What Causes the Gravitation?

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From the 17th century we inherited a theory of gravity:

Newton's law of gravitational force,

(0) **m(body;i) a = - G(gravitation) M(g) m(body;g) / r^2**,

has led with the equality of gravitational mass and inertial mass

(1) m(body) = m(body;g) = m(body;i),

to the well known equation

(2) m a = - G(Newton) M m / r^2,

whereby G(Newton) is understood to be the universal gravitational constant.

Previously, **Kepler's third law**

(3) $R_j^3 / T_j^2 \, (1 + m_j/M(sun)) = const$, for all the planets j,

and **Galileo's Universality of Free Fall (UFF),** were stated.

Here I will talk about a new TEST:

We want to look now how far the experimental data support the theory of gravity with a constant G(Newton) and with the equality of the two kinds of mass m(body;g) = m(body;i).

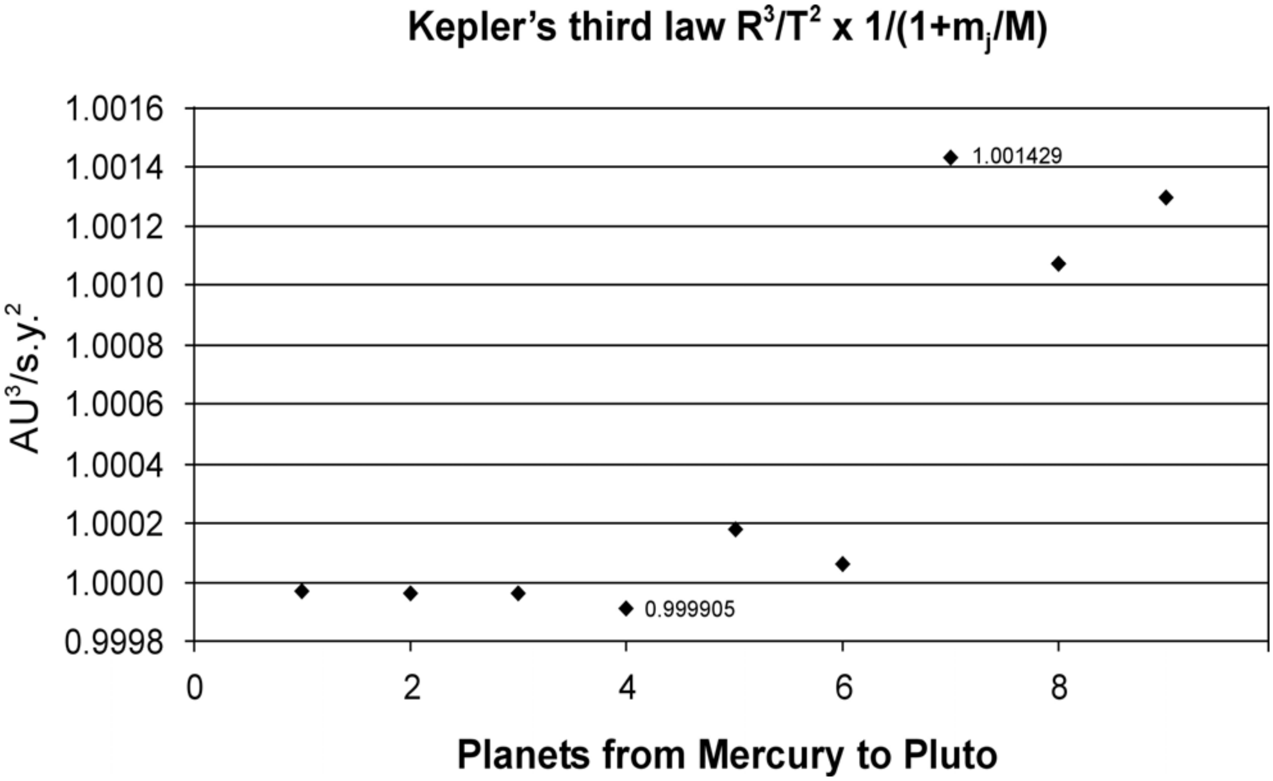


Fig. 1 The value of Kepler's third law constant for the planets shows that the further a planet is from the sun, the larger the deviation of its 'constant' from 1.

The ansatz

(4) $R_j^3 / T_j^2 \, (1 + m_j/M(\text{sun})) = \text{const} \times \mathbf{m_j(g)/m_j(i)}$

is verified if we assume a **composition dependent relation of gravitational mass and inertial mass**

(5) $\mathbf{m_j(g)/m_j(i) = 1 + 0.15\ \%}$,

of the planets in a range of pro mille.

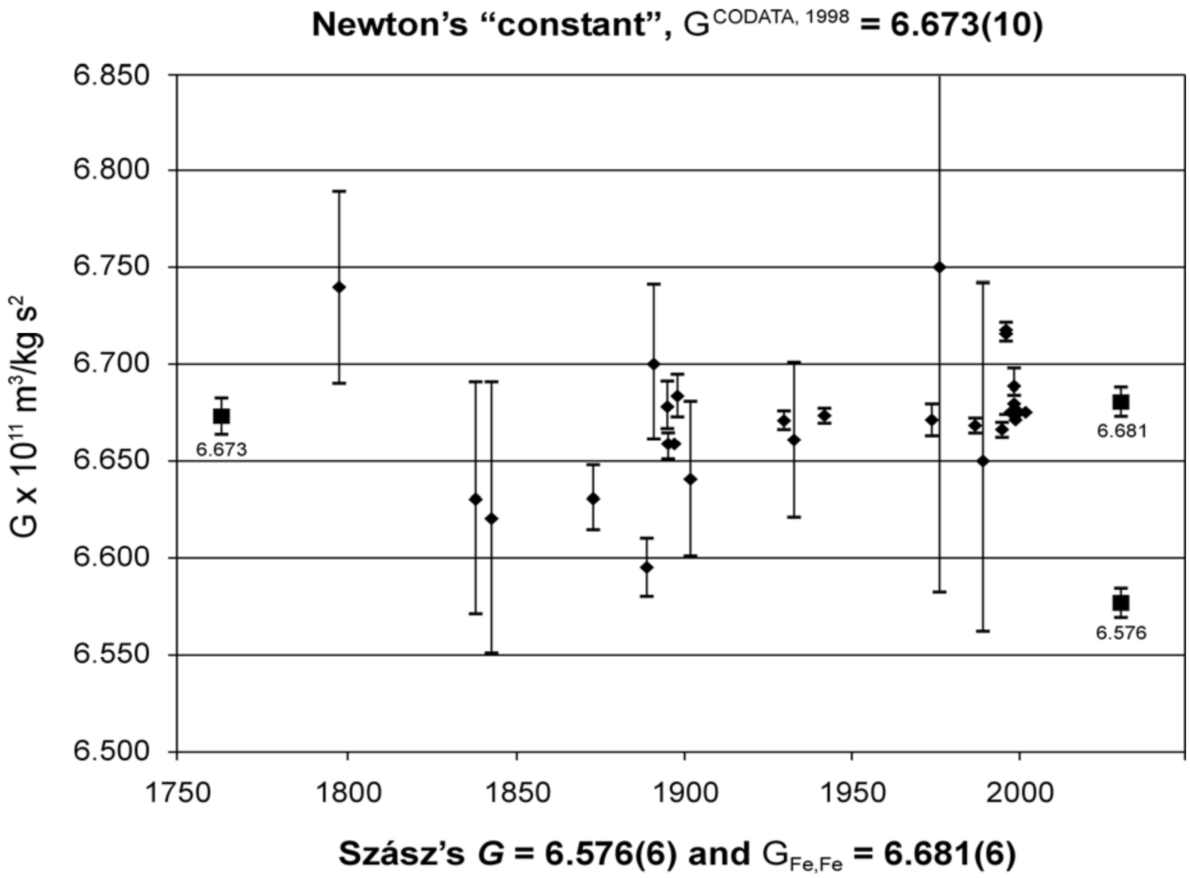


Fig 2. Results of G(Newton) measurements, from Cavendish (1798) up to now, are compared with the literature value $G^{(CODATA,1998)}$, the gravitational constant **G** and $\mathbf{G}_{Fe,Fe}$. (The last two values have been calculated in the book.)

We see that the deviations of the measured G(Newton) values are unsystematic in a range of **about 2.4 %**.

G(Newton) **is far away from being a constant**.

(The CODATA value has an uncertainty of **0.15 %**.)

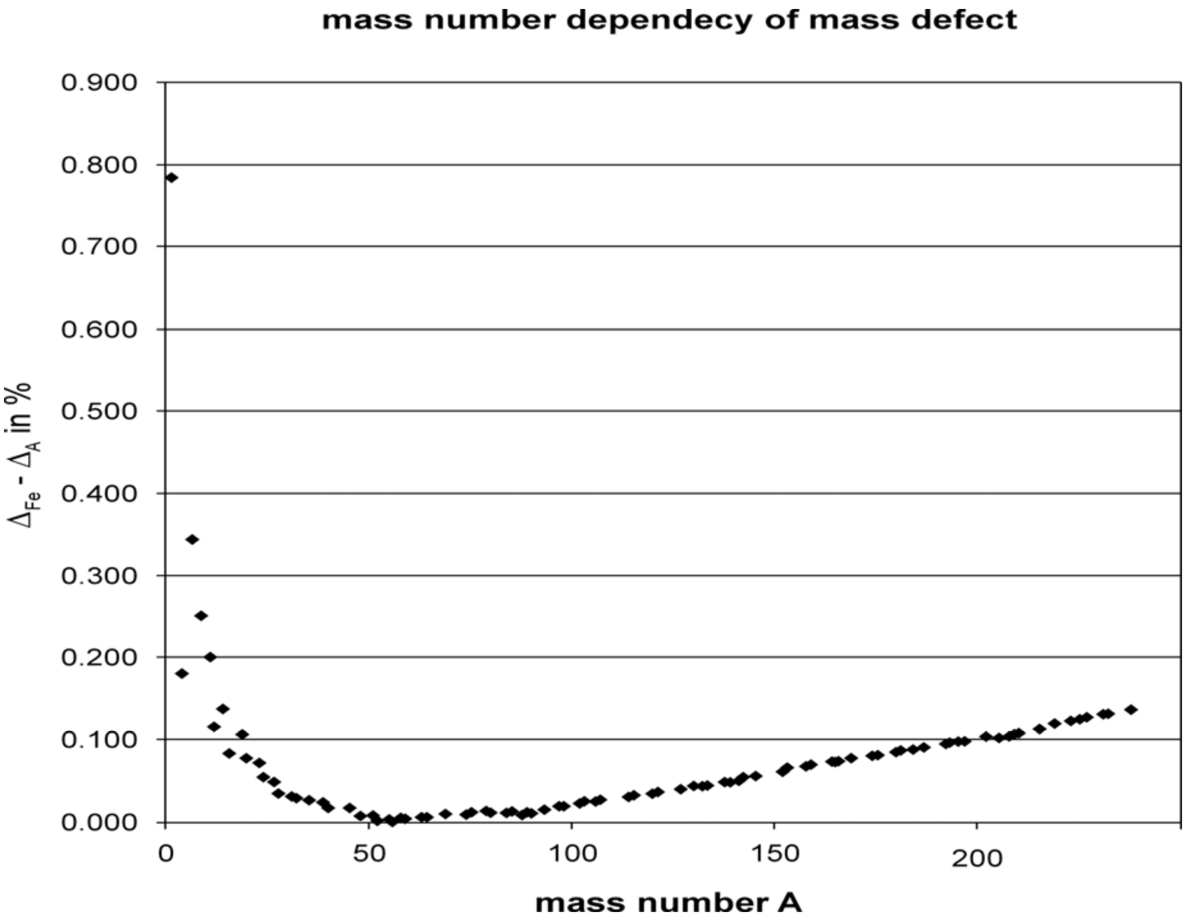


Fig. 3 The relative mass defect Δ_A of the most frequent isotopes with a mass number A compared to that of iron Δ_{Fe} . The Figure shows the relative defect of the inertial masses of isotopes measured in mass-spectrometers.

We see that the **0.15% uncertainty of G(Newton)** covers the whole range of the mass defects of elements, up to (H), He, Li, Be and B.

At the moment, I want to point at aluminum at mass number A = 27 in **Fig 3**. which would be important for a performed drop experiment and which will be discussed below.

After the shown experimental deviations from Kepler's third law, the large uncertainty of the Newtonian „constant" G(Newton) and the relative mass defect of isotopes, we can write down an expession for an isotope

(6) **m(isotope;i) = m(isotope;g) (1 – Δ (isotope))** ,

if **we assume that the gravitational mass of an isotopic nucleus does not change** at the forming of the nucleus, i.e. it corresponds to what is conventionally understood as 'mass'.

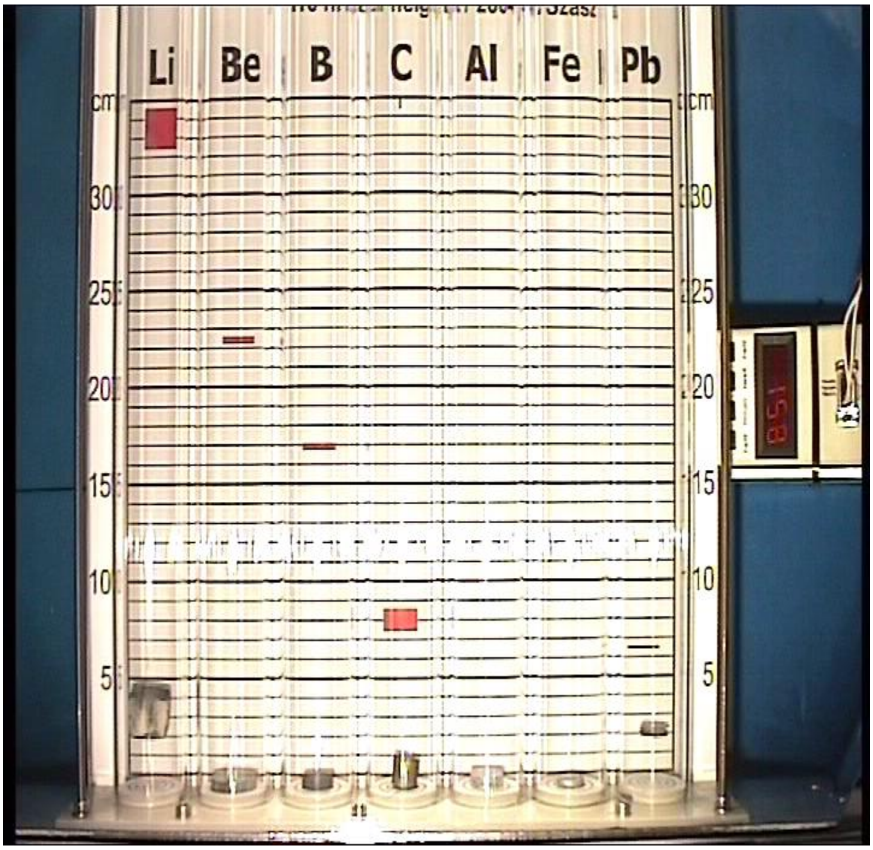
To verify experimentally our assumption, we consider the dependence of the acceleration of test bodies in the gravitational field on Δ **(isotope)**

(7) a = const m(isotope;g)/m(isotope;i)

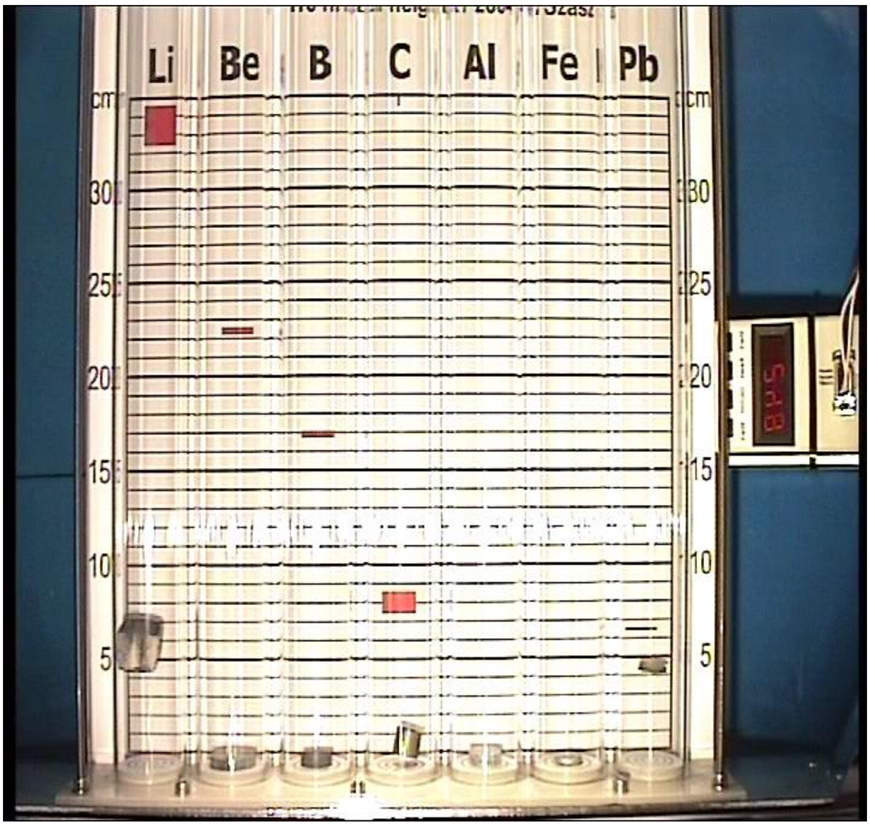
a ~ const (1 + Δ (isotope)),

and performed a drop experiment with the elements Li, Be, B, C, Al, Fe and Pb from the height of 110 m in vacuum. The experiment was performed in the drop tower of the University of Bremen; the drop capsule consisted of aluminum.

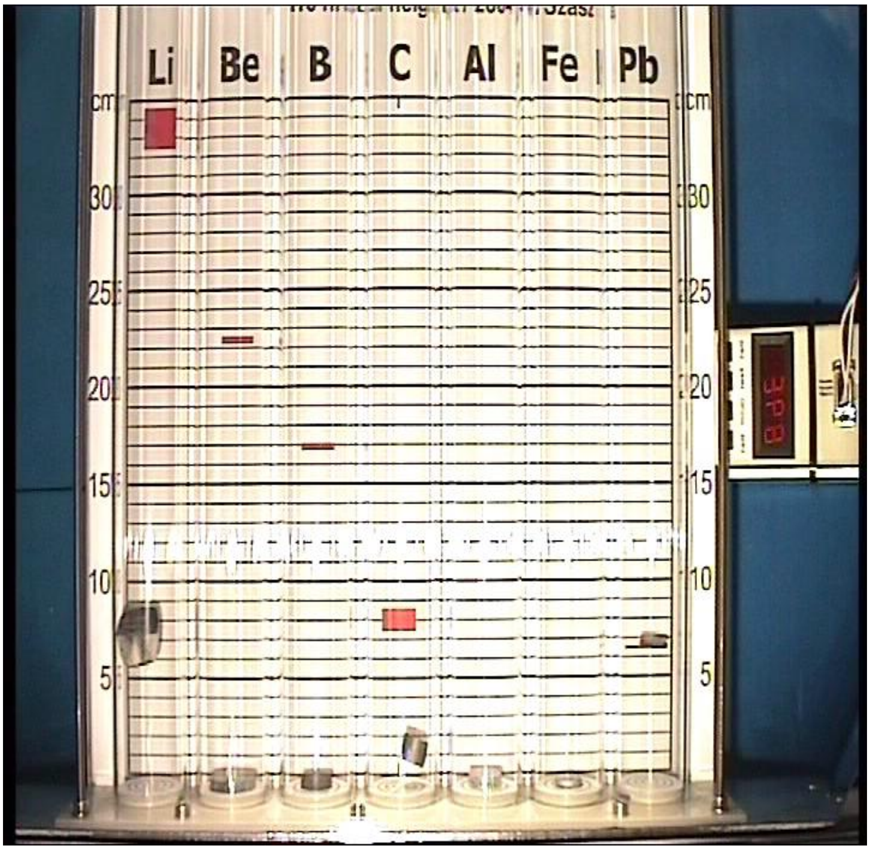
The following four video pictures show the relative movement of the test masses during the fall experiment in comparison to the aluminum drop capsule at four different times (1.2 s, 2.4 s, 3.6 s and 4.6 s).



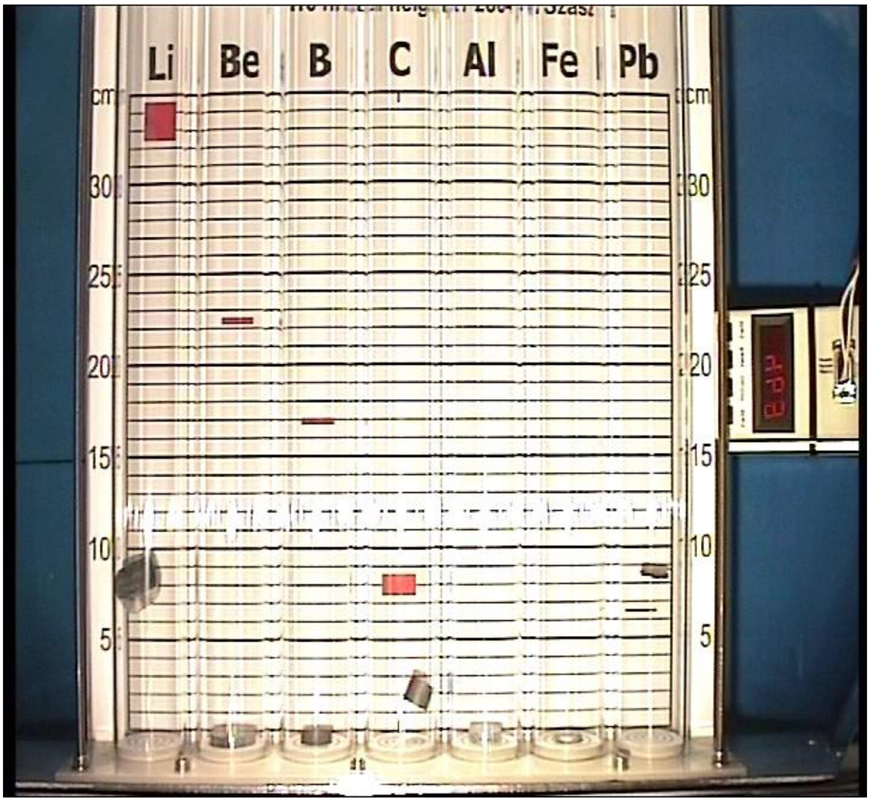
Time t = 1.2 s



Time t =2.4 s.



Time t = 3.6 s.



Time t = 4.6 s.

We fitted the relative movements of the test bodies according to

(8) $s = v_0 t + a/2\, t^2$

and obtained the following values for the initial velocities v_0 and accelerations a:

	Li	C	Pb
v_0 [cm/s]	1.63(4)	0.0	1.81(2)
a [cm/s^2]	0.434(5)	0.150(3)	0.102(8)
Δa/a [%]	**0.0442(5)**	**0.0150(3)**	**0.0104(8)**

The result of the drop experiment: **the acceleration depends on the composition of the test bodies**.

The experiment contradicts the equality of gravitational mass and inertial mass between the elements lithium and aluminum in the range of

(9 $\Delta a/a = \Delta(Al) - \Delta(Li) =$ **0.044 %** = Eötvös parameter.

Now, we are able to make an assumption **on a second fundamental property of the four stable elementary particles**, electron (e), positron (p), proton (P) and elton (E) ('elton' = negative charged proton = antiproton), **on the existence of the elementary gravitational charge:**

The elementary and invariant gravitational charges are

(10) **$g(e) = - g\, m(e)$, $g(p) = + g\, m(e)$,**
$g(P) = + g\, m(P)$, $g(E) = - g\, m(P)$.

Than the universal gravitational constant is

(11) **$G(gravity) = g^2 / 4\pi$,**

whereby **g is the specific gravitational charge** of the four elementary particles e, p, P and E.

<u>Consequences:</u>

- **The gravitational mass never changes** because it is derived from the invariant elementary g-charges.

- **The universal gravitational constant G(gravity) is not the G(Newton).** It is 1.5% less than the literature value of G(Newton) which is only an average value.

- Between proton and electron (as well as between e and p and P and E) **a repulsive gravitational force exists.**

- **Two kinds of neutrinos exist**, the (e,p)- and the (P,E)-neutrino and they are 7.03×10^{-14} cm and 3.83×10^{-17} cm large. The neutrinos are bound states of (e,p) and (P,E).

- **The gravitational mass and the inertial rest mass** of an isotope with the mass number A and Z **is different:**

(12) **m(A isotope;g) = A (m(P) –m(e)),**

m(A, Z isotope;i) = A m(P) + (A + 2 M(e,p)) m(e)

- E(bound)/c^2.

(13) **E(bound)/c^2 = Δ (A, Z isotope) A (m(P) –m(e)) +**

2(A+M(e,p)) m(e),

for A ≥ 2. (A = 1 and M(e,p) = 0 is the hydrogen**.)**

- E(bound) and the number of (e,p)-neutrinos M(e,p) in the nucleus of an isotope **follow from a variational principle with a Lagrange multiplier h(0) = h / 387**. The Planck's constant **h** is also a **Lagrange multiplier**.

- **The elementary g-charges cause the gravitational field** which is very similar to the electromagnetic field.

- **The field equation of the gravitational field is**

(14) $\partial_\alpha \partial^\alpha A^{(g)\,\beta} = - j^{(g)\,\beta}$, with the condition $\partial_\beta A^{(g)\,\beta} = 0$.

The minus sign causes that g-charges with the same sign attract each other. **The g-field is a covariant and non-conservative field** in a finite range of the Minkowski space. (14) is the Lagrange equation of the g-field with a subsidiary condition $\partial_\beta A^{(g)\,\beta} = 0$.