know". At least for this reader it was obvious that nothing can be learned from the machine – "it did not explain the Theory of Relativity" as he had expected:. He had not realized that the theory reqires studying of the physics of the 20 century – and that this can not be done by a machine.

Nevertheless, the machine could reveal that some of the readers cosmological ideas are outdated. What he himself could not realize remained unexplained, nevertheless he expected from the machine an almost supernatural capability: to explain his non-relativistic concept of physics which he himself could not understand.

The machine has triggered a fundamental metamorphose of his consciousness: A few hours befor he fiercely defended the principles of all standard theories (expansion of the universe, Black Holese, etc.). Now, but without being aware, he has adopted from the machine the opposite: that energy is equivalent a mass, and, since this energy can be stored or supplied, it is <u>variable</u>, and the same must be true for mass. However this is the opposite of all "standard" theories, where a dropping mass is assumed to be <u>constant</u>. In these theories, the source of the gravitational energy is the "field" (or the "space") – not the mass.

If the machine's principles are convincing and the standard theories are also convincing, then no inconsistency should arise when both theories would be true simultaneously. Now he is confused because if he accept the standard theories then he get in contradiction with the performance of the machine.

What the energy balance of the machine reveals was unexpected for many: It shows that the fall energy of a mass **m** does not originate in an abstract "space" (or "field", or in "zero-point energy", "dark energy", "dark mass", in higher "dimensions"), – it reveals that energy of free fall is supplied by its **own substance**, **m** (by the intrinsic energy $\mathbf{E = mc^2}$). The only condition we must accept are the measurements, which have been predicted by Einstein. The so-called "standard" cosmologies contradict these measurements.

In a sense the machine may be of higher importance for us than the telescope was for Galilei. Everywhere in the universe energy transports obey the same logic, hence a cosmological theory can be examined by comparing these transports with corresponding transports in the machine. If a theory explains these transports in a different manner in the machine than they are in reality, then the theory must be wrong. This means: The Einstein machine, not being **an explanation** of any theory, offers a device for **checking theories by comparision**. The machine may be considered as an arbitrator.

In this way some controverses can be solved: Does the universe expand? Was there a Big Bang? Does dark matter, dark energy, Black Holes exist? How does this effect the theories about the origin of the elements?

The machine reveals – without a measurement, just by its sheer existence**:** <u>If</u> the **SRT** is true, <u>then</u> any hypothesis which is not consistent with this machine (may be in an experiment in thought) must be wrong. Let us remember: This is a consequence of the change of mass when the gravitational field changes.

The critic is dissatisfied because, in his words, he could not see that the machine had "measured" the relativistic change of mass. Indeed: The machine is not used for "measuring" anything. However when we, step by step, apply the **SRT** to the universe, the machine offers a clear and convincing check of energy transports. This is in contrast to the "standard" theories where these transports are concealed by unknown conditions and incorrect statements, for instance: ☀The not provable statement that the red shift of distant galaxies where an effect of cosmic expansion. ☀The source of fall energy where the "field" or the "space" (introduced with Poisson's equation, derivable only from the untenable condition of *classical* physics that the mass would remain *constant*. Mass cannot be both: constant and relativistical variable.)
Many of the almost metaphysical problems in the "standard" theories (some contradictions quoted on **P. 80**) could arise only because in these theories the change of mass in case of energy transports is ignored. Though some people declare they can understand these "demanding" theories I did not met one who would engage in a dialogue about its fundmental assumptions, or even to defend it.

In the "standard"-hypotheses (concerning <u>expansion of the universe</u>, <u>Big Bang</u>, i.a.) the energy transports, shown in the Einstein machine, are ignored. The "standard"-hypotheses are based on a wrong interpretation of the red shift of distant galaxies, for instance their interpretation by expansion (or a receding velocity). In the view of these hypotheses it is difficult to recognize that these interpretations are incompatibel with **SRT**.

On **Page 106** I tried to explain that the red shift is not an effect of expansion. Can it be that this book is the only representation of gravitation where the **SRT** is recognized (especially the measurements predicted by Einstein)?
In any case this book is free of the most common fallacies about Big Bang, Black Holes, etc, the correlated contradictions are also eliminated (see **Page 106**).

# Red Shift of Distant Galaxies

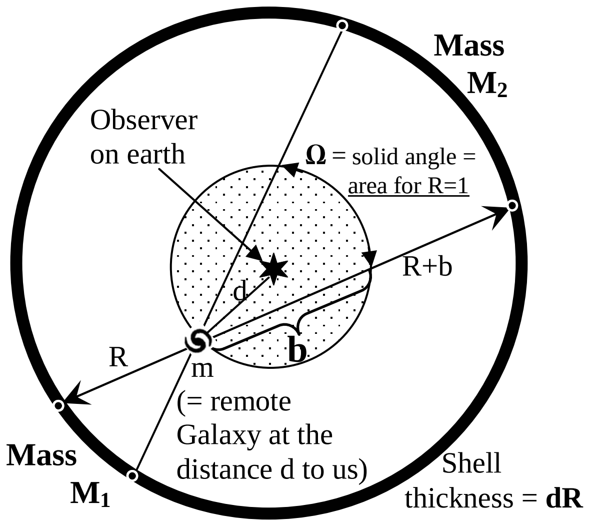
According to Einstein the run of time decreases when we move towards the center of gravitation – it decreases proportional to the increase of the gravitational field (see measurement of Hafele & Keating 1972). The clock is calibrated by the period **τ** of the frequency of a specified quantum jump of an atom or molecule. This jump is proportional to both, the run of time *and* the mass of the atom (→ measurement of Pound, Repka & Snider 1960). Conclusion:

**1.** The period **τ** of a specified spectral frequency is the ideal time standard for calibrating an atomic clock.
**2.** The source for the kinetic energy of a falling atom is the energy equivalent of its mass, hence the rate of the clock and the mass decrease by the same rate (according to Einstein, verified by Hafele & Keating and by GPS).

**Einstein's message:** The kinetic energy a stone acquires by falling is not supplied by the field, it is supplied by the energy equivalent $\mathbf{mc^2}$ of the stone's mass **m**, which decreases by the mass of the kinetic energy.

The proportionality between mass and the lapse of time in a gravitational field is one of the best documented measurements in physics (proved by frequency comparison), however it is ignored in the "standard" theories.

The following diagram may be extended over the whole universe. We are the center ✶ of a sphere with the radius **d** (= distance to the galaxis ૬). Inside and outside **d** are stars and galaxies distributed at the same mean density.




**Ω** = solid angle (= angle area at distance **1** from **m**)
$[\Omega R^2]$ = area of $\mathbf{M_1}$,
$[\Omega(R+b)^2]$ = area of $\mathbf{M_2}$;
[areas in brackets]

**ρ** = mean density of the universe

The **universe is thought composed of mass shells**, each of thickness dR. The opposite masses relative to ૬ are the masses $\mathbf{M_1}$ und $\mathbf{M_2}$:

$$\mathbf{M_1} = [\Omega R^2]\, dR\, \rho, \qquad \mathbf{M_2} = [\Omega(R+b)^2]\, dR\, \rho$$

We calculate the
**Gravitational forces of $M_1$ and $M_2$ upon m**
seen from an observer upon ✶,
(***not*** from **m** or any other location**!**).

$$K_1 = \frac{GmM_1}{R^2} = \frac{Gm[\Omega R^2]dR\rho}{R^2} = Gm\,\Omega\, dR\rho$$

$$K_2 = \frac{GmM_2}{(R+b)^2} = \frac{Gm[\Omega (R+b)^2]dR\rho}{(R+b)^2} = Gm\,\Omega\, dR\rho$$

$\mathbf{K_1 = K_2}$. This means: $\mathbf{K_1 - K_2 = 0.}$

(the squared radii in each formula reduced)

The gravitational attractive forces $\mathbf{K_1}$ and $\mathbf{K_2}$ of opposite sections of the same shell neutralize mutually. Hence the mass of the distant galaxy will be attracted only by those masses which are within the dashed sphere (note: in the view of the observer at ✶). This remains true if we insert for each mass its relativistic expression $me^{-a/R}$, because, when R goes to infinite then the factor $e^{-a/R}$ approaches 1 and the factor

$\rho e^{-\frac{G}{c^2}AR^2\rho}$ decreases to zero (refer to Equ. **3.56, Page 37** in the book – see also **Page 84**).

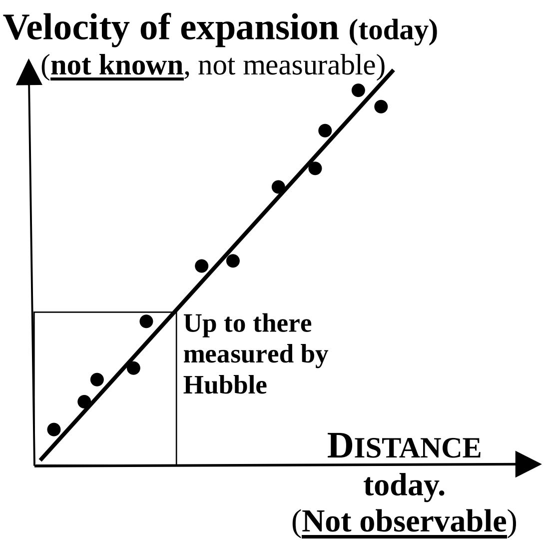
For galaxies at a greater distance **d** (= radius) is the gravitation of the dashed sphere greater. This – not an expansion velocity of the universe – determines the *gravitational* red shift of its light (measurement of Hafele and Keating). The careful examination on **Page 37** proves even more: at very great distances the gravitation becomes inverted (due to the e-factor), and if the distance grows infinitely it goes even to zero.

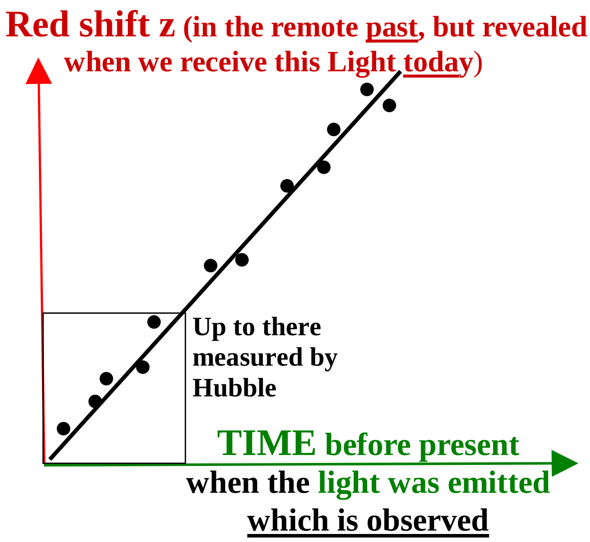
By the way, the heaven is dark at night due to the decrease of gravitation to zero when **R** grows limitless (explained on **Page 84**).

# Basic Diagram of Cosmology (Hubble-Diagram)

*All* cosmological theories of the 20th century culminate in a fundamentally wrong conclusions due to wrong labelling of the Hubble diagram. This diagram is the base of each theory, but it has been

**incorrectly labelled (left).** **The correct labels should be (right):**




All "standard"-theories are based on the diagram at left. However this is incorrectly labelled. It associates the light at each measuring point (•) with a galaxy having (1) a velocity the greater the greater its distance, and (2) a red shift caused by this velocity. (The distance was estimated by other indicators.) This is a fallacy, because this light we cannot see. Even Hubble could see only light which *arrives* us today and which has been emitted by a remote galaxy far in the past. The light *emitted* today needs millions or billions of years to cover the distance to us and will arrive us after these years. Light which arrives us today carries the red shift of the far past which cannot indicate a velocity which did not exist when the light was emitted.

By a mistaken logic the red shift of the past has been interpreted as an "escape velocity" of today (or as present expansion of space) and was recorded in the diagram on the ordinate. The corresponding abscissa was assumed to be the present distance, though this distance too is not known. Both these wrong entries are the foundation of *all* "standard"-hypotheses about the past and the future of the universe. The wrong entries are considered (1) as a verification of the expansion of the universe (Hubble "constant") regardless that they are not observable, and (2) that the expansion had to be started by a Big Bang. Moreover these wrong postulates are the base of all "standard"-theories, which are: (3) hypotheses about Black Holes, (4) starting point of the elements, (5) sometimes with dark energy, and (6) dark matter. Since these hypotheses are not verified and because their logical contradictions are not eliminated they cannot proof anything and must be discarded.

The red shift of most galaxies is so great that in the early days is was not realized that all spectral lines emitted at the same time have the same red shift because many of the characteristic lines where shifted into a section of the infrared which was not observable at this time.

Of course, relevant for cosmology can only be the correct diagram at the right. This diagram is not based on hypotheses, it is based on known parameters (distances, velocities, i.a.), each verified by measurements. Moreover on the subsequent pages it will be proved that the assumption of a galactic escape velocity leads to contradictions, for instance with energy conservation and with the sign of the velocity. Especially the idea of expansion leads to contradiction with itself, because the result of an assumed expansion is – shrinking!

The consequences of energy conserving gravitation was already realized 1886 by **Ludwig Boltzmann**. At least since 1992 it is explained (in the book "**Gravitation Correlated With Light**") by Einstein's Spez.Rel. Theory and energy conservation. Alternatives are not known to the author. Today some autors begin to realize that the masses are the source of gravitational energy, i. a. **Harald Lesch**, **Marcus Chown** (see note on **Page 102**). However none of these authors examines the far reaching mathematical implications and the impact upon the "Standard"-Theories, as if the change of the base condition would not effect the Theory.

# "Light in Coma"

The reflections in this chapter should not be interpreted as an established theory. It is rather a test for checking the own power of judgment. Its unaccustomed physical suggestions and conclusions should inspire a critical dialogue – before it can be evaluated, acknowledged or refuted.

Sometimes psychologists judge the mental power of a test person by the time the person needs to present a solution for a problem in question. In contrast I tend to evaluate a person's brain-power the higher the less this person accepts to be set under stress of time. The history of science shows that, in general, it turned out that those have been proven to be wrong which are the first with opposition to an unconvential idea – often before they concede for the new idea the chance to be understood.

The reader will remember many instances where a reflective concideration have been refused.

The following unusual idea should be understood as initiating a "**dialogue with open end**".

Each time when in a remote galaxy a photon becomes emitted it starts a journey of billiards of years until it becomes absorbed or will even reach – extreme unlikely – a telescope. Sharpwitted reporters in television or in one of the beautiful astronomical yournals may think about photons as if they where on a journey. However little Gerlinde had some doubt: Could a tiny photon endure such a long voyage? One evening, when she once again had fixed her eye on a galaxy, an arriving photon could no longer bear the secret-mongering of the heaven and it dared to direct a question to Gerlinde: "What do you whish so much?", and Gerlinde quickly seized her chance: "Could you really endure such a long journey?"

"Oh no, Gerlinde" replied the photon, "I was not at all on a journey. Instead of travelling I appear directly, as I do it in this moment." Then the photon revealed to little Gerlinde its secret. Its words where about as follows:

Have you ever heard of persons who – by accident, desease, or narcosis – have fallen into unconsciousness, so deep, that later, after awaked, they could not remember any event in the time where their mind was absent.

Sometimes this unconsciousness lasts for years, years which do not exist in their life. Nothing was stored in their memory in that years, where they did'nt speak, feel and think, and no contact to any living being was possible. After awakend they continued their life up from that state where they had lost the awareness of anything. Such a deep unconsciousness is called Coma.

If you understand this, then you will understand me and all photons. The photon emitted by an atom remains a part of the emitting atom, *however this part is in coma* – meaning a "condition of emptiness". As such – in the view of human beings – it may last a long time, milliards of years or even unlimited. *Though the photon exists, it is not mentally alive because its own time is zero.* It can be "*alive"* only when waking up from the coma, and it will wake up only when it is aborbed by an atom – in a sense: when it becomes "kissed awake" by a "time-creature". "Awaken" means fusion, and fusion converts emptiness into "lifetime". Lifetime of what? In that moment the photon disappears, its existence is a zero-time-existence, this means it is the link between two realities, one reality before its emission, the other afterwards.

However there is more, because it may be that the photon is awake only for a single event and then it falls again into coma. If a living being awakens fully from the coma then its life is enriched by this single event, by including it in his recollection.

If such events are repeating then this is life – composed of such wake experiences and nothing else. Now someone could say, "life" is just the sum of events. Each event *is* life, and its sum is what we call "Time". In this way "Time" defines itself simply by <u>the number of the possible elementary events</u>. Only events count, nothing else exists, nothing can be interspersed or inserted or added. This would explain what for thousands of years has been a riddle for thinking beings, not only in Physics: This is **TIME**.
"Time" is simply the "number of all possible <u>elementar</u>y events which can be experienced".

That is all – and it is much.

If we are speaking of the duration of a physical event then we only compare it with the number of known events we have in mind. This is easier to imagine than the idea of "time flowing". If we compare the duration with real events then the "time" is not a "flowing" thing but simply the number of possible events. If this number is in one system $T_1$ and in an other system $T_2$, and if $T_2 < T_1$ (regardless of why, perhaps because the system of $T_2$ is moving relativ to $T_1$ ), then we say: the time runs slower in the moving system.

If the system of $T_2$ reaches the velocity of light, then the flow of time is zero, that means $T_2 = 0$, and this is the time of a "photon in Coma". It means: Between emission and absorption of the photon no event (no life) is possible. So we have got an entirely other idea of time, which is identical with the time in Special Theory of Relativity. May be this is unaccustomed, but it is not complicated.

If a photon is emitted then the emitting atom supplies the photon with a well defined quantum of energy. Max Planck has discovered that any energy transition, especially by light, goes in steps, called quants. Each step is within a precise time interval and its energy is expressed by the light's frequency, hence such a jump can define the TIME and also the unit of mass.

Planck's quantum of the **smallest** possible event has in fact the "dimension" *energy multiplied by time*. By absorbing a quantum an atom obtains both: 1 quantum of energy and its "duration" (this is 1 quantum time).

Because the smallest oscillation is 1 periode, one periode of light has always the same energy, designated by Planck with the letter **h**. It is an universal constant. This is the postulate of Planck and also of Einstein.

"**Time**" is the absorption of the sum of all periods. It is practicable to use the designation "quant" for these sum. Each periode has therefore the energy **h** and the duration **τ**.

Both is made "real" by absorption of a quant, and a quant is Energy *and* time.

Though this sounds logical, it provokes a lot of questions and doubts. We may ask immediately: What is an event? If these considerations should have a meaning then it may be the fact that it provokes pondering about it, and this means, that we may be open for critic instead of sticking to any of its conclusions.

If in place of Time or Duration the "number of elementary events" is understood, and if (in the view from "outside") the emission of a photon produces nothing else than coma (that is the condition of being ready, but nothing happens), the "time" of the photon is zero. For the photon exists no clock, no rotating pointer, no process or issue, no "time" which is passing by. There exist also no "distances", because distance can only be imagined by correlating some events which would define the way.

If according to **SRT** the run of time in a moving system is slower than in a system at rest, then the number of possible events in the moving system is less than it is in the system at rest, whatever we mean with "event". Essential is only that it should be understood as a universal constant energy **h** within a periode **τ**, which is not dividable. If a photon has been emitted then its state is a condition outside of space and time.

**"Space" and "time" are abstractions in our imagination, not-explainable.** Their interpretation depends on the context where it is used. When correlated with a photon then it indicates *ready to be absorbed*, when correlated with an atom then *it is* absorbed.

Question: Is our image of the world identical with the world itself?
Each creature has an image of the world – a human being, an ant, a burring cat.
Which of the image is "World"? Is it true for all: "You see the mind you comprehend, not me!".

# Where exists a scientific dialogue about astronomy?

For some readers the topics in this book seemed to be a blasphemy, for others the same topics are a relief from the misuse of mathematics as a spell to protect science against rational critic. Almost no editor can be found who tries not to exclude an autor from publication when his text contradict a standard hypthesis, regardless of the autor's qualification. Big Bang, Black Holes, expansion of the universe and other science fiction belong to the religion required for an author before just a single word can be published in the journals. The only forum left for rational scientific publications is the internet.

You can order only the german edition of a computer print of this essay. It is available in paper covers.
An english edition will be published at a later date under the heading:

**Gravitation correlated with Light**

Computerprint, paper cover, more than 100 pages, € 20,–.
The autor will be grateful for contributions by the reader.
**kiesslinger@rudolf-kiesslinger.de**

**Definition of the time unit 1 second by a natural frequency of the Cäsium Atom:**
**The SI-basic unit 1 Second** has been defined 1967 on the
13nd General Conferenz for Measures and Weight.
It is **9 192 631 770 times of the periode of an oscillation**, which corresponds with the transit time radiated at the transit between the two hyperfine structur niveaus **of the $^{133}$Cäsium nuclide**.

# Annotations

**1. <u>Longitudinal and Transversal mass</u>**
**An alternative to the derivation of the relativistic orbit, Chap. 3.6, <u>Page 30</u>:**

We have used the classic Equ.(3.27) for $E_{pot/orth} = 2\frac{GMm_q}{R} = \frac{GMmF^2}{R^3c^2}$, but we obtain the same result if we use the exact relativistic formula for the kinetic energy [$E_{pot/orth} = Mc^2 + 2m(1 - e^{-a/R})c^2$, $a = GM/c^2$]:

$E_{pot/orth} = Mc^2 + 2c^2m_q(1 - e^{-a/R}) = Mc^2 + \frac{mF^2}{R^2}(1 - e^{-a/R})$. With the power series for $e^{-a/R}$ we obtain

$$K_{kin/orth} = \frac{dE_{pot/orth}}{dR} = \left(-\frac{2mF^2}{R^3}\left(1 - e^{-a/R}\right)\right) - \frac{mF^2}{R^2}\cdot\frac{a}{R^2}e^{-a/R} = -\frac{2mF^2}{R^3} + \frac{mF^2}{R^3}\left(2 - \frac{a}{R}\right)\cdot\left(\underbrace{1 - \frac{a}{R} + \frac{a^2}{2R^2} - + \cdots}_{= e^{-a/R}}\right) =$$

$$= -\frac{2mF^2}{R^3} + \frac{mF^2}{R^3}\left(2 - \frac{3a}{R} + \frac{2a^2}{R^2} - \frac{5a^3}{6R^3} + - \cdots\right) = \frac{mF^2}{R^3}\left(-\frac{3a}{R} + \frac{2a^2}{R^2} - \frac{5a^3}{6R^3} + - \cdots\right)$$

$$\mathbf{K_{kin/orth}} = -\frac{\mathbf{mF^2}}{\mathbf{R^3}}\left(\frac{\mathbf{3a}}{\mathbf{R}} - \frac{\mathbf{2a^2}}{\mathbf{R^2}} + \frac{\mathbf{5a^3}}{\mathbf{6R^3}} - + \cdots\right) \cong -\frac{\mathbf{3GMmF^2}}{\mathbf{c^2R^4}}.$$

If terms with higher power are omitted, then the formula would be identical with Equ.(3.28).

If the orthogonal velocity is inserted, Equ.(3.22) $v_q = \dot{\varphi}R = \frac{F}{R}$, we would obtain $K_{kin/orth} = \frac{3GMm}{R^2}\left(\frac{v_q}{c}\right)^2$.

In order to save the reader's time for searching in reference lists, I adopt the integration of Equ.(3.29):

In any case, Kepler's **Law of Equal Areas Equ.(3.19):** $\dot{\varphi} = \frac{F}{R^2}$ states the condition for a central force.

**2. <u>Velocity of free fall from R = ∞ as a function of the distance R</u>,**

**<u>Formula (3.6), Page 22</u>:** $\mathbf{v = c.\sqrt{1 - e^{-2a/R}}}$ velocity at R *<u>When</u>* <u>$R = 0$ then $v = c$</u>.

Squaring:

$$\mathbf{e^{-2a/R} = 1 - \frac{v^2}{c^2}}, \qquad \textbf{or} \qquad \mathbf{e^{-a/R} = \sqrt{1 - \frac{v^2}{c^2}}}.$$

At $\mathbf{R} = \infty$ was the energy of both, the mass **m** plus the central mass **M**: $\mathbf{E = Mc^2 + mc^2}$.

When falling a part of **m** transforms into kinetic energy. Kinetic energy does not excert gravitation in the direction it falls. When reaching the distance **R** the gravitative mass has decreased by the factor $\mathbf{e^{-a/R}}$. Hence it remains from the whole energy $\mathbf{Mc^2 + mc^2}$ at $\mathbf{R = \infty}$ the potential energy

$$\mathbf{E = Mc^2 + mc^2\sqrt{1 - \frac{v^2}{c^2}}}.$$

This means: From the potential energy $\mathbf{E = Mc^2 + mc^2}$ at $\mathbf{R = \infty}$ remains at **R** only the intrinsic energy of the rest mass which has decreased by the kinetic energy.

**3.** Eine klare Darstellung, wie sich die Bewegungsgleichungen von Newton durch die Relativitätstheorie verändern, findet sich in der 2-bändigen Ausgabe (die alle 7-Bände enthält) der Vorlesungen von **Bernhard Baule** (die selbst zu erleben ich das Glück hatte):

**Die Mathematik des Naturfoschers und Ingenieurs**

(ISBN 3.87144-534-7).

In Band IV, Seiten 106 bis 109, berechnet der Autor, die beiden Komponenten der Gravitationskraft. Sie liegen in der *Bahnebene* der Bewegung:

1. eine radiale, auf das Grav.-Zentrum gerichtet, und
2. eine zur radialen Richtung (zu **R**) orthogonale.

Nur bei Änderung der Distanz **R** zum Grav.-Zentrum wird Energie (= Kraft mal Weg) umgesetzt, d.h. nur bei Änderung des Abstandes **R** ändert sich die Masse relativistisch.
Nicht verändert wird die Masse von der Kraft, die der *Fliehkraft* das Gleichgewicht hält – weil diese Kraft *orthogonal ("transversal") zur Bahn-Bewegung* steht.

Diese Kraft setzt keine Energie um, bewirkt aber die *Krümmung* der Bahn mit dem *Krümmungsradius* **ρ** proportional zu $^{1}/\boldsymbol{\rho}$. Das ist anschaulich erkennbar an der Mondbahn um die Erde: Obwohl der Mond dauernd auf die Erde "fällt" kommt er ihr nicht näher, das heißt: die Fall-Energie (Longitudinale Energie) des Mondes ist Null, obwohl die Transversale Energie (d.h. Rotationsenergie ≡ Drehung der Bahntangente) größer als Null und Teil der Summenenergie ist (alle relativ zur Erde!). Dessen Mittel über den vollen Umlauf bleibt konstant, konstant natürlich auch bei konstantem Abstand **R**.

Was für den Mond gilt, gilt auch für den orbitalen Umlauf der Planeten um die Sonne.

Wenn man gelernt hat, sich diese Bewegungen vorzustellen, ist das Geschehen leicht verständlich.

Die berechneten vektoriellen Kräfte **k→** und **k↓** sind: (**ρ** = Krümmungsradius)

$$\mathbf{k}\rightarrow\ = \frac{\mathbf{m_0}}{\left[1-\left(\frac{\mathbf{v}}{\mathbf{c}}\right)^2\right]^{3/2}}\,\mathbf{dv/dt} \quad \textbf{(transversal)} \qquad \mathbf{k}\downarrow\ = \frac{\mathbf{m_0}}{\sqrt{1-\left(\frac{\mathbf{v}}{\mathbf{c}}\right)^2}}\,\frac{\mathbf{v}^2}{\boldsymbol{\rho}} \quad \textbf{(longitudinal)}$$

"Transversal" heißt *quer* zum Abstand **R** vom Zentrum "Longitudinal" ist die radiale *Richtung* zum Zentrum.

Beide Kräfte liegen in der Bahnebene des Himmelskörpers.
"Longitudinal" bezieht sich auf die radiale Richtung **R** zur Zentralmasse. Gegen diese dreht sich der Geschwindigkeitsvektor auf der Bahn mit dem Krümmungsradius **ρ**, wobei die Fliehkraft $\mathbf{v}^2/\boldsymbol{\rho}$ der Gravitation in Querrichtung ("transversal") die Waage hält.

Diese Anmerkungen habe ich eingefügt, weil die Vorstellung von zwei Gravitationskräften, "longitudinal" und "transversal", auch bei Physikern oft zu Verständnisschwierigkeiten führt.

# INDEX

*Extremely frequent key words are omitted, e.g. “relativity”, “gravitation”, “Einstein”, ...*