PROBLEM OF THE MASS IN THE GRAVITATIONAL FIELD

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1. Space is a three-dimensional – Euclidean space.
2. Time is the duration of the physical process (half-life of the radioactive element, torsion oscillations of the pendulum ...). The duration of the physical process is different in different places in a gravitational field.
3. Rest mass is the sum of all energies in a limited area, divided by light speed squared. Mass creates and feels gravitational field.

Basic assumptions (mathematical background)

- Rest mass of the body decreases in free fall in a gravitational field.
- Energy is conserved.
- The mass (energy) can not have a greater speed then the speed of light.
- The speed of light is constant under all conditions.

Free fall in a gravitational field:

$$m_0 c^2 = \frac{m c^2}{\sqrt{1 - \frac{v^2}{c^2}}} = const \qquad (1)$$

m_0 – rest mass before free fall in a gravitational field.
v – velocity of the object in free fall in a gravitational field (measured from source of the gravitational field) just before stopping and weighing its mass m.

Further assumptions:

$$v^2 = 2gR$$
$$v^2 = 2\frac{\gamma M}{R^2} R$$
$$v^2 = 2\frac{\gamma M}{R}$$

$$m_0c^2 = \frac{mc^2}{\sqrt{1-\frac{2\gamma M}{Rc^2}}} = const \qquad (2)$$

M – Mass that creates gravitational pull on the mass *m*

γ – Gravitational constant ($\gamma = 6{,}673 \cdot 10^{-11} \frac{m^3}{kgs^2}$)

R – Distance between the masses *M* and *m*.

INTRODUCTION

There are four basic points around which I will try to shape the story.

1. The first and main point from which everything else follows, and which is fully consistent with the present understanding of the relativity theories[1] and physics in general is a rest mass change in a gravitational field.

2. The second point is the quark structure of the electron.

3. The third point is electric charge change in a gravitational field and related to previous; look, shape and size of the quark.

4. The fourth thing is the Planck constant.

All subsequent claims arising from the first: change of the rest mass in a gravitational field. All stories are mutually supportive and one is derived from the other.

Statements:

- Rest mass changes in the gravitational field.
- It follows that the amount of the electric charge changes in the gravitational field.
- The change of the rest mass in a gravitational field has a cause and effect connection with the change of time (duration of physical processes) in a gravitational field.
- The change of the rest mass in a gravitational field implies electron quark-ed structure.
- Change of the rest mass and electric charge in the extreme gravitational fields, with the laws of energy conservation, has the cause and effect connection with the look, shape and size of the quark.
- All previous statements imply that Planck's constant is not constant; it is a number, but it has different values in different conditions.
- The variable value of Planck's constant allows us to talk about the particle dimensions in the magnitude order of 10^{-58} meters.

[1] Please insert proper reference to special and general relativity theories.

- Etc...

1. REST MASS CHANGE IN THE GRAVITATIONAL FIELD

Current understandings of the physics accept rest mass[2] change in gravitational field and it is closely connected with time[3] change in the gravitational field.

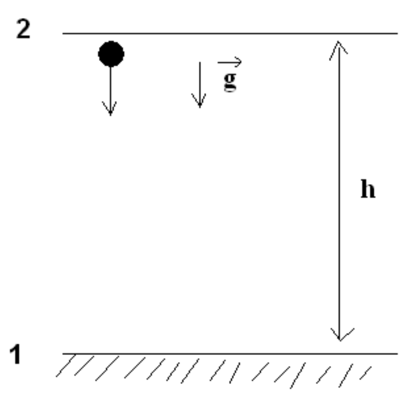
(Different "time" on different "heights" is in the cause and effect connection with the rest mass on those "heights".)

I agree that the rest mass of the body is different at different heights in a gravitational field.

Relation between rest mass and energy $E=mc^2$

Rest mass changes during free fall in a weak (Earth's) gravitational field:

$$\Delta m = m_2 - m_1 = \left(m_2 c^2 - m_1 c^2\right)\frac{1}{c^2} \approx \frac{m_1 v_1^2}{2}\frac{1}{c^2} \approx m_2 g h \frac{1}{c^2}$$



For weak fields hold $m_1 \approx m_2 \approx m$, therefore:

$$\Delta m = m_2 - m_1 = \left(m_2 c^2 - m_1 c^2\right)\frac{1}{c^2} \approx \frac{m\, v_1^2}{2}\frac{1}{c^2} \approx m g h \frac{1}{c^2}$$

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[2] http://www.sciencemag.org/content/339/6119/554
http://newscenter.berkeley.edu/2013/01/10/a-rock-is-a-clock-physicist-uses-matter-to-tell-time/?goback=%2Egde_2251395_member_203427753

[3] Gravitational time dilatation
http://hyperphysics.phy-astr.gsu.edu/hbase/relativ/gratim.html

Δm – change in rest mass
m_2 – rest mass at hight 2
m_1 – rest mass at hight 1 (ground)
$v_2 = 0$
v_1 – speed of the free falling body at height 1 just before it hits the ground.

(Speeds v_2, v_1 and height h are measured relative to ground (Earth surface).)

2. STRUCTURE OF THE ELECTRON

There are two (2.1 and 2.2) basic indicators of the electrons quark-ed structure.

2.1. The change of the rest mass in a gravitational field suggests quark-ed structure of the electron.

Again, in accordance with the present understanding of the physics rest mass is different at different places in gravitational field, from here it follows that:
There is a place in our universe (close surroundings of the very massive neutron star) where the rest mass of a proton is identical to rest mass of the electron at Earth surface.
To reiterate:
<u>There is a place where the rest mass of a proton out there[4] - is the same as the rest mass of an electron here[5]</u>.

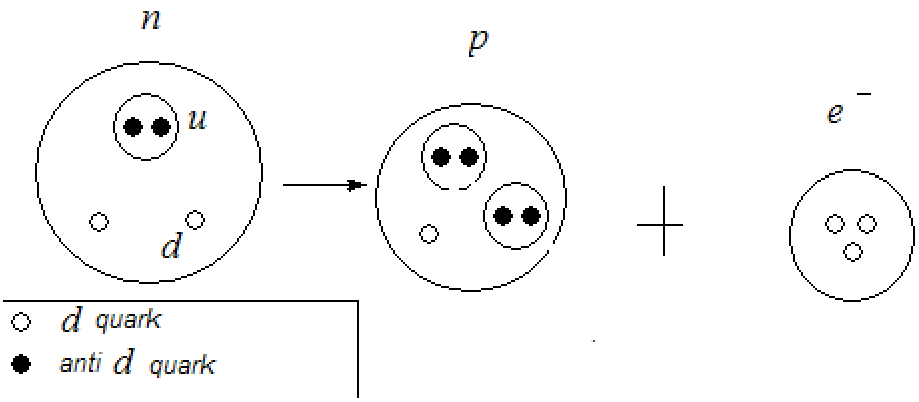
2.2. Another indicator of electrons quark-ed structure is their electric charge of exactly -1.

In other words; combination of quarks inside the proton creates electric charge +1, combination of quarks inside the neutron gives electric charge 0.

In this regard, the most logical assumption is that the electron consists of several quarks that provide electric charge -1.

[4] very strong gravitational fields
[5] very weak gravitational fields

The structure of neutrons, protons and electrons shown in the decay of the free neutron:



n – neutron
p – proton
e^- - electron
u – up quark
Neutron consists of one *u* quark and two *d* quarks. Proton consists of two *u* quarks and one *d* quark. Electron consists of three *d* quarks.
u quark is composed of two anti- *d* quark...

3. ELECTRIC CHARGE REDUCTION IN THE GRAVITATIONAL FIELD

3.1. Reduction of elementary electric charge in the gravitational field

I assumed that rest mass is the sum of all energies in a limited area, divided by light speed squared.

In this regard; electric field of charged particle has an electric potential energy *We*, this energy contributes to rest mass of charged particle m_e .

$$m_e = \frac{W_e}{c^2}$$

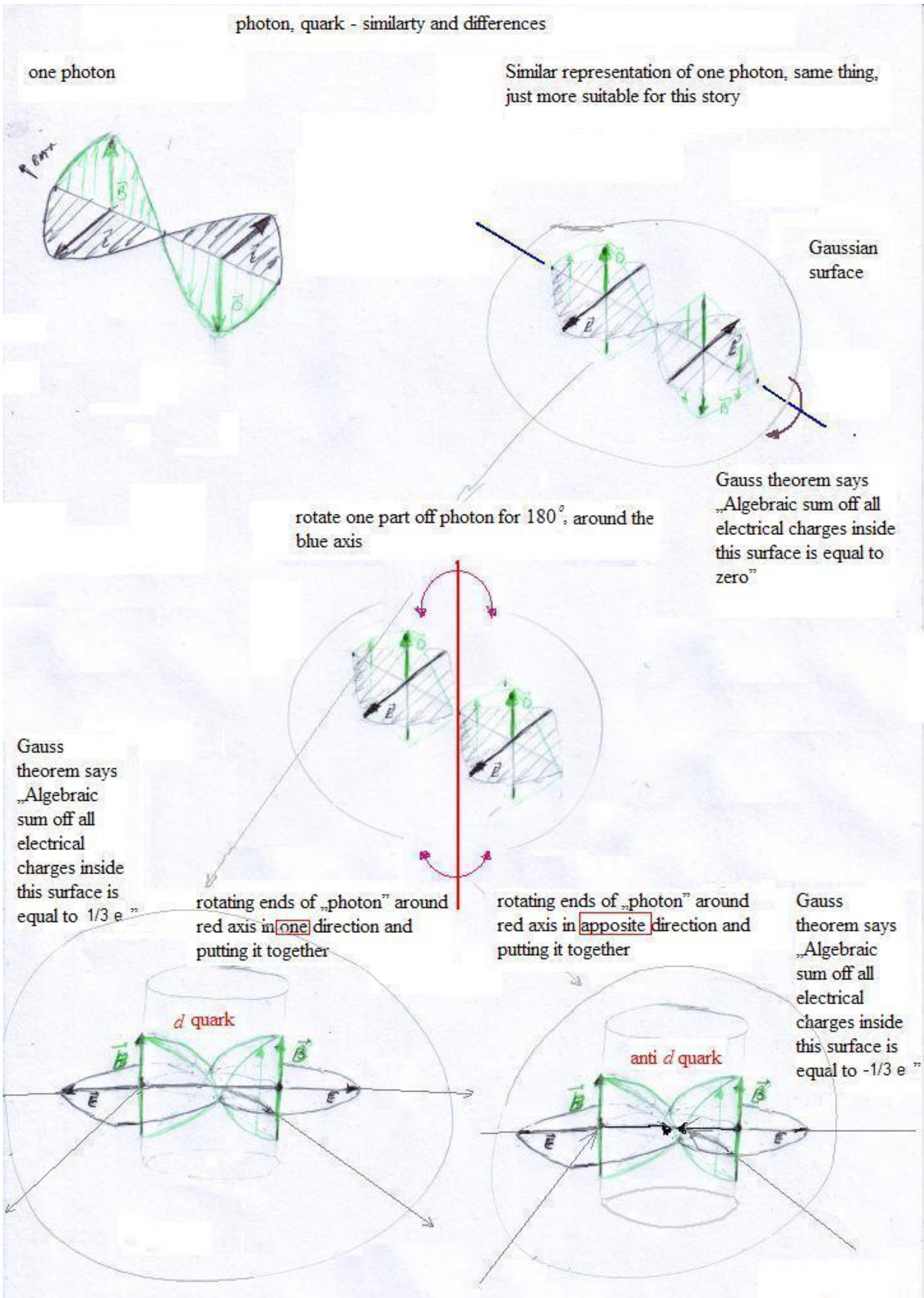
<u>In other words, the electric potential energy of charged particles creates and feels gravitational field.</u>

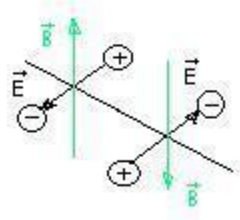
If we slowly lowering charged particles in the strong gravitational fields, we will see that their rest mass goes to 0; therefore it is logical to assume that the amount of the electric charge goes to 0 in the extreme gravitational fields.

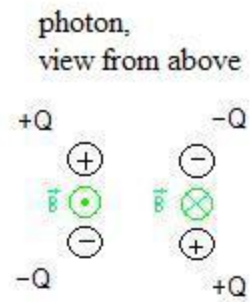
An interesting example:

Rest mass of the proton; (and its electric charge) while freefalling in extremely strong gravitational field, decreases to 0 as his speed increases up to the speed of light.

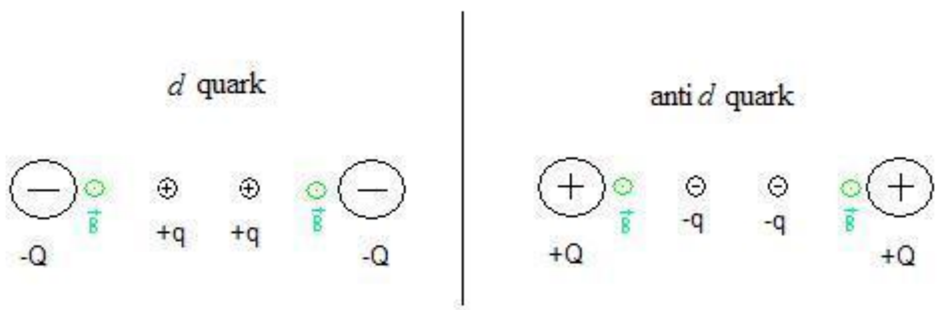
3.2. Look, shape and size of the quark







quark, view from above



$$|+Q| = |-Q|$$
$$|+q| = |-q|$$
$$|\pm Q| > |\pm q|$$

$$2\,|\pm Q| - 2\,|\pm q| = \frac{1}{3}\,e$$

$$e = 1{,}6 \cdot 10^{-19}\ \mathrm{c}$$

For easy visualization; quark is a photon-like particle which is self-entangled, extremely deformed and mutilated by its own gravitational field.

Self-entangled:
Quark is held together by its own gravitational field, against its own electric and magnetic forces.

Extremely deformed:
Its own very strong gravitational field deforms him as in drawings above.

Mutilated:
Quark can exist only if its gravitational force is very strong; therefore its own gravitational field reduces its own internal electric charges (there is reduction in external electric charges as well, but not to that extent as internal)…

Quark size

Due to necessity of the extremely strong gravitational field needed for detectable reduction of the electric charges, and extremely strong gravitational pull needed to balance opposing electric and magnetic forces; radius *R* of the quark is determined by:

$$\frac{2\gamma M}{Rc^2} \to 1$$

Now we come to the point where we have to define one basic principle in nature:

$$\frac{2\gamma M}{Rc^2} < 1$$

<u>There is a limit in how much mass (energy) you can put in space determined by radius *R*.</u>

$$R > \frac{2\gamma M}{c^2}$$

Radius assessment for quarks in different conditions:

Masses of proton, neutron, electron

$m_p \approx 1{,}67 \cdot 10^{-27} kg$

$m_n \approx 1{,}67 \cdot 10^{-27} kg$

$m_e \approx 9{,}11 \cdot 10^{-31} kg$.

Masses of up quark and down quark in neutron and proton

$m_u + 2 \cdot m_d \approx 1{,}67 \cdot 10^{-27} kg$

$2 \cdot m_u + m_d \approx 1{,}67 \cdot 10^{-27} kg$

Therefore

$$m_u \approx m_d \approx \frac{1{,}67 \cdot 10^{-27} kg}{3} \approx 5{,}567 \cdot 10^{-28} kg \ .$$

Mass of one *d* quark in electron

$$m_{de} \approx \frac{1}{3} \cdot m_e \approx \frac{1}{3} \cdot 9{,}11 \cdot 10^{-31} kg \approx 3{,}037 \cdot 10^{-31} kg \ .$$

Mass of one anti down quark $\tilde{d}$ in up quark which is in neutron (proton)

$$m_{du} \approx \frac{1}{3}\frac{1}{2} \cdot m_p \approx \frac{1}{3}\frac{1}{2} \cdot m_n \approx \frac{1}{6} \cdot 1{,}67 \cdot 10^{-27} kg \approx 2{,}783 \cdot 10^{-28} kg \ .$$

Mass of one “free“down *d* quark in proton (neutron)

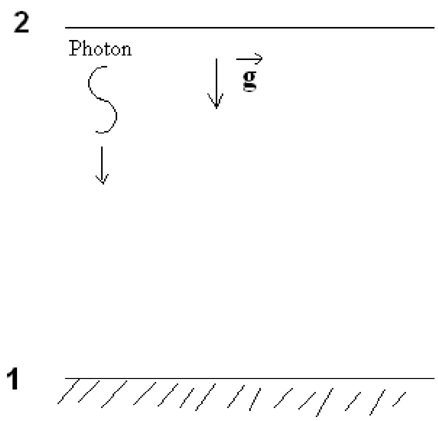
$$m_{dp} \approx \frac{1}{3} \cdot m_p \approx \frac{1}{3} \cdot m_n \approx \frac{1}{3} \cdot 1{,}67 \cdot 10^{-27} kg \approx 5{,}567 \cdot 10^{-28} kg \ .$$

	d quark in electron	$\tilde{d}$ quark in up quark	d quark „free“ in proton (neutron)
mass $m[kg]$	$3{,}037 \cdot 10^{-31}$	$2{,}783 \cdot 10^{-28}$	$5{,}567 \cdot 10^{-28}$
radius $R[m]$ $R \approx \frac{2\gamma m}{c^2}$	$4{,}5 \cdot 10^{-58}$	$4{,}1 \cdot 10^{-55}$	$8{,}3 \cdot 10^{-55}$

4. PLANCK'S CONSTANT

- Photon changes its frequency while free falls in gravitational field[6].
- Energy in free fall is constant.

Therefore value of Planck's constant is different at different heights in gravitational field.



$$E_1 = h_1 v_1$$

$$E_2 = h_2 v_2$$

$$E_1 = E_2 \quad \Rightarrow$$

$$h_1 v_1 = h_2 v_2$$

$$h_2 = \frac{v_1}{v_2} h_1$$

As frequency of the photon increases in free fall in gravitational field value of the Planck's constant is reduced as you come closer to the source of gravitational field.

In other words: Stronger the gravitational field at some point of space; smaller the value of the Planck's constant at that point.

Therefore in places with very strong gravitational fields Planck's constant has very small value, and that among other things gives us the right to talk about quark as a particle with size of 10^{-58} meters...

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[6] Harvard Tower Experiment, http://hyperphysics.phy-astr.gsu.edu/hbase/relativ/gratim.html

Harvard Tower Experiment, ^ Pound, R. V.; Rebka Jr. G. A. (November 1, 1959). "Gravitational Red-Shift in Nuclear Resonance". Physical Review Letters 3 (9): 439–441. Bibcode:1959PhRvL...3..439P. doi:10.1103/PhysRevLett.3.439.