GRAVITATION IN THE MAKING

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Abstract: 1st **Premise:** *Exclusively* standard physics, but adapted to *Special* Relativity (Lorentz-Invariance) *without* any new hypotheses + *all* empirical facts **2nd** **not cancelled:** Energy Conservation, **3rd** **cancelled:** A hypothetical "Energy Supplying Field", and **4th** **that integrated** into Classical Law of Gravitation. The result is a surprise:

1. **a)** *relativistic* orbits of planets, **b)** *relativistic* bending of light near large masses, **c)** *gravitational* Doppler shift, moreover:
2. General Relativity with new discoveries, among others: **d)** fossil light is red shifted proportional to distance *without* expansion of the Universe, **e)** an imploding mass ends not as Black Hole but annihilate totally by radiation, **f)** *Calculation*(!) of the Hubble-Constant, **g)** Gravitation is the inverse of the 2nd. Law of Thermodynamics, ...

Introduction

Two facts ahead: 1st: Red Shift of far Galaxies

An experiment with clocks performed in 1971 by J. C. Hafele and R. Keating [Science 177, 166 (1972)] raised world wide attention. For the first time it confirmed empirically Einstein's prediction that a clock (that means the run of time!) slows down when its distance to the gravitational center decreases. Since then the measurement has been repeated many times with high precision, for instance by a group of physicists at the university of Maryland 1975-76.

The stronger the gravitational field the slower the course of time. Now I will demonstrate that *this*, and not an expansion of the universe, causes the red shift of fossil light almost proportional to the distance of the source.

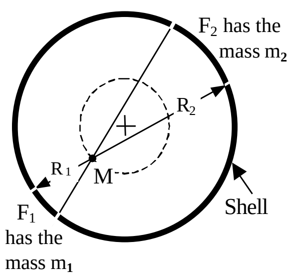
Foremost it must be emphasized that we assume no new hypothesis and no other physical laws than those which are known and accepted by *all* physicists and astronomers. That means, no other facts are assumed than the following:

1. The gravitation of a spherical symmetric mass remains the same when we consider its whole mass concentrated in its center. The proof can be found in relevant textbooks.
2. Inside a homogeneous spherical mass the gravitation decreases linearly and reaches zero when the distance to the center goes to zero (see explanation to the drawing below).

3. Fundamental Principle of Cosmology: All points in the Universe are equivalent, no point is physically distinguished from any other. In its own view is each point the center of the Universe, peripheral points do not exist.
4. Fundamental Principle of Relativity: In different reference systems the course of time is different, hence the reading of clocks is different. To be precise: The course of time inside a defined reference system is the same everywhere, but it differs between different reference systems if either (A) their velocities, or (B) the gravitational fields are different. The stronger the field, the slower proceeds the time.
5. Precise time measurements are possible with clocks synchronized by an atomic resonance frequency (called natural frequency).
6. The Gravitational Force is $K = \frac{GMm}{R^2}$ in a system of two masses M and m.

   (G is a constant, R is the distance between the two bodies).

Proof of fact 2: How is a mass M inside a sphere attracted by the masses outside?



The gravitation of the masses of the “shell” upon M cancel mutually. This can be seen if we consider all forces of the shell upon a mass M inside it. The masses of opposite areas F_1 and F_2 of the shell (with respect to M) increase with the square of their individual distances R_1 and R_2.
However, their gravitation on M decreases with the square of the *reciprocal* distance, hence opposite forces cancel mutually. That means: the masses outside exert no gravitational inside.

(That argumentation was first used by Cavendish and Priestley 1771 for the proof of the law of electrostatic attraction.).

Now consider a spherical symmetric mass. As recognized in classical theory the gravitational force of a spherical mass remains the same if we think the mass concentrated in its center. What happens if a mass M approaches the sphere? First the force upon M increases until it reaches the surface. If however the dropping mass penetrates the surface of the sphere, that means if its distance R(in) to the center is less than the radius R, then M will be attracted only by the mass of the remaining inner sphere with the smaller radius R(in) ≤ R because the gravitational forces of the masses of the shell outside cancel mutually.

If, for instance, the sphere is hollow, then inside the empty space no gravitational force exists. Only outside the shell the gravitational force is the same as if the mass (of the shell) would be concentrated in its center.

Now imagine the whole Universe is the outer sphere. By a general principle of Cosmology no point in the Universe has a distinguished position relative to the others, hence an observer at any point considers his location to be the center of the Universe. This is often explained in analogy to the surface of the earth, where *each* country can rightfully claim to be the “Empire of the middle”.

Next imagine a large sphere inside the universe with us in the center. Of course, it is smaller than the universe itself. Its radius R(in) should be exactly the distance to a remote galaxy M. Inside that sphere (dashed circle) are millions of galaxies. Their combined gravitation upon M is the same as if all these galaxies would be concentrated in its center where we are. Since all objects *outside* this sphere belong to the shell, they can not cause any gravitational force on the galaxy located at the surface of that imagined inner sphere.

If we know the average density of the universe, we get the total mass of that gigantic sphere by multiplying its volume with its mean density. Then, with the formula given above at point 6, we can calculate the gravitational force K of that sphere upon the observed galaxy, or the strength of the gravitational field at the location of the galaxy, all relative to our point of view in the center.

„To our point of view“ means that the *strength of the field is a relative quantity*. It depends on location and velocity of the observer. For instance, another observer, being at rest at a greater distance than we are, attributes to the same galaxy a greater field strength. Another instance is a free falling observer. The field at his location is zero. The gravitation decreases with the square of the distance, that is with $1/R^2$, whilst the gravitational mass of the cosmic sphere increases with its volume, that is with R^3, hence its gravitation increases with increasing R.

Because a gravitational field causes the time slowing down, the light emitted in that field is red shifted proportional to that field. That is the observed red shift of remote galaxies, first measured by Edwin Hubble.

If a remote galaxy would recede then its frequency would have an additional Doppler red shift due to its receding velocity. Such an excess frequency shift does not exist. It would contradict all measurements known up to now.

So the main argument for the Big Bang breaks down in itself. It shows just the contrary: The red shift disproves Big Bang and expansion of space, empirically and theoretically. That is the compelling result of all observations and of accepted theories without any additional assumption or hypothesis. The precise mathematical deduction can be found in the book “Gravitation in the Making”. The proof is confirmed by a lot of additional observations not explainable by receding velocities. Since more than 20 years such observations with large telescopes have been presented by Halton C. Arp, Fred Hoyle and others, but up to now all measurements not consistent with the Big Bang hypothesis have been ignored. With these observations H. C. Arp has done ground breaking work.

Of course, there exists also an additional red shift caused by local gravitational fields in the vicinity of the big masses of galaxies, especially on the light we receive from the surface of extremely concentrated Quasars.

The dependence of gravitation on distance does not surprise. It can easily be realized because due to mutual gravitation the universe with all galaxies must collapse. The greater the distance to an observer the faster is the *relative* velocity of collapse. For another observer in a greater distance to M the relative velocity *and* its cause, the acceleration of free fall, would be greater. However the acceleration of free fall is precisely that what we define as "gravitation". Hence it is not a contradiction that in the view of an observer at greater distance the gravitation is greater. After having disproved the Big Bang hypothesis we must accept the collapse of the Universe. But don't be afraid, there is no danger. It would result in a crash only when the Theory of Relativity wouldn't be true. As explained in "Gravitation in the Making" the relativistic effects upon length and time prevents that the collapse results in an ultimate crash. In fact, if Black Holes would exist then the Universe would be a Black Hole. That can be realized by inserting the mass of the universe into the formula for the radius of a Black Hole. The result is the radius of the universe and we are living *inside* it!

By the same argumentation another famous effect can be explained, that is the

2nd fact: The Gravitational Doppler Effect,

predicted by Einstein, measured 1960 with high precision by Pound and Rebka. The Effect states that the frequency of Gamma-Rays emitted at the base of a tower decreases on the way to the top. A wrong interpretation says the ascending photon loses energy due to climbing up the *field*. In a correct interpretation however the field does not affect the photon, *it effects the frequency meter*. (The photon consists exclusively on kinetic energy, and, in case of *dropping*, the kinetic energy cannot create itself.) The photons emitted at *the base* have been measured by comparing its frequency with the corresponding natural frequency of identical atoms *at the top*. However proportional to the decreased time scale the natural frequency is less at the base than at the top. Hence the measured decrease of the frequency of ascending photons does not indicate an energy decrease due to climbing up the field, it rather indicates that the natural frequency used as reference is less at the base than at the top. In many textbooks the measured frequency have been confused with the reference frequency, and that has been misinterpreted as a decrease of the frequency of the rising photons. The decrease of the time scale with an increasing field and vice versa had not been taken into account.

Now we can start with the essential parts of that essay. But notice:

If you expect a new theory or a new hypothesis then you will be disappointed. This text deals only with Physics as accepted by all physicists and which you can read in any textbook. There is just one difference: The Classical Law of Gravitation has been adapted to Special Relativity. It seems that has been tried only once by E. Milne and W. McCrea 1934, but that for an expanding universe.

The Clock Experiment

Let us consider again the experiment with clocks mentioned above. It confirms empirically Einstein's famous prediction that the time proceeds slower when the distance to the gravitational center shrinks, that is when the altitude is lowered. The effect has also been observed as deviation in time when measured with atomic clocks placed at different altitudes. The predicted and measured decrease of time is $\Delta\varphi/c^2$, when $\Delta\varphi$ is the decrease of the potential energy of gravitation, c is the velocity of light. There has never been any doubt that this is a confirmation of the General Relativity Theory. However up to now it has not been realized that this very experiment and even its theoretical argumentation requires a new interpretation of the General Theory of Relativity. Why that has not been realized and what is signified by such a challenging assertion has been pointed out in the book "Gravitation in the Making" by the following argumentation:

The decrease of the course of time does not depend on the kind of clock used. The measurement has been made with atomic clocks. *Atoms are clocks* because *any* natural frequency of the atom can be used as time standard. However, since the natural frequencies of an atom are proportional to its mass, decrease of the natural frequencies indicates decrease of the atomic mass by the same factor. Consequently a dropping mass also decreases by $\Delta\varphi/c^2$, *and with it its gravitation*. That is the same amount as the Kinetic Energy per unity mass increases at the expense of the Potential Energy. Potential Energy is *inner* energy. Conversion into Kinetic Energy is its transformation into *external* energy, characterized by being extractable. "Extractable" means convertible into *any* kind of energy, for instance into heat. Because $\varphi - \Sigma\Delta\varphi = 0$ even the largest mass must *decrease to zero* if, due to gravitation, it collapses without being stopped. It can never reach the velocity of light because it *must* become used up when approaching that velocity. Thereby it transforms into Kinetic Energy, and, at the impact, into heat of unlimited temperature T. Since the *whole* mass radiates proportionally to T^4 that renders Black Holes to Science Fiction.

Up to now that consequence has not been noticed or not taken into account, in spite of the fact that in most textbooks that decrease of a dropping mass has been realized. [An example for many others in Edwin F. Taylor and Archibald Wheeler/Physik der Raumzeit, 1994, Spektrum Akad. Verlag, even as exercise 8.6 page 403: „Which percentage of your rest mass transforms into Potential Energy when you are climbing up the Eiffel Tower of Paris?" Check it the other way round: To which distance to a point mass have you to drop until your mass has been used up for Kinetic Energy in the view of an observer at rest?].

It must be noticed that all these considerations and conclusions refer to an observer not moving and not displaced with respect to the central mass or the Center of Gravity. However an observer upon the dropping mass itself will not notice any change of the mass because his own mass has no velocity relative to himself. In his own view he has not the kinetic energy which other observers attribute to him. The change of his measuring units exists only in the view of other observers. For each of them a special factor of change is true, but identical for mass, length and time. The *relation* of these units does not change. An effect of his kinetic energy can be realized only when his mass interacts with the other mass, e.g. at the impact. The idea that the relativistic change of a mass will affect its inner structure would be a complete misunderstanding of relativity. Any relativistic change of mass is an effect of observation and does not effect the intrinsic constitution of the object to be observed.

The following must be accentuated: When a fraction Δm of the dropping mass m transforms into Kinetic Energy then the mass left is $m-\Delta m$. It has less gravitation due to the loss of $\Delta m = E_{kin}/c^2$ (= $m\Delta\varphi/c^2$). That means:

The Kinetic Energy has no gravitation in the direction of movement.

The decreased mass $m-\Delta m$ has got the velocity v. Multiplication by the relativistic factor $1/\sqrt{1-v^2/c^2}$ yields the original mass m, as it must be due to mass conservation. That is possible only when $m-\Delta m = m\sqrt{1-v^2/c^2}$. Then and only then the issue of the Clock Experiment is conclusive:

The gravitation of a mass decreases in that (and only in that) direction, where it produces Kinetic Energy. Precisely that part of the mass which transforms into Kinetic Energy ceases to exert gravitation in the direction of movement. However orthogonal to the movement the gravitation is not reduced, because in that direction no potential energy is transformed into kinetic energy. *Note: That is not a postulate, it is the result of a measurement!*

The dependence of the mass (and its gravitation!) on the direction of its movement is not a new discovery. It is well-known in Special Relativity and has been called long ago „**longitudinal**“ and „**transversal**“ mass.

Because velocity is an one-dimensional quantity it does not surprise that mass and gravitation appear decreased only in the direction of movement, and that by the same one-dimensional factor as the length.

The result is shocking for many Physicists, the more because due to *empirical* evidence it is a compelling consequence.

It turns out that all the *measurable* results of Einstein's General Relativity follow from the **Classic Gravitational Law** *without* field energy, **if** we accept:
(1) Not the space but the mass is the source of gravitational energy, and
(2) the laws of Special Relativity are true (*including* energy conservation!).

The Clock Experiment of Hafele and Keating shows the decrease of a dropping mass m. That can be expressed by an adequate positive factor $f(R) < 1$. To simplify matters let us assume a two body system with an observer upon a central mass M. When m falls to M from $R = \infty$ the mass m decreases to $mf(R)$. Seen from the central mass the **remaining potential energy** of both the masses has

(1) decreased to $\mathbf{E_{pot} = [M+m\cdot f(R)]c^2}$ with $0 < f(R) < 1$.

Because $E_{kin} = |\int_{\infty}^{R} K dR|$ and $E_{pot} = (M+m)c^2 - E_{kin}$ the derivative with respect to distance R is the **„Energy converted from E_{pot} into E_{kin} per unity of R":**

(2) $|\mathbf{K}| = |\frac{\mathbf{dE_{pot}}}{\mathbf{dR}}| = \mathbf{mc^2 \cdot f'(R)}$. The factor K is called **„<u>Force of Gravitation</u>".**

If "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. That is characteristically for a relativistic quantity, especially for mass, whose dependency on velocity is already accepted. All the more it may surprise that the rest mass has never been introduced as a *relativistic* quantity in the Gravitation Law. When doing so the Gravitation Law, instead GMm/R^2, becomes

(3) $\mathbf{K = G\frac{M \cdot mf(R)}{R^2}}$ and $E_{pot} = (M+m)c^2 - \int_{\infty}^{R} K dR$, hence $|\mathbf{K}| = \frac{\mathbf{dE_{pot}}}{\mathbf{dR}}$.

Gl.(3) = Gl.(2) leads to: $\mathbf{G\frac{M \cdot mf(R)}{R^2} = mc^2 \cdot f'(R)}$,

in other arrangement: $\frac{f'}{f} = \frac{GM}{c^2} \cdot \frac{1}{R^2}$. 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 ∞ to R: $\ln f = -\frac{G}{c^2}\frac{M}{R}$. Inserted as exponent of the base e yields

The Energy-Conserving Law of Gravitation:

(4) $\mathbf{f(R) = e^{-a/R_o}}$ where $\mathbf{a = \frac{G}{c^2}M}$. [f(∞) = 1, f(0) = 0]. Inserted into (1)+(3):

(5) $\mathbf{E_{pot} = (M + m e^{-a/R_o})c^2}$, and with the condition $\mathbf{E_{kin} = (M+m)c^2 - E_{pot}}$:

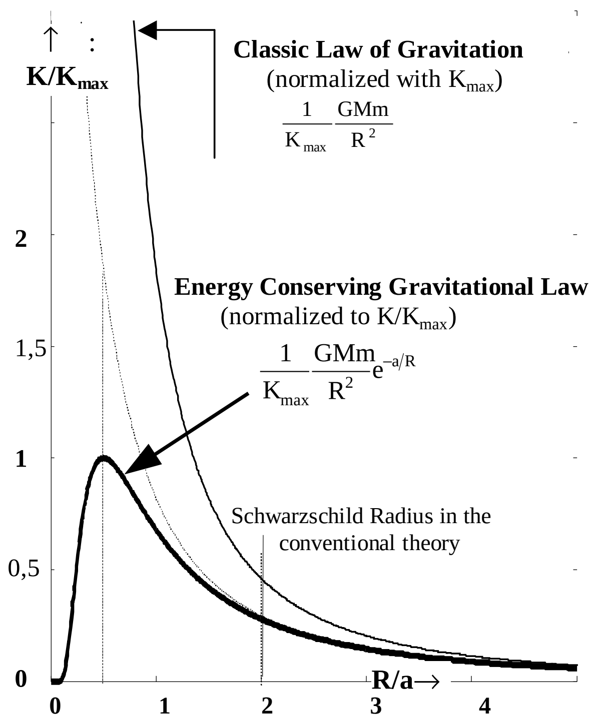
(6) $\mathbf{E_{kin} = mc^2 \cdot (1 - e^{-a/R_o})}$ and

(7) $\mathbf{K = G\frac{Mm}{R^2} \cdot e^{-a/R_o}}$. **(R is replaced by R_o for reasons of symmetry. That is explained below with the <u>Center of Gravity</u>.)**

For $R \to \infty$ is $e^{-a/R} = 1$. Then the whole mass is potential energy according to Equ.(5). A mass in such a far distance is called **<u>Prime Mass</u>** or **<u>Initial Mass</u>**.

Einstein used the Classical Law of Gravitation as reference when formulating the set-up for his theory. I did the same with just one difference: I have the Classical Law adapted to Energy Conservation by expressing each mass by the identity m = E_{pot}/c^2, and E_{pot} is conceived as source of the gravitational energy. The reader will experience the same surprise I had when he too, step by step, realizes that this adaptation converts the Classical Law into the General Theory of Relativity, but that without adding a hypothetical curvature of space and without postulating the vacuum as a possible source of energy.

Diagram of the gravitational force:



Symmetry of the Masses with respect to the Center of Gravity

What at first catches the eye of an expert is the odd symmetry of the Energy Conserving Law $K_1 = G\frac{M \cdot me^{-a/R}}{R^2}$.

That looks as if $me^{-a/R}$ would have priority with respect of supplying Gravitational Energy. But an observer upon the other mass obtains the same formula

for K_2: $$K_2 = G\frac{m \cdot Me^{-a/R}}{R^2}.$$

So at a first glance K_1 and K_2 seem to be symmetrical, but they are not because the constant factor a has different values in the formula for (K_1) and (K_2):

$$a_1 = GM/c^2 \text{ and } a_2 = Gm/c^2 \neq a_1.$$

That spoils the equilibrium of the forces because the principle **actio = reactio** demands $K_1 = K_2$. Moreover the observers would measure different values for the same relative velocity, namely [the formula will be shown below].

$$\underline{\text{for m}} \quad v_1 = c\sqrt{1-e^{-2a_1/R}}, \text{ and } \underline{\text{for M}} \quad v_2 = c\sqrt{1-e^{-2a_2/R}}.$$

The condition $K_1 = K_2$ and $v_1 = v_2$ would be met only when the distances of the two masses would be different for each mass. If we consider such a paradox situation where the distances are different then we get

for $K_1 = K_2$ $v_1 = c\sqrt{1-e^{-2a_1/R_1}} = v_2 = c\sqrt{1-e^{-2a_2/R_2}}$. That is true only if $\frac{a_1}{R_1} = \frac{a_2}{R_2}$. Because $a_1 = \frac{GM}{c^2}$ and $a_2 = \frac{Gm}{c^2}$

the exponents would be equal only if $\frac{GM}{c^2R_1} = \frac{Gm}{c^2R_2}$. Hence $mR_1 = MR_2$.

That Formula however reveals the solution of the paradox, because it is the **Condition for the Center of Gravity S**, according to its definition:

(8) **M |** $\underset{v_2}{\rightarrow}$-----$\mathbf{R_2}$-----o$_\mathbf{S}$-------$\mathbf{R_1}$------$\underset{v_1}{\leftarrow}$-● **m** with $\mathbf{R = R_1 + R_2}$ and $\mathbf{MR_2 = mR_1}$

That means: As „distance" R in the exponent a/R has to be understood not the mutual distance of the two masses but for each mass its distance to the common Center of Gravity. Then not only becomes $v_1 = v_2$, but also the forces and the acceleration will be in equilibrium and the principle of symmetry **actio = reactio** is met. Of course, that has to be derived mathematically. For that we proceed as before:

From **(8)** we obtain $R_1 = \frac{RM}{M+m}$, and $R_2 = \frac{Rm}{M+m}$.

Analogous to Equ.**(1)** and **(3)** we write **(1a)** $E_{pot} = [M + mf(R_1)]c^2$,

$$K = \frac{dE_{pot}}{dR} = mc^2\frac{df}{dR_1}\frac{dR_1}{dR} = \frac{Mm}{M+m}f'(R_1) = \frac{GMmf(R_1)}{R^2} \Leftarrow \textbf{(3a).}$$

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

$$\textbf{(4a)} \quad \mathbf{f(R_1) = e^{-a/R}} \quad \text{with} \quad \frac{\mathbf{a}}{\mathbf{R}} = \frac{\mathbf{G(M+m)}}{\mathbf{c^2R}} = \frac{\mathbf{GM}}{\mathbf{c^2R_1}} = \frac{\mathbf{Gm}}{\mathbf{c^2R_2}}.$$

When applying the Equ.(4) to (7) it should be realized that R in the *exponent* a/R refers to the common Center of Gravity and *not* to the distance between m and the central mass M. If however in the exponent the whole distance R between the two masses is used then the sum M+m has to be written instead of M, as can be seen in the formulas (4a). Then the symmetry of the law is apparent.

The subscript $_o$ of R_o in the exponent a/R_o of the equations (4) to (7) should indicate that R_o should be R_1 or R_2 or R, depending which expression for a is used.

The Course of Time and the Axioms of Einstein and Newton

According to Special Relativity the course of time decreases with increasing velocity by the formula

(9) $$\mathbf{t = t_o \sqrt{1 - v^2/c^2}}\ .$$

That is the same formula we got for the time decrease of a mass m when it falls from R = ∞ to the distance R (clock experiment of Hafele and Keating). The consequence is far reaching since with the time the mass too must have decreased by the same factor:

(10) $$\mathbf{m(R) = m \sqrt{1 - v^2/c^2}}\ .$$

On the other hand, according to Energy Conserving Gravitation [Equ.(5), (6) and (4a)], the Potential Energy, that is the mass itself, decreases by the factor $e^{-a/R}$ when dropping from ∞ to R:

(11) $$\mathbf{E_{pot} = m\, c^2 e^{-a/R}}\ .$$

Comparing Equ.(10) and (11) shows the important relation between v and R:

(12) $$\mathbf{\sqrt{1 - v^2/c^2} = e^{-a/R}}\ . \qquad \text{(v is the velocity after a fall from } \infty \text{ to R)}$$

For his famous “Field Equations” Einstein adopted from the classical Potential Theory the postulate that the gravitational energy originates in the field. He soon realized that this postulate has the remarkable consequence that a *time interval* t_o decreases to t when the distance to the center decreases from infinite to R. For that decrease he assumed the following formula for the square of the interval

(13) $$\mathbf{t^2 = t_o^2 \left(1 - 2GM/c^2R\right)}.$$

It looks as if that formula would be imperative by mathematical reason, but it is a postulate. Einstein has even proved that it is not derivable from any other principle. Moreover, it can be shown that this postulate implies the hypothesis that the gravitational energy has no source. If the interval had been postulated by another formula, then, of course, that would result in another theory, but Einstein’s definition of the interval *by that formula* has turned out to be an ingenious stroke because its empirical verification was convincing. Up to now and for about eight decades any doubt on it has been abandoned as an impossible idea.

If however Energy Conserving Gravitation is true then the time interval cannot be postulated at all because it *is* already defined, and that by a formula different from Einstein's vision. It is a consequence of Special Relativity and of Energy Conservation, and as such it *has been verified by measurement*. According to Special Relativity the course of time decreases with the velocity by the formula $t = t_o\sqrt{1-v^2/c^2}$. That formula must be true also for the velocity v of free fall from R(start) = ∞ to R which obeys Equ.(12) $e^{-a/R} = \sqrt{1-v^2/c^2}$. Hence, if at R = ∞ a time interval has been t_o, then at the distance R it has decreased to

(14) $\mathbf{t = t_o e^{-a/R}}$.

In order to make that comparable with the squared interval postulated by Einstein we have only to square the formula, $t^2 = t_o^2 e^{-2a/R}$, and expand that e-function in a series. Theories having corresponding terms are written beneath.

$$t^2 = t_o^2 e^{-2a/R} = t_o^2\left[1 - \frac{2a}{R} + \frac{1}{2}\left(\frac{2a}{R}\right)^2 - \frac{1}{3!}\left(\frac{2a}{R}\right)^3 + - \ldots\right]$$ = Squared interval. Compare that with

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

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2. Approx.: **Einstein's Hypothesis** all terms after the 2nd neglected (Black Hole at R = 2a). Time decreases too much, mass too less

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

The differences of these three theories can be realized at a glance. It can be seen why the three theories converge to the correct result when the neglected terms are successively inserted.

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

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 = $2GM/c^2$. For the mass M of the sun is 2a = $2GM/c^2 \cong 3$ km, the distance to the earth is 150 millions km, hence the orbits in Einstein's General Theory and in Newton's Theory are almost identical and highly accurate. The hardly measurable deviation from Newton's Law was a brilliant confirmation of

the interval postulated by Einstein. A more suitable postulate could hardly be imagined, or seemed to be somewhat metaphysical because it would never be distinguishable from the irregular disturbances caused by the other planets.

Substantial deviations appear only near the so called Schwarzschild Radius $R = R_S = 2a$. For that radius Einstein's formula results in $t = t_o(1– 2a/2a) = 0$. That means a standstill of time at $R_S > 0$. In that case is $t = 0$ and the formula $t = t_o\sqrt{1 - v^2/c^2} = 0$ proves $v = c$ = velocity of light. In Einstein's theory R_S defines the surface of a Black Hole, from which "not even light can escape".

3. If no term is neglected then the time interval obeys precisely the formula of the Energy-Conserving Law $t = t_o e^{-a/R} > 0$ for all $R > 0$. That means the condition $t = 0$ and $v = c$ is true *only* at $R = 0$, where $m(R) = 0$, so the possibility of the existence of a Black Hole has vanished.

Another consequence of neglecting the terms of higher power is a distortion of the space geometry. If time intervals would become zero at $R_S > 0$ then length must decrease by the same factor, and too become zero, because, for light, the quotient of length and time must be the constant velocity of light. That means the circumference of a Black Hole must be zero and with it its surface. How should that be consistent with $R_S > 0$?

The same inconsistency arises with the whole universe. According to Einstein's theory the radius of a Black Hole is $2GM/c^2$. If M is the mass of the universe then that is its radius, and the universe is a Black Hole. Because its radius can be measured we know its volume. We get its mass M by multiplying the volume with its mean density. The most remote galaxies are at its radius and can be seen in each direction. But with zero circumference their mutual distances should be zero! Such a strange world remains to be explained.

Here is the place to answer some critics who are accusing me I had the intention to refute Einstein! My answer is simple:

1. Why should it be a taboo to "refute Einstein"?
2. Nevertheless I belief "mutual refuting" is a bad motivation for scientific work. If a critic cannot imagine a better motivation then it is difficult for me to explain it. I never had such destructive intentions and don't like it.
3. The series for t^2 on the preceding page demonstrates the contrary of such an intention, because it *proves* Einstein's formula to be almost perfect if R is far greater than R_S. Einstein envisioned the mathematical precise expression of the first two terms of that series at a time when nobody had even the idea of a possible underlying formula. At his time no empirical check could be imagined to reveal additional terms in that formula–except Einstein himself! It was he who had the releasing idea that time could depend on the strength of the gravitational field. It was he who proposed to check that as soon as precise clocks are available.

4. Since it is impossible to check this formula in the vicinity of Black Holes it was impossible to proof their existence. Nevertheless within a few years almost the whole physical community become convinced of the existence of Black Holes–except Einstein! Though Einstein had not found the precise formula, he had the correct intuition that Black Holes could not exist, whereas the critics mentioned above have the correct formula but can neither read it nor imagine its simple consequence.
5. Why is the critic afraid to "refute Einstein"? Einstein never claimed for his *many* brilliant scientific contributions that they must be the ultimate truth. He never excluded further research. If this essay presents some new ideas, then that was possible only on the fundament of Einstein.

Acceleration and Velocity as Function of Distance R

We obtain from Equ.(12) $\sqrt{1-v^2/c^2} = e^{-a/R}$ the velocity v of a body as function of R when it falls from infinite to the distance R:

(15) $\mathbf{v = c\sqrt{1-e^{-2a/R}}}$.

That too excludes the possibility of Black Holes because v = c only at the center (R = 0). There the mass transforms into radiation and can escape. Radiation would escape even if the mass would not vanish because radiation does not sense gravitation in the direction it propagates. However mass can be transformed into radiation at any distance due to other physical effects. An instance is a meteor's impact on the earth. Most of its kinetic energy transforms into heat which is radiated.

By multiplying Equ.(12) with the dropping mass m we get

(16) $\mathbf{m\sqrt{1-v^2/c^2} = m\,e^{-a/R} = E_{pot}}$. That means E_{pot} is a function

1. of distance R of the mass after descending from ∞,
2. of the velocity the mass has got on the way from ∞ to that distance.

Differentiation on either side with respect to time t (left $\frac{d}{dv}\frac{dv}{dt}$ = right $\frac{d}{dR}\frac{dR}{dt}$)

and with Equ.(4a) $a = GM/c^2$ we obtain

$$\frac{m}{\sqrt{1-v^2/c^2}}\cdot b = -\frac{mc^2}{R^2}\cdot a\cdot e^{-a/R} = -\frac{GMm}{R^2}\cdot e^{a/R} = -K \qquad \text{[K according Equ.(7)]}$$

With $b = \frac{dv}{dt}$ = acceleration and $v = \frac{dR}{dt}$ = velocity of free fall we obtain

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

That is the Law of Inertia.
It states
Conservation of Momentum
(because for K = 0 is b = 0, hence v = const.)

Since this law has not been postulated, neither directly nor implicitly, it is a consequence of the Energy Conserving Law of Gravitation. The left side is mass times acceleration (Note: the mass is the relativistic *increased* mass). The cause of the acceleration is the gravitational force at the right side with the relativistic decreased mass $me^{-a/R}$.

The equation is valid when the force (acceleration) is directed to the center. There are good reasons for the assumption that *all* forces are gravitational forces, electromagnetic forces included [which are stronger by a factor of about $(10^{21})^2$]. For central forces that has been proved in "Gravitation in the Making".

From Equ.(17) we get the acceleration b:

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

The negative sign is the condition for balancing the central force.
b = 0 implies R = 0 *or* R = ∞. That differs from Einstein's source-free field, where in case of a sufficient concentrated central mass a Black Hole should appear because near the so called Schwarzschild horizon the velocity of free fall would approach the velocity of light (and, according to his theory, the acceleration of free fall should be infinite even for photons!).

In opposition to that prediction Energy Conserving Gravitation leads *not* to the singularity of a Black Hole. If we introduce Equ.(12) into Equ.(18) we get

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

For $e^{-2a/R} = 1$ is $b = GM/R^2$ in accordance with the Classic Law.
For R = 0 is b = 0. That means: In contrast to Source Free Relativity *and* to the Classical Law, the gravitation vanishes at R = 0. **There is no Black Hole** and nothing can prevent the energy to escape by radiation.

Again it must be emphasized that all these results have been deduced without an extra curvature of space or any additional assumption.

For R >> 2a the function $e^{-2a/R}$ can be approximated by $1 - 2a/R$.
Then, with $a = GM/R^2$, the velocity is

$$v \cong c.\sqrt{\frac{2GM}{c^2R}} = \sqrt{2GM/R}$$ in accordance with v in the Classical Law.

We should note that all these results have been deduced from the Clock Experiment. Hence they are not a mere alternative to the prevailing theory but a *compelling* correction of the conventional interpretation of Relativity.

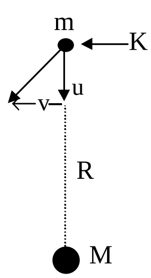
Inertia Orthogonal to Velocity

One result of Special Relativity has been disturbing for many physicists. If a force is applied *rectangular* to the velocity of a mass then the mass increases with the third power of the mass transform factor found in the direction of the movement, that means: rectangular it is $m\Big/\left(\sqrt{1-v^2/c^2}\right)^3$ instead $1\Big/\sqrt{1-v^2/c^2}$.

That implies that one and the same body shows two different masses which have been designated „longitudinal" and „transversal" mass. Multiplied with c^2 that yields two different energies for on and the same body:

(20) $$E_{long} = \frac{mc^2}{\left(\sqrt{1-v^2/c^2}\right)^3} \quad \text{and} \quad E_{trans} = \frac{mc^2}{\sqrt{1-v^2/c^2}}.$$

Since for many physicists such a result is disturbing it is often ignored. Nevertheless in textbooks longitudinal and transversal masses exist, they are derived and measurable. Now I will try to show how that can be understood by Energy Conserving Gravitation. Where is the additional energy $E_{trans} - E_{long}$ hidden and why is it *not* part of the kinetic energy of the rectangular movement?



The diagram shows the velocity u of the mass m by an arrow pointing down. All the masses of the universe are playing the game of gravitation since ever. Hence we can conceive the velocity u caused by a free fall of the mass m towards an imaginary central mass M (provided value and distance of M are adequate for causing its momentary velocity u and acceleration b). It was Einstein who coined that "**Principle of Equivalence**". It states: Acceleration and hence the resulting velocity cannot be distinguished from gravitation. Now we choose that conceptual gravitational Mass M as an advantageous reference point. No other reference point fits better to all possible constellations. With such an conceptual mass M each system can be transformed into a closed system. With Energy-Conserving Gravitation we can calculate the appropriate value and distance of M in order that m will be accelerated to its actual velocity u.

Next we accelerate the mass m by a force rectangular to its velocity u until it has an orthogonal velocity v. The value of the transmitted kinetic energy must be

(21) $$E_{kin/orthogonal} = \frac{mc^2}{\sqrt{1-v^2/c^2}} - mc^2.$$

(*That kinetic energy corresponds to the transversal velocity* v.) The first term is the relativistic increased mass $m_{pot/orthogonal} = \frac{m}{\sqrt{1-v^2/c^2}}$. That mass must be inserted in the place of m because kinetic energy acts fully gravitational in the direction orthogonal to the movement. It is marked by the index „potential". By inserting that mass into Equ.(5) and (6) we obtain:

(22) $E_{pot} = (M+\frac{m}{\sqrt{1-v^2/c^2}} e^{-a/R})c^2$ and **(23)** $E_{kin}= \frac{m}{\sqrt{1-v^2/c^2}} c^2(1- e^{-a/R})$.

Note: there are *two* kinetic parts of the energy:

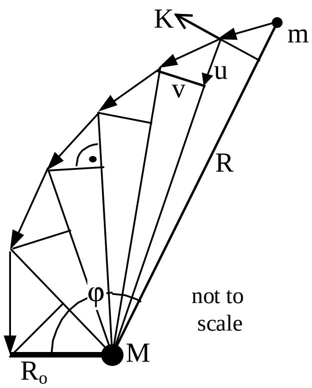
1. the u-part in the direction ↓R to the center M because m falls towards M and
2. the v-part ←orthogonal to R.

According to Energy Conserving Gravitation the kinetic energy of the *free fall* emerges at the *expense* of the primary mass. However we have just before assumed a *constant* primary mass which should increase only due to the applied lateral force. The reason for such a condition is the purpose to find the energy demand for an acceleration of m *exactly* orthogonal to the velocity u ($\neq 0$). This implies that the mass m should not be altered by other effects. Free fall *is* an other effect. Certainly we cannot stop the free fall because it is the cause of the velocity u which is our premise. Still there exists an alternative. *The energy inserted by means of our orthogonal acting force must be raised by exactly the same amount as the mass loses energy for the free fall*. That means the kinetic energy of Equ.(21) for the rectangular acceleration of m must be made equal the kinetic energy of the free fall according Equ.(23). Then both the energies increase simultaneously by the same amount. The one is added and the other subtracted, so the mass will not change. That condition is met when

u = v *and* Equ.(21) = Equ.(23), that means,
the energy decrease by $e^{-a/R}$ is compensated by the increase of m:

(24) $$\frac{mc^2}{\sqrt{1-v^2/c^2}} - mc^2 = \frac{m}{\sqrt{1-v^2/c^2}} c^2\left(1-e^{-a/R}\right)$$

In order not to become lost in abstract formulas it will be helpful if we look at the trajectory of a mass when this condition is met. The shape of the curve is determined by the condition u = v. That is the condition of the so called **logarithmic spiral** when the radius R intersects the curve with an angle of 45°.



Its equation is

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

After solving the brackets at the right side of Equ.(24) and reduction with the left side an equation remains which easily can be seen as the condition for energy conservation for E_{pot}:

(26) $mc^2 = \dfrac{m}{\sqrt{1-v^2/c^2}} c^2 e^{-a/R}$

(The energy decrease by $e^{-a/R}$ is compensated with the increase of m by the reciprocal root)

With dv/dt = b and dR/dt = v the derivation of Equ.(26) with respect to time is

(27) $$0 = \frac{mv}{c^2\left(\sqrt{1-v^2/c^2}\right)^3} b \cdot e^{-a/R} + \frac{m}{\sqrt{1-v^2/c^2}} \cdot \frac{a}{R^2} \cdot e^{-a/R} u \,.$$

Because $a = GM/c^2$ and the requirement u = v [condition for orthogonality of K and u, see Equ.(24)] we can reduce v, u, $e^{-a/R}$ and c^2. The result is

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

That is the <u>Law of Inertia</u> for a force rectangular to Gravitation.

The factor $e^{-a/R}$ for the decrease of the potential energy has vanished because in that case the loss of energy (mass) was refunded by the energy input via the rectangular force. In total three energy quantities had to be inserted by means of the rectangular force in order to maintain orthogonality. These are:

1. The kinetic energy for the rectangular velocity $E_{kin(v)} = m\left(\dfrac{1}{\sqrt{1-v^2/c^2}} - 1\right)c^2$.
2. The kinetic energy of the free fall, which has to be refunded to the mass m. Because u = v its value is the same as $E_{kin(v)}$ of the preceding point 1.
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 movement rectangular to the distance R. This effect raises the energy of the free fall extracted from the mass. That additional loss of mass must be restored too. Its value equals each one of the other two energies as can be

seen at the formula (28) where m at the right side is increased once more by the reciprocal root factor.

That threefold energy increase introduced by the rectangular force corresponds to the third power of the reciprocal root factor at the left side. In Special Relativity it is called „longitudinal mass“. The increase is caused by the additional fall energy and the additional potential energy, each having the same amount.

The right side of Equ.(28) represents the gravitational force with the effective mass. In Special Relativity Theory that mass is called “transversal mass”. But note: The designations “longitudinal” and “transversal” are often confused.

The shown derivation of the „Transversal Inertia“ allows a better understanding. It is not a meaningless formalism. It has revealed that the radial and rectangular masses represent different qualities of both, inertia and gravitation, which up to now have not been distinguished. The same understanding could hardly be found with Einstein's Source-free Gravitation. With that new understanding we see:

1. An acceleration exactly rectangular to *Gravitation* occurs only if the lateral force causes a velocity of the same amount (absolute value) as the velocity due to gravitation. If a two-body system is given, then orthogonality requires a force which is equal that caused by the gravitational Center M. If the force has another value, then only that component of it satisfies Equ.(28) which has that amount. The remaining component satisfies an increase of the mass according to Special Relativity.
   It may be difficult to realize that with the usual interpretation.
2. A force rectangular to Gravitation generates a trajectory with the shape of a logarithmic spiral having a 45° angle to the radius.
3. Note that the mass m can be reduced in Equ.(28). That is of high importance. It means that the equation remains valid when the mass m changes. It can change if the energy for the rectangular movement will be extracted from the dropping mass as is the case for planets at their orbital movements. That does not contradict the required constancy of that mass mentioned above, since that constancy is essential only for the *relation* of the three parts of that mass and not for its absolute value. That can be realized if each step of the argumentation is considered for its own. Between each step the mass can be reduced by that part dm which produces the rectangular movement of the following step. During the step itself however the mass remains constant.

Relativistic Orbits

The following is assumed to be known:

(29) Kepler's 2nd Law = $\mathbf{R^2\dot{\varphi} = F}$ =constant = true for all central forces, hence

(30) $\int_0^t R^2 \dot{\varphi} dt = \int_0^t F dt = Ft$ = **Law of Equal Areas.**

(31) $v_q = \dot{\varphi} R = \frac{F}{R}$. **= Transverse Velocity** = velocity rectangular to R)

(32) $b = \frac{d^2R}{dt^2} = \frac{v^2}{R}$ **= Centripetal Acceleration**

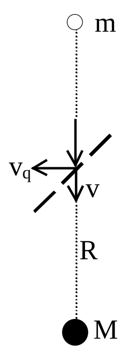
The orbits of planets are defined by Newton's friction free Law of Gravitation and the principle **actio = reactio**, where all forces acting upon m are in equilibrium (the following variables are expressed by their amounts):

Inertia + Mass Attraction K = Centripetal Force, **$\underline{K = GMm/R^2}$**.

Usually that equation is written with components interchanged:

(33) $m\ddot{R} - mR\dot{\varphi}^2 = -\frac{GMm}{R^2}$. Additional $\dot{\varphi} = \frac{F}{R^2}$, Law of Equal Areas, which is true for <u>all</u> Central Forces. $K = GMm/R^2$ *is* a central force.
By integration we get (according to Newton):

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



Now the *Relativistic* Equation of Movement can be deduced. Consider a mass m dropping along a small distance to M. At the same time the movement of m should be diverted into the horizontal direction. The horizontal component v_q reaches its maximum when the velocity v to the center disappears. We are asking only for the effects resulting from such a deflection regardless of the underlying mechanism.

In the course of dropping the mass m *<u>de</u>creases* by the mass of the kinetic energy $E_{kin}/c^2 = mv_q^2/2c^2 = m_q$. Its force of gravitation decreases too because kinetic energy has no gravitation in the direction it moves. *If* however that energy is *returned* to the mass m, then neither m nor its gravitational force will decrease.

The energy *is* returned to m when the kinetic energy released by braking is stored *inside* the mass m, of course by transforming it into *heat* or *tension of a spring* inside m. In case of planets that energy-return to m happens by turning the kinetic energy of free fall into kinetic energy $mv_q^2/2$ of a movement v_q *orthogonal* to R until the free fall is stopped. In that case the braking is caused by an increase of the centrifugal force which acts like a buffer spring inside the dropping mass m. Note: the *cause* for retaining the original mass is not the orthogonal velocity v_q but the *<u>dec</u>eleration* of the velocity of free fall. To count for that the factor $e^{-a/R}$ (or simply the change of the mass on the way from R_{max} to R_{min}) has to be omitted in the Gravitational Law. That however will not be sufficient because it would restore the original condition only if the gravitation of the kinetic energy would be like that of a bodily mass, that is independent on direction. For instance: Energy stored as heat or as tension of a spring exerts gravitation not dependent on direction, the gravitation of Kinetic energy however is unidirectional orthogonal to the movement (for that it is zero in the direction of movement). That means: the mass *defect* in the direction of dropping is equal the *gain* of mass orthogonal to it, having gravitation in orthogonal direction only. That ensures that the mean value of the mass m remains constant because gain and loss relative to the mean value are equal, but the mass difference is twice that value. So the excess of gravitational mass is twice that of the mass $\underline{m}_q = E_{kin}/c^2$ of the kinetic energy. By the 90°-deflection that excess is *turned back* into the radial direction. Formulated mathematical: Compared with the inertial mass $\underline{m}_q$ the *gravitational* mass of the kinetic energy is $2\underline{m}_q = 2\,mv_q^2/2c^2$.

The argumentation must be reversed if by an *increasing* distance R the mass regains its gravitation potential. Then the horizontal movement slows down and its kinetic energy is used for restoring the potential energy.

The same conclusion follows from the condition of orthogonality in the preceding chapter, which too requires two identical amounts of energy. The one is the kinetic energy needed for the orthogonal movement, the other is the additional energy of free fall (returned by braking), as pointed out with Equ.(24).

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.

(35) $$E_{kin/cross} = \frac{mv_q^2}{2} = \frac{mF^2}{2R^2}$$ [$v_q = \dot{\varphi} R = \frac{F}{R}$ see Equ.(31)]. Its Mass m_q is

(36) $$m_q = \frac{E_{kin/cross}}{c^2} = \frac{mv_q^2}{2c^2} = \frac{mF^2}{2c^2R^2}.$$

Because of the twofold effect we have to add to the gravitational force twice the force of that utterly small mass of the kinetic energy. Since for planets $e^{-a/R} \cong 1$ the *classic* formula for potential energy $E_{pot} = GMm_q/R$ is extremely accurate.

(37) $$E_{pot/cross} = 2\frac{GMm_q}{R} = \frac{GMmF^2}{R^3c^2} = \frac{2GM}{Rc^2} \cdot \frac{mF^2}{2R^2} = \frac{v^2}{c^2} \cdot \frac{mv_q^2}{2}$$ Hence:

(38) $$\underline{K_{kin/cross} = \frac{dE_{pot/cross}}{dR} = \frac{d}{dR}\left(\frac{GMmF^2}{R^3c^2}\right) = -3\frac{GMmF^2}{c^2R^4}},$$ [m_q, v_q from Equ.(36)+(31)]

that is an *additional* force of gravitation on planets (and comets).

In order to get the relativistic set-up of the Mechanics for Celestial Bodies there remains to be done nothing else than to introduce (instead of the *relativistic* factor $e^{-a/R}$) that *additional* force into the classical set-up according to Equ.(33).

Classical set up, Equ.(33), $m\ddot{R} - mR\dot{\varphi}^2 = -\frac{GMm}{R^2}$, adding Equ.(38) we get the

Equation for Planetary Orbits according Energy Conserving Gravitation

(39) $$\underline{m\ddot{R} - mR\dot{\varphi}^2 = -\frac{GMm}{R^2} - 3\frac{GMmF^2}{c^2R^4}},$$

The sign of the additional force must be the same as the sign for the central force. The equation is identical with the relevant equation in textbooks. In these textbooks however it is deduced (in a much more complicated way) from the Schwarzschild solution of Einstein's Field Equations and with the Tensor-Algorithm. Now with the Energy Conserving Law of Gravitation we got the same equation in a far simpler way. The last term is responsible for the advance of the perihelion. The resulting total deflection is the same as can be found in textbooks (see its derivation also in the book "Gravitation in the Making"):

(40) $$\underline{\Delta\varphi = \frac{6\pi}{c^2}GM\frac{GM}{F^2} = \frac{6\pi GM}{ac^2\left(1-\varepsilon^2\right)}}.$$ (a = great semi axis of the ellipse, ε = e/a, e = distance focus-center.)

That is the famous **Equation of Einstein for the Advance of the Perihelion**.

Gravitational Light Bending

Equ.(4) to (7) represent the Energy Conserving Gravitational Law for the case of a shift in radial direction. The generalized Equ.(39) describes the movement in two dimensions of a plane. Note, these equations have not been postulated. They are a consequence of the proportionality between the unity of time and potential energy of gravitation, verified by measurements. These equations are valid also for the propagation of light. For photons the equations assume a simpler form because photons consist of kinetic energy only and have no rest mass m. Note: the mass m is a common factor on both sides of the equation and may be reduced. This is a formal procedure. The physical meaning of the mass m in the two terms is different. The law $GMme^{-a/R}/R^2$ refers to the gravitational quality of a bodily mass m in the radial direction. For light however that term is zero because light has no bodily mass m, hence it cannot supply gravitational energy and not exert a gravitational force in the direction it spreads.

After reducing m and without a bodily mass, we obtain from Equ.(39) the

Differential Equation for Light in a Gravitational Field:

(41) $$\ddot{R} - R\dot{\varphi}^2 = -3\frac{GMF^2}{c^2R^4}$$

That equation is identical with its equivalent in Einstein's Theory, though it has not been deduced from his Field Equations for an energy supplying field. We derived it without field energy, that means without an additional curvature of space. Because we got the same formula the total deflection of light is identical and can be found in relevant text books (also in "Gravitation in the Making"):

(42) $2\varphi_{(R=\infty)} = -\frac{4GM}{c^2 R_o}$, **Light Bending in a Gravitational Field**.

According to that formula the light bending is 1,75 seconds of arc for stars visible at the rim of the sun during an eclipse. That agrees with the measured values within the accuracy of such difficult measurements. The Classical Theory predicts also a deflection of light, but with half of that value. This was of historical importance as a verification of the Theory. (For comparison: 1mm will be seen from a distance of 118 m at an angle of 1,75 seconds of arc.)

Curvature of Space

Gravitational light bending confirms curvature of space. However near the Schwarzschild radius $R_S = 2GM/c^2$ the curvature is fare less than in the conventional theory. It can never be a closed curve. The curvature can be verified by the delay of a radar echo from a planet opposite to the earth relative to the sun. Due to curvature the transition time for the echo increases by about 0,2 ms.

The observer's location on earth is defined by the distance R to the sun and the local time t. Let us designate by R_{phot} and t_{phot} location and proper time of the points of the trajectory of the radar photons. The relativistic relations for differentials in length dR and dR_{phot} and for the corresponding time dt and dt_{phot} are:

Viewed from earth: $dR = dR_{phot}e^{-a/R}$ (length decreased), hence $dR_{phot} = dRe^{+a/R}$

and $dt = dt_{phot}e^{+a/R}$ (time-intervals extended, compare that with the twin "paradox")

At point R_{phot} is: $dt_{phot} = \frac{dR_{phot}}{c} =$ [dR_{phot} inserted] $= \frac{dR}{c}e^{+a/R}$.

Inserted into the 2nd equation: $dt = \frac{dR}{c}e^{+2a/R}\cdot$ viewed from earth.

With $e^{2a/R} \cong 1 + 2a/R$ we obtain for the transit time between sun and earth

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

$$\cong \frac{\mathbf{R_{earth} - R_{sun}}}{\mathbf{c}} + \frac{\mathbf{2a}}{\mathbf{c}} \int_{sun}^{earth} \frac{\mathbf{dR}}{\mathbf{R}} = \frac{\mathbf{R_{earth} - R_{sun}}}{\mathbf{c}} + \frac{\mathbf{2a}}{\mathbf{c}} \mathbf{ln} \frac{\mathbf{R_{earth}}}{\mathbf{R_{sun}}}$$

The same calculated for the planet and added (shortest distance R_{sun} relative to R_{earth} neglected) we get:

(43) $$\mathbf{T = T_{sun-earth} + T_{sun-planet} = \frac{R_{earth} + R_{planet}}{c} + \frac{2a}{c} \ln \frac{R_{earth} R_{planet}}{R^2_{sun}}}.$$

For the sun is $a = GM/c^2 = 1{,}48$ km.

The echo needs twice that time. The last term at the right is the extra transit time due to curvature. The calculated result is

for **Mercury 0,20** ms ($R_{mercury} = 58 \cdot 10^6$ km),

for **Mars 0,22 ms** ($R_{mars} = 228 \cdot 10^6$ 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 also for a greater angular distance from 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 confirmed very precisely [measurement according I. I. Shapiro, Phys. Rev. Lett. 13, 789 (1964)].

Gravitational Doppler Effect

For lack of a bodily mass the photons have no source for supplying fall energy. Consequently photons do not sense gravitation in the direction they propagate. Because photons consist on kinetic energy only, their bodily mass is zero in the differential equation (39), hence the energy of their frequency cannot change. However, in contrast to that statement, a change of its frequency *has* been measured by an experimental arrangement proposed 1958 by Rudolf Mößbauer.

Pound and Rebka performed that measurement 1960. With an accuracy of 10% they could verify the functional dependency of frequency on the gravitational field of the earth proportional to $\int KdR$ calculated with Equ.(7).

We can repeat that calculation by inserting in the Law of Gravity the mass of the kinetic energy of a photon $m_o = h\nu_o/c^2$ in the place of m. Of course, that is not correct, because kinetic energy does not sense gravitation in the direction of movement. Nevertheless, if we insert that mass into Equ.(5) and (6) then we get

(44) $$E_{pot} = c^2\left(M + \frac{h\nu_o}{c^2} e^{-a/R}\right), \qquad E_{kin} = h\nu_o\left(1 - e^{-a/R}\right).$$

Along the distance dR the "dropping" photon would acquire the kinetic energy

(45) $dE_{kin} = KdR = \frac{GM}{R^2} \cdot \frac{h\nu_o}{c^2} e^{-a/R} dR$. Because that energy must be $= hd\nu$ the frequency ν would increase by $d\nu$. According to Energy Conserving Gravitation that energy is supplied by the mass, in this case by $h\nu_o/c^2$, provided the photon could really accelerate itself by its own kinetic energy like Münchhausen! Let's continue the calculation before trying an answer to such a paradox. We equate Equ.(45) with $hd\nu$ and arrange it as follows:

(46) $\frac{d\nu_o}{\nu_o} = \frac{GM}{R^2c^2} e^{-a/R} dR$. That can be integrated from R_{source} to R:

(47) $\ln\frac{\nu_o}{\nu} = \frac{GM}{c^2a} e^{-a/R} - \frac{GM}{c^2a} e^{-a/R_{SOURCE}} = e^{-a/R} - e^{-a/R_{SOURCE}}$, ν frequency at R,

In Physics the <u>potential energy per unit of mass</u> (m = 1) is called **„<u>Potential</u>“**. Since only potential *differences* are of interest the constant Mc^2 in Equ.(3) $E_{pot}= (M+me^{-a/R})c^2$ can be omitted. It remains:

(48) $\boldsymbol{\varphi = c^2 e^{-a/R}}$**,** that is the usual definition of the **<u>Potential</u>** φ.

With that definition is $e^{-a/R} = \varphi/c^2$ and Equ.(46) can be written in the form:

$$\ln\frac{\nu_o}{\nu} = \frac{\varphi - \varphi_o}{c^2} = -\frac{\Delta\varphi}{c^2} \quad \text{or} \quad \frac{\nu_o}{\nu} = e^{-\Delta\varphi/c^2}, \quad (\text{with } \varphi_o = \varphi_{source}) \text{ and}$$

(49) $\nu = \nu_o e^{+\Delta\varphi/c^2}$ **Gravitational-Doppler-Effect**

For R >>a we can approximate $e^{-a/R} \cong 1 - a/R = 1 - GM/c^2R$.
That changes Equ.(49) and Equ.(47) to:

(50) $-\Delta\varphi = \frac{GM}{R_{source}} - \frac{GM}{R}$, for $R_{source} = \infty$: $\Delta\varphi = \frac{GM}{R} = \frac{ac^2}{R}$ and $\boldsymbol{\nu_o = \nu e^{-a/R}}$.

That is in exact concordance with the resulting formula of Einstein.

We got that result on the wrong condition that $m_o = h\nu_o/c^2$ is a bodily mass whose potential energy is $h\nu_o$ at R = ∞. In contrast to that condition the photon is entirely *kinetic* energy, as such it cannot be effected by gravitation in the direction it moves. Two facts must be true simultaneously:

1. The „falling“ photon does *not* change its frequency because it represents the only form of energy which can *not* be influenced by gravitation in the direction it propagates.
2. If however the frequency is *measured* at different altitudes R and R+H then the frequency $\nu = \nu_o e^{+\Delta\varphi/c^2}$ *measured* at the base point R is greater by the factor $e^{+\Delta\varphi/c^2}$ compared with ν_o at altitude R+H.

At the first glance the two statements seem to be contradictory, but they are not. What changes with altitude is not the photon's frequency but the *frequency meter* according to the Relativity Theory. That has not been realized for almost a century.

The mass $m_o = h\nu_o/c^2$ inserted into the Equ.(44) and (45) has just the same value than the mass of the photon (for R= ∞) but it is *not* the photon. It is part of the mass of the atoms of the frequency meter used as time reference for its calibration. When dropping from ∞ to R the original mass of *all* the atoms of the frequency meter *de*creases by the factor $e^{-a/R}$. That means: When the instrument is shifted from R+H to R the frequency of the photon must *appear* to be *in*creased compared with the *de*creased reference frequency inside the frequency meter.

Equ.(49) is valid not in spite but *because* the frequency of the photons does *not* change. That can be written with renamed symbols:

(51) $$\frac{\nu}{\nu_1} = e^{-\Delta\varphi/c^2}$$

ν_1 = measured frequency showing the Gravitational-Doppler Effect.

For the "frequency increase" of photons two explanations are conventional:

1st The equivalence principle. It states: A gravitational field is equivalent an accelerated reference frame. The acceleration causes a movement. The velocity of that movement is correlated to a corresponding *time dilatation* of the internal clock rate of the frequency meter.

2nd The Axiom of "Field Energy": The kinetic energy of a dropping mass is supplied by the *field*, hence the dropping causes an increase of the energy, that is in case of a "dropping" photon its energy hν by increasing its frequency.

Even Einstein has drawn the wrong conclusion that both the principles where true simultaneously because he *added* the kinetic energy of a dropping mass to its energy mc^2. If that would be correct then the frequency change would be *twice* the measured value. **The decision has been settled by measurement:**

The field does not create Energy. Energy has mass and is always conserved.

Nevertheless the Gravitational Doppler Effect is the evidence that the measured frequency-shift in a gravitational field is not fictitious. The frequency-shift of the photon *is real* for *any* observer, since he cannot help as to measure by comparing each quantity with the fundamental units *defined in his own environment*, his own mass included (that refers also to all energetic effects of the photon). *Relative* to the observer *none* of the masses of *his* reverence system have been altered, just as the passengers inside an airplane will not notice an increase of their own masses which an observer from the outside attributes to the kinetic energy of the moving masses. On the other hand, in the view of the reference system of the photon's source, there too no frequency-shift occurs because for that observer the frequency meter is located at the source. Every observer has its own frequency meter and his own clock, defining *his* units and *his* time. However that photon which goes to another observer carries that clock time and that units with it which are defined at its origin. The units and clocks of different origins are different just *because* they are defined inside their different locations relative to the locally resting masses. „Relativity of Time“ and the „Gravitational Doppler Effect“ refer to the same physical phenomenon.

Calculation of the Diameter of the Universe

If the Radius of the universe is R, and its mean mass density is ρ then

(52) its volume is $\mathbf{V = AR^3}$ and its mass is $\mathbf{M = AR^3}\rho$, with $\mathbf{A = 4\pi/3}$,

The idea of a defined surface on a spherical universe may be wrong, however that does not exclude that we can assume a sphere with a very large radius inside the universe. As we have seen the gravitational force upon a small partial mass ΔM of its surface depends only on the mass inside that sphere whereas the gravitation of all the masses outside cancel mutually.

Each partial mass ΔM of M represents a small fraction of the potential energy of the whole mass of M, but we have to account that ΔM cannot exert gravitation on itself. It can only be attracted when it is considered to be separated from the mass M, that means it must be subtracted from M. Then Equ.(5) has the form:

(53) $E_{pot/\Delta M} = c^2(M-\Delta M) + c^2\Delta M e^{-a/R}$ with $a = GM/c^2 = GAR^3\rho/c^2$

The contribution of each partial mass to E_{pot} is $-c^2\Delta M + c^2\Delta M e^{-a/R} < 0$, that is negative because on the way from ∞ to R a part of the potential is used up for producing E_{kin}.

By integration we obtain the potential energy of all partial masses together. The first term disappears because $\Sigma\Delta M = M$ and we get

(54) $\underline{E_{pot} = c^2 M e^{-a/R}}$.

Cross checking: for $R \to \infty$: $E_{pot} = c^2M$, for $R \to 0$: $E_{pot} = 0$, both are met.

If we define as <u>weight K</u> the sum of the forces, then we get, since M = constant:

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

After division by the whole mass M, which can be assumed to be distributed over the surface, we get the summarized force upon one unit of mass, the so called <u>gravitational acceleration</u>:

(56) $$\underline{\mathbf{b} = \frac{\mathbf{GM}}{\mathbf{R}^2}\mathbf{e}^{-\mathbf{a/R}} = \mathbf{GAR}\rho\mathbf{e}^{-\frac{\mathbf{G}}{\mathbf{c^2}}\mathbf{AR^2}\rho}}$$ (In Classic Theory is $b = GM/R^2$).

That is the gravitational acceleration at the surface of any sphere inside the universe and at any location, but note: that is true only relative to an observer at its center. The masses of such imagined spheres must collapse. We see: its gravitation depends only on R and density ρ, but that formula for acceleration of a collapsing sphere differs from Equ.(19). Equ.(19) is correct only if the path of dropping remains outside the attractive central mass (that is in the *empty* space).

What is the graph of the function of Equ.(56) if the *density* ρ *is constant*?

The function has a maximum since there exists an R where the derivative of Equ.(56) becomes zero:

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

(57) $$\mathbf{R = \sqrt{\frac{c^2}{2GA\rho}} = proportional \frac{1}{\sqrt{\rho}}} \quad = \text{ Distance of maximal gravitation}$$

For the following numerical calculations some values are needed:

Constant G = $6{,}6726 \cdot 10^{-8}$ cm^3/gs^2	**1 Light-year** = 1 Lj = $0{,}946 \cdot 10^{18}$ cm
Velocity of light c = $2{,}998 \cdot 10^{10}$ cm/s	**1 cm** = $1{,}056 \cdot 10^{-18}$ Light-years

The average **density of the visible matter** of the universe is often assumed to be ρ = 1 H-atom/m^3 = $1{,}675 \cdot 10^{-30}$ g/cm^3. For lack of a better estimation we will assume four times this value when dark matter is included. Then $\rho = 6{,}7\ 10^{-30}$ g/cm^3. (That should not be confused with the higher density of a galaxy.)

Applying Equ.(57) to the universe as a whole yields for its radius:

$$\sqrt{\frac{c^2}{2GA\rho}} = \sqrt{\frac{9 \cdot 10^{20} \cdot 3}{2 \cdot 6{,}67 \cdot 10^{-8} \cdot 4\pi \cdot 6{,}7 \cdot 10^{-30}}} = \mathbf{1{,}55 \cdot 10^{28}\ cm \cong 16 \cdot 10^{9}\ Light\text{-}years.}$$

That is the radius where the gravitation of the universe has a maximum (if its density is 4 H-atoms/m^3). It is important to note that the maximum has been calculated on the condition that the density ρ is constant. Hence the differentiation of Equ.(56) confers not to a shrinkage of the universe by dR = 1 (in the common theory shrinkage would increase the density).That differentiation shows the change of gravitation when *without* changing the density the radius R of the universe would be reduced by dR, that means to R–dR.

Equ.(56) and its derivative Equ.(57) reveals the unexpected, that the gravitation of the universe *has a maximum* and that it depends solely on its density ρ.

The second surprise is the fact that the maximum of gravitation appears *at an radius of the universe* which has been roughly estimated by many cosmologists as $R \cong 16 \cdot 10^9$ Light-years for a closed space. In a closed space there must be such a maximum because no larger mass is possible than that encircled by that radius. Thus the assumption of the cosmologists seems to be better confirmed than could be hoped. However „closed“ can be defined also for a space having an insurmountable borderline. That is at the distance where the red shift is infinite. The distance of maximum gravitation R is less according to Equ.(57):

$$\mathbf{R = \frac{c}{\sqrt{2GA\rho}}} \,. \quad \text{From that we get} \quad \rho = \frac{c^2}{2GAR^2} \,.$$

The density ρ can also be expressed by Equ.(52): $V = \frac{M}{\rho} = AR^3$, or $\rho = \frac{M}{AR^3}$.

Both the values must be equal, hence R must be:

(58) $$\mathbf{R = \sqrt{\frac{3c^2}{8\,G\pi\rho}} = \frac{2GM}{c^2}} = \textbf{Radius of the Universe}$$ (= constant, because G, M, c are constants)

That can be called its radius since its best *definition* is the same as for all celestial bodies, that is by the distance where the gravitation has its maximum.

That radius is identical with the Schwarzschild Radius of a Black Hole in the conventional theory. If that theory where true then we would live inside a Black Hole and should be imaginary creatures. Such a remark is often said to be irrelevant because "inside" makes sense only as contrast to an outside, but the universe has no outside. However *all* Black Holes are unobservable „from the outside" because the only alternative for indicating their existence is the concentration of a certain amount of mass in a defined volume, provided it can be measured. Hence observation „from the outside" is a vicious circle because it needs the existence of Black Holes in order to proof their existence! If Energy Conserving Gravitation is true then even the highest mass concentration creates *no* Black Hole, hence high mass concentration is not an argument for its existence.

Galactic Distances as Function of Velocity

According to the Energy-Conserving Law the attractive force upon a mass m is $GMme^{-a/R}/R^2$. It is directed to the center, the observer. Compared with the original value m (m at R = ∞) the mass appears decreased to $me^{-a/R}$ with a corresponding red shift of its natural frequencies. The value of a is a constant only when the dropping mass remains all the time outside the central mass. If we however consider a mass at a distant R *inside* the universe, and the universe is filled with countless galaxies, then the gravitational effect upon m is the combined effect only of the galaxies *inside* the sphere of radius R, because the gravitational effects of the masses outside (that are the masses of the shell yonder the momentary R) compensate to zero. The observer is in the center. The less the distance R the less is the mass $M = 4R^3\pi\rho/3$ of that sphere, and the less is the „constant" $a = GM/c^2 = G4R^3\pi\rho/3c^2$. In order to obtain the red shift for a remote galaxy having the distance R from us we insert that a in the factor $e^{-a/R}$:

(59) $$e^{-a/R} = e^{-4GR^2\pi\rho/3c^2},$$ (ρ = density of the universe > 1 H-atom/m^3)

(60) $$\mathbf{v = c\sqrt{1 - e^{-2a/R}} = c\sqrt{1 - e^{-8GR^2\pi\rho/3c^2}}}$$ (according Equ.(15).

So v and with it **red shifts of remote galaxies** are not symptoms of expansion of the universe. On the contrary the red shifts are effects only of gravitation of all those galaxies which have less or equal distance than the galaxy observed.

For such a gigantic sphere we have to use the underlined formula. Though that velocity may be slowed down long ago, we can use its theoretical value as a label for indicating mass decrease and red shift. With R goes v and with v goes the red shift to zero. With $R \to \infty$ goes $v \to c$, that corresponds to an infinite red shift.

It must be emphasized that v is a real velocity only after dropping from $R_\infty = \infty$ to R in a shrinking universe due to gravitation. Otherwise it is an imagined velocity which can be used as indicator for red shift. In no case can it be interpreted as verification of an expansion of the universe. Solved for R we get:

(61) $$\mathbf{R = \frac{B}{\sqrt{\rho}}\sqrt{\ln\frac{1}{\sqrt{1-v^2/c^2}}} = \frac{5{,}67\cdot 10^{13}}{\sqrt{\rho}}\sqrt{\ln\frac{1}{\sqrt{1-v^2/c^2}}}.} \quad \text{or} \quad \mathbf{R \underset{v<<c}{\cong} \frac{4\cdot 10^3}{3\cdot\sqrt{\rho}}v}.$$

Red Shift of Remote Galaxies

Let us consider a natural frequency ν_R of an atom at the distance R from a central mass. If the atom would be lifted to an infinite distance $R_\infty = \infty$ then the atomic mass would increase by the mass of the energy applied. Proportional to the mass the spectral frequency increases to a certain value ν_∞.

The relation of the frequency increase $\nu_\infty - \nu_R$ to the frequency ν_R is called frequency shift z:

(62) $$\mathbf{z = \frac{\nu_\infty - \nu_R}{\nu_R} = \frac{\nu_\infty}{\nu_R} - 1,} \quad \text{or} \quad \mathbf{\frac{\nu_\infty}{\nu_R} = z + 1.}$$

If the atom is shifted in reversed direction, that is from $R_\infty = \infty$ to R, then the result is reversed and the frequency ν_R has a <u>red shift</u> relative to ν_∞

(63) $$\mathbf{\frac{\nu_R}{\nu_\infty} = \frac{1}{z+1} = e^{-a/R}}$$ because the frequency must change by the same factor $e^{-a/R}$ as the mass decreases. From Equ.(63) we get

(64) $$\mathbf{z = e^{+a/R} - 1 = e^{+4GR^2\pi\rho/3c^2} - 1.}$$ For z <<1: $\mathbf{z = 4GR^2\pi\rho/3c^2}$

(65) We define the abbreviation $\mathbf{B} = \sqrt{\frac{\mathbf{3c^2}}{\mathbf{4G\pi}}} = 5{,}67{\cdot}10^{13}\ [\text{cm}^{-½}\ \text{g}^{½}]$.

If Equ.(64) is solved for R we get the distance R as function of the red shift z:

(66) $$\mathbf{R = 5{,}67\cdot 10^{13}\sqrt{\frac{\ln(1+z)}{\rho}}}\ [\text{cm}] \underset{z<<1}{\cong} \mathbf{5{,}67\cdot 10^{13}\sqrt{\frac{z}{\rho}}}\ [\text{cm}]$$

If ρ = 4 Hydrogen atoms/m^3 = $6{,}7{\cdot}10^{-30}$ g/m^3 then $\frac{B}{\sqrt{\rho}} = 2{,}19\cdot 10^{28}$ [cm] and

(67) $$\mathbf{R = 2{,}19\cdot 10^{28}\sqrt{\ln(1+z)}}\ [\text{cm}] \quad \text{or} \quad \mathbf{R \underset{z<<1}{\cong} 2{,}19\cdot 10^{28}\sqrt{z}}\ [\text{cm}]$$

That means: When the red shift is small then the distance R of an object is approximately proportional to the square root of its red shift. With increasing red shifts the distance increases less than the root √z.

Calculation of the Hubble "Constant"

The **Hubble Constant** v_H has been defined as the

velocity v_H at a distance R_H = 10^6 Parsec = $3{,}26 \cdot 10^6$ Light-years = $3{,}1 \cdot 10^{24}$ cm.

If we assume ρ = 4 Hydrogen atom/m³, then we get for the Hubble Constant

$$\text{(68)} \qquad \mathbf{v_H = c\sqrt{1 - e^{-8\pi G\rho R_H^2/3c^2}} \underset{G8\rho R^2 << c^2}{\cong} 2R_H\sqrt{\frac{2}{3}G\pi\rho} \cong 60\ km/s}$$

That agrees with a current estimation. Equ.(60) shows that v is not a linear function of R. That means the Hubble "Constant" Equ.(68) can not be used as a constant factor for deriving the distance. But for distances where the exponent is $8GR^3\pi\rho/3c^2 << 1$ the function v = v(R) can be considered as linear.

Velocity v as Function of Red Shift z

In the common theory the red shift has been interpreted as an effect of a receding velocity of far galaxies or of an expanding universe. Now with Energy-Conserving Gravitation it is explained by the velocity of a collapsing universe relative to an observer at rest. The observer is the center. The collapse is equivalent the velocity v of free fall from infinite and can be calculated by Equ.(60):

In order to get v as function of z we square Equ.(63)

$$\text{(69)} \qquad e^{-2a/R} = e^{-8GR^2\pi\rho/3c^2} = \frac{1}{(1+z)^2}$$

Inserted into Equ.(60) and solved for v and for z respectively we get

$$\text{(70)} \qquad \mathbf{v = c\sqrt{1 - \frac{1}{(1+z)^2}}}, \qquad \text{or} \qquad \mathbf{z = \frac{1}{\sqrt{1 - v^2/c^2}} - 1}$$

By the way it should be mentioned that the second formula shows the known proportionality between energy E and frequency ν:

$$1 + z = \nu_{R=\infty}/\nu_R = h\nu_{R=\infty}/h\nu_R = E_{R=\infty}/E_R = \frac{1}{\sqrt{1 - v^2/c^2}}.$$

Groups of Galaxies

If however R is „small" but still greater than the distances of individual members of a **group of galaxies** then we have to use the formula $v = c\sqrt{1 - e^{-2a/R}}$ if we wish to calculate the gravitation of the individual galaxies upon a mass. Only for such distances near the group v **in**creases (large red shift) when R **de**creases.

If at least R is less than the distances *inside* the group, that means if a mass penetrates the cluster and approaches its center of gravity, then for $R \rightarrow 0$ the red shift relative to that center disappears because then again v goes with R to zero.

Halton C. Arp has shown that in clusters of galaxies the smaller companion galaxies are always red shifted *relative* to the center of gravity inside a massive central galaxy. That can be verified precisely with the formulas above and it is easily explainable in the following way:

For remote galaxies, such as observed by E. P. Hubble, the red shift *in*creases when the distance R increases because the measuring point is *inside* the universe upon a large spherical surface of radius R. That sphere is filled with countless galactic masses scattered in it. Their combined masses increase with R^3, hence the ratio $a/R=4GR^2\pi\rho/3c^2$ increases with R^2.

However near a cluster of galaxies each galaxy acts like a point mass M = const. in the formula $a = GM/c^2$. Hence, in the vicinity of that cluster, the red shift caused by such "point masses" *in*creases with decreasing distance. That is the red shift of companion galaxies relative to the cluster's center observed by H. C. Arp. It is superimposed to the red shift caused by that large cosmic sphere around us.

Whether the masses are point masses or distributed over a volume, the red shift is always caused by gravitation.

The hypothesis of an *expanding* universe is not consistent with all these facts. For very large distances R the function $\mathbf{e^{-a/R} = e^{-4GR^2\pi\rho/3c^2}}$ approaches zero. That means v approaches c, that corresponds to an infinite red shift.

Calculation of Red Shift of Quasars

The mass of quasars and the nuclei of some galaxies are extremely concentrated The evidence for that is compelling: great orbital velocities of objects near the center, and rapid changes of its luminosity. Mass concentration has consequences upon each spectral frequency. The dropping to the gravitational center is accompanied by a decrease of the mass of each atom by the factor $e^{-a/R}$ due to transformation into kinetic energy. If, for instance, an atom falls from infinite to the distance 2a to the center then its mass and with it each of its natural frequencies decreases by the factor $e^{-a/2a} = e^{-1/2} = 0{,}6$. If Red shifts would be either Doppler Shifts or an effect of the expansion of the universe (as asserted by the conventional theory), than the red shift of 0,6 would indicate a receding velocity, and that could be misinterpreted as a distance to us much greater than it actually is. Since such a receding velocity does not exist, it cannot be used as indicator for distance.

Nevertheless, any red shift caused by the gravitation of *local* masses is superimposed to the red shift due to the cosmic sphere mentioned above according the formula (60) $v = c\sqrt{1-e^{-8GR^2\pi\rho/3c^2}}$. It seems to be impossible to distinguish the two superimposed components of the red shift. In many cases however quasars have a „label“ which is not red shifted by the *local* gravitational field of the concentrated mass of the quasar. Halton C. Arp has paid greatest attention to such „labels“. These „labels“ are galaxies in the vicinity of quasars. Their short distance to the quasar is indicated by a faint luminous bridge of „connecting material“ to it. If the red shift would be an indicator for distance then the quasar's distance would be by milliards of light years greater than that of the associated galaxy, but a material bridge via milliards of light years is impossible. The Quasar's distance cannot much differ from the distance of the galaxy.

Gravitation is the Inverse of the 2nd Law of Thermodynamics

Heat is *internal* energy of a body. It can be extracted by cooling. According to the 2nd Law of Thermodynamics that is possible only by a transport of heat into a cooler of less temperature. Only *that* part of heat can be extracted which is above the lowest temperature of the cooler. After arriving that lowest level the internal heat left in the body had to be transferred against a temperature gradient of the higher outer temperature of the cooler, but that is impossible. That means:

From the whole heat content Q of a body only that part can be extracted which is stored at the temperature interval $T_1 - T_2$ *above* the level T_2 of the environment (and even that needs idealized technical devices). The heat stored between the absolute zero point and T_2 is not extractable. From that simple fact we can calculate the maximal energy E which can be extracted from the internal energy Q:

(71) $$\mathbf{E = Q\frac{T_1 - T_2}{T_1}}$$ (that is called **Carnot's Efficiency**.)

That is the essential issue of the Second Law of Thermodynamics.
T_1 is the initial upper temperature and T_2 the lowest temperature reached.

Transformation of external energy, for instance kinetic energy, into heat is always possible with 100%, but not the inverse. Since with *each* transformation of energy a part of it will become heat at a lower temperature level, the whole energy of the universe must ultimately arrive at the lowest temperature level. No further work of that energy can be accomplished and the universe would be dead for ever. Naturally, there have been doubts whether in the whole universe the 2nd Law of Thermodynamic could be generalized to such a consequence.

Now at once with Energy Conserving Gravitation these doubts are confirmed. Gravitation *is* the very cosmic process which ultimately inverses and neutralizes the Second Law of Thermodynamics. The gravitational transformation of *internal* energy (that is potential energy) into kinetic energy is the exact and complete restitution of external energy. Since the gravitational effective internal energy can be any kind of energy it can also be heat.

The process of dropping is conversion of inner energy into *external* energy, hence it is the inverse of the 2nd Law of Thermodynamics. External energy is disposable with 100%. „Disposable" means: any external use is possible, and if it is used then it is associated with transformation into heat until the whole energy has reached the lowest temperature level. Subsequently no further usage is possible. Every living creature is user of energy. The energy becomes disposable for its life whilst its planet with its sun approaches the galactic center by gravitation, but there the whole energy transforms into initial matter (energy) for new worlds.

The prevailing spiral form of galaxies with a dense nucleus has always been compared with gigantic vortexes and a central drain. Of course, such an intuitive conception must not be true. It requires verification theoretically *and* by observation. Not only in its early days a correct understanding of Relativity is a hard challenge. Even today extreme mass concentrations, where "not even light can escape", are still misinterpreted as Black Holes and "explained" by quantum mechanic models where part of its increasing energy could be radiated as particles or photons. Even in that models the energy of a self-devouring Black Hole would increase limitless. Non of these explanations have convinced the whole astronomical community. According to the Big Bang hypothesis galaxies should be unique entities, emerging from the primordial universe, growing old, and ultimately vanish in a collapsing universe. However such a collapse can happen only when its mass would be by some orders greater than all the actual observable masses together.

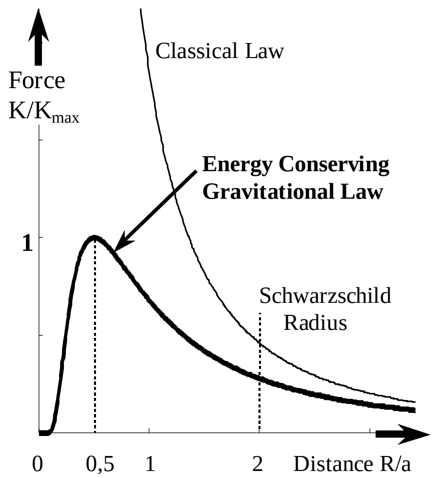
With the Energy Conserving Law the search for the missing mass can be saved, and with it all the speculations about Black Holes. It must be emphasized that Energy conservation does not exclude even highest mass concentrations. It excludes only Black Holes because on no condition the masses can be caught in a maximum of entropy by capturing "even light". At the contrary, when dropping into the center the mass must either escape or transform into radiation. Subsequently all the radiated or ejected masses can condense to new stars with new life. The dropping mass can never reach the limiting velocity of light except by transformation into photons. The entropy at the center must be zero.

The observable gigantic fountain-like ejecta on both sides of the axes on many galaxies could be explained in this way. The ejected material can be captured by other galaxies. The more their periphery becomes enriched by that material the higher is the probability that its density tends to disassemble into accretion discs. Due to small differences of distances to the galactic center and hence of their orbital velocities they collide, that slows down the velocities, distances to the center decline, their orbits can not be closed. On its way the masses can condense to planetary systems forming new cycles of stars. The angular momentum, not following the descending masses, remains at the „outskirts". Of course, this is not a proofed knowledge. It *could* explain many observations but up to now it has to be confirmed and probably modified in each detail.

Black Hole by Deflection of Light?

A friend proposed the following experiment of thought. If a mass would be sufficiently concentrated then a light ray could pass at such a short distance that it is deflected to an orbit round that mass. That should be possible *because orthogonal* to the ray's direction the gravitation upon it is maintained. Due to the short distance the light could not escape that orbit. That however defines a Black Hole which could carry an unlimited amount of energy.

That argument is correct for all theories except Energy Conservation.



Explanation of Gamma-Bursts

First it must be affirmed: Light is deflected *radial*, that is in the direction *to the central mass* M. But note:

The shorter the distance between light ray and center the less is the gap left for the volume of the central mass M. M can only be compressed into that small central volume by a gravitational collapse. However the *velocity* of such a collapse transforms the mass into Kinetic Energy which has no gravitation in its direction. Increasing the central mass by adding new masses to M will neither change the *standardized* distance 0,5R/a, nor the maximum of the gravitational force. That is the message of this diagram.

Relative to the Schwarzschild Radius R/a the gravitation remains unchanged, hence the deflection of light cannot reach a circular orbit neither by a larger central mass M nor by decreasing the distance R. The gravitation is always less than it would be in the Classical Law, because, when the ray's distance falls below 0,5R/a, then the gravitation and with it the deflection of light decreases with decreasing R. In any case it remains considerable below the value required for a circular orbit regardless how large the concentrated central mass may be.

That can be understood also by the following consideration: Such a high mass concentration cannot be a *steady state*, it is an unimaginable dynamical *process* because such a compression exist only *during* the instability of a gravitational implosion of the central mass. During that very short collapse the parts of the masses accelerate to the center by almost the velocity of light. “Imploding” means that the mass transforms into *kinetic* energy which exerts no gravitation in the radial direction it moves. The dropping parts of the central mass reaches the velocity of light at the latest in the center because for R = 0 is v = c as can be seen on the formula $\mathbf{v = c\sqrt{1-e^{-2a/R}}}$. At v = c the mass can only be radiation, most likely gamma rays. But due to other physical processes mass annihilation by radiation is also possible before the center is reached. Since radiation does not sense gravitation in the direction of its propagation, it leaves the place of its origin without loss of energy.

The characteristic curve in the graph with the *declining* branch below 0,5R/a reflects exactly the transformation of Potential Energy into Kinetic Energy.

The gravitational collapse of a cosmic mass appears as a short Gamma and X-ray Burst with the greatest energy output possible in the universe.

Further Consequences

In Classical Physics the Law of Inertia is one of the fundamental axioms defined by Newton. Now, as shown in the book "Gravitation in the Making", Inertia is no longer an axiom. It is a consequence of relativistic Gravitation. The entirely new Idea of Einstein is the reversed definition of all fundamental quantities by defining the velocity of light c as a fundamental *constant*. That is an *axiom*, that means c is not a *derived* quantity. It implies that the *other* quantities must be defined anew in such a way that each measurement of the vacuum velocity c leads to the same value. Hence the second has been defined by a certain number of periods of an atomic natural frequency, and the unit of length is defined by c divided by these number of periods, may be multiplied by a constant. The mass is defined as energy. "Force" is defined as the “change of energy per unit of length” in the gravitational field. That applies also for electrostatic forces. Magnetic forces must be considered as caused by moving electric charges. “Force” can only be understood as a dynamical quantity.