Fundamental particle

Abstract. The article precisely calculates the mass of the fundamental particle and its relations with masses of other particles. The results are theoretically supported by the works of Ruđer Bošković and Antonio Alfonso-Faus.

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Introduction

In the appendix you will find the values of physical quantities from [1] which will be used in this article. In my previous article [2], I labeled the particle whose mass I determined with temporary acronym "EM", in order to avoid confusion with the existing names. Its mass and relations with other masses are shown in [2, figure 1].

Now I have found in [3] and [4] that the term **"fundamental particle"** has been used for the EM particle. I agree with that name, even though it is a virtual particle. However, its importance is so great that it deserves that name. The mass of the fundamental particle (**m_f**) is m_f=1.088622E-28 kg, and this value will be further explained below.

The quotation from [3] follows:

2.- The Weinberg relation

In 1972 Weinberg [4] pointed out a linkage between cosmology (using *G* and the cosmological Hubble´s constant *H*) and quantum mechanics (using Planck´s constant $\hbar$ and a fundamental particle mass *m*) with the expression

$$m^3 = A\frac{\hbar^2 H}{Gc} \quad (3)$$

where *A* is a numerical constant of order one. Since *G* and *c* do not depend

In section 3 of the article [3] the author explained how he obtained the value $\Lambda c \approx 1$, cosmological constant, lambda. I have to admit that I have never understood the meaning of that constant. And why would I even understand it when it produces paradoxes and even its own author Einstein rejected it. Therefore, we do not need the cosmological constant. The concept I have been using functions very well without the cosmological constant and does not produce paradoxes.

Or directly from Weinberg [4, page 619], who correctly assumes the influence of the entire universe on particles. In addition, not only does this influence exist, but owing to it the particles switch from attraction to repulsion, depending on the mass and distance between particles [7]. Weinberg also assumes that the mass of that particle is approximate to the pion mass, which is a good assumption. Here we will see that that mass is about two times less than the pion mass.

Below is the quote from [4]:

> ## 4 Models with a Varying Constant of Gravitation
>
> Gravitational forces are remarkably weak by the standards of atomic or nuclear physics. For instance, the ratio of the gravitational to the electric force between the electron and the proton has the value
>
> $$Gm_p \frac{m_e}{e^2} = 4.4 \times 10^{-40} \qquad (16.4.1)$$
>
> Despite many attempts,[22] there have been no convincing explanations of why such a tiny dimensionless number should appear in the fundamental laws of physics. However, there is one clue, which suggests that numbers like (16.4.1) are not determined solely by considerations of microphysics, but in part by the influence of the whole universe. This clue is simply the fact that, from the quantities G, $\hbar$, c, and the Hubble constant H_0, it is possible to construct a mass, which is not too different from the mass of a typical elementary particle, such as the pion:
>
> $$\left(\frac{\hbar^2 H_0}{Gc}\right)^{1/3} \approx m_\pi \qquad (16.4.2)$$

"Numerical constant A of order one" from [3] I also find redundant. Instead of the Hubble Constant, which I find unnecessary as well, I am using the reciprocal value of the cycle of the universe (the term age of the universe is commonly used). In the above paragraphs you can notice the application of Occam's razor. My version of the above formula is:

$$m_f^{\ 3} = \hbar^2/(T_u Gc) \qquad \textbf{(1)}$$

Before we start calculating the above mass, let's discuss one more useful formula from [3], which confirms my concept. In the section ***4.The law of the geometric mean*** the author suggests the formula:

$$\hbar_m/(mc) = \sqrt{(cT_u)*Gm/c^2} \qquad \textbf{(2)}$$

With the following comment:
"Again this relationship is not restricted to black holes of any kind. The expression (9) is a connection between quantum mechanics and general relativity, including cosmology that may be stated as follows: ***The generalized Compton wavelength of any gravitational mass m is of the order of the geometric mean between its gravitational radius, Gm/c²*** ***, and the visible size of the Universe ct."***

Instead of the reduced Planck constant, the author is here using *"generalized $\hbar_m$"*. So the author, just like with the cosmological constant, does not believe himself and complicates by introducing *"generalized $\hbar_m$"*, instead of using only the reduced Planck constant $\hbar$. The above statement is useful and in my interpretation it states:

The generalized radius of any mass m is the geometric mean between its gravitational radius, Gm/c^2, and the size of the Universe ct.

Occam's razor has again played its part here. When applied to proton, we would get:

$$r_{gp} = \sqrt{(cT_u)*Gm_p/c^2} = 1.2665982\text{E-}14\text{m} \qquad \textbf{(3)}$$

Approximate values from [3] for the quantities of the universe are:
Mass of the Universe (M_u~5.10^{56}gr.), age (T_u~5.10^{17}sec.), Radius $cT_u=10^{28}$ cm. The more accurate value from [6] for the cycle (age) is $T_u=4.3\times10^{17}$. If we apply that value, we get the fundamental mass:

$$m_f^3=\hbar^2/(T_uGc)=1.3\text{E-}84 \text{, i.e. } m_f=1.09\text{E-}28$$

which is in the accuracy spectrum of the input values, equal to the initial value. As the pion mass is m_π=2.4061762E-28, we can see that the mass of the fundamental particle is about 2.2 times less than the pion mass.

For the fundamental particle we would get ***generalized radius***:

$$r_{gf} = \sqrt{(cT_u)*Gm_f/c^2} = 3.23130883\text{E-}15\text{m} \qquad \textbf{(4)}$$

The value of the radius of the universe in the previous text should not be understood as the radius of the sphere or some other shape, because the **universe has no shape**. The shape is a term which is useful for certain ratios, but not for the universe as a whole. Therefore, it is the best to adopt that the radius of the universe is the distance which would be traveled by moving at the speed of light for the duration of the age of the universe, as defined above.

Relation of the fundamental mass to other masses

The assumption of the existence of virtual particles such as this one has existed since Ruđer Bošković [7].

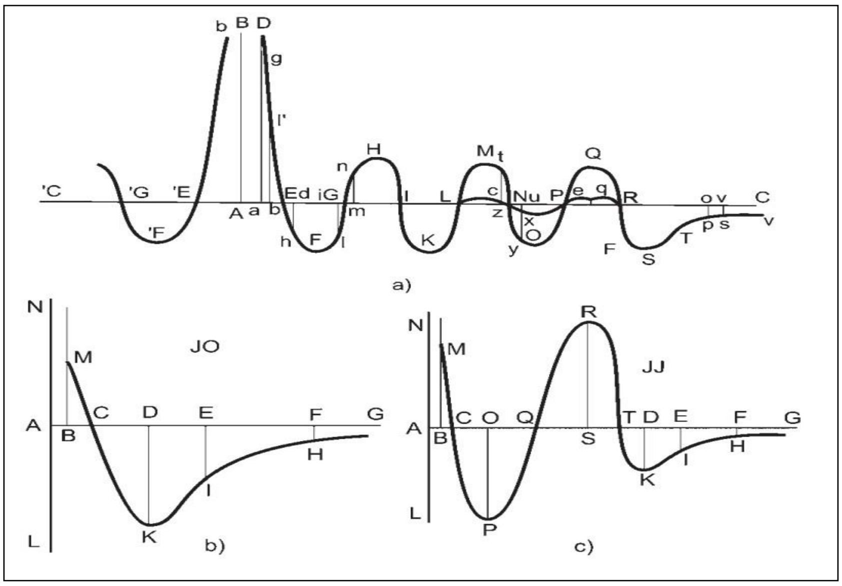

Figure 1. *General (a) and particular (b, c) shapes of curves that present the attractive and repulsive forces (F) (bottom and upper ordinates, respectively) vs. distance (r) (abscissa) between the elementary points and particles of [8].*

"Bošković emphasized the importance of distances at which the curve crosses the abscissa: R, N, I and E represent the stable, but P, L and G are the unstable positions. The elementary points are combined producing the particles of first order, which are combined producing the second order particles, etc. Thus, atoms, molecules, bodies are formed" [8].

Our fundamental particle is evidently somewhere between proton and electron when it comes to mass (about 15.36 times smaller than the proton mass and 119.5 times more massive than electron). Actually, it is a virtual particle in an unstable position according to the Bošković force curve.

Before proceeding to determining the mentioned relations, I would like to state the following: **We should expect the mathematical constant 2π to appear in the relations of masses as frequently as in the relations of lengths.**

This statement derives from the fact that there is a fundamental connection between all the phenomena in the universe; hence also between the mass and length, and that connection is direct. The appearance of 2π is expected at least once in the relation of the mass of the proton and the fundamental mass. Therefore, we can adopt that $15.36=2\pi\boldsymbol{\sigma}$, hence $\boldsymbol{\sigma}=15.36/2\pi=2.44$. What remains to be determined is $\boldsymbol{\sigma}$.

The first way to determine sigma is through the ratio of the radius of the universe, Compton-proton wavelength, mass of the universe and the mass of the proton, as shown below:

$$\sigma = \sqrt[3]{\frac{(\mathrm{R_u}/\lambda_\mathrm{p})^2}{2\pi * (M_u/m_p)}} = 2.44 \qquad \textbf{(5)}$$

The second way would be to define the proton time (*time jiffy*) $\mathbf{t_y}$ as the time needed to travel the distance of the Compton-proton wavelength traveling at the speed of light.

$$\mathbf{t_y=\lambda_p/c=4.4E\text{-}24\ sec}$$

The quotient of the cycle of the universe and the proton time is $k=t/\mathbf{t_y} =4.3*10^{17}/4.4*10^{-24} =9.77*10^{40}$. So, we calculated the number of the proton time units during the cycle of the universe. This number divided by the cube root of the large number which has the value from [9] $\mathbf{N\approx 6.3*10^{121}}$ or from [10] $\mathrm{N}\approx\mathbf{6.38708*10^{121}}$ gives sigma:

$$\mathbf{k/N^{/1/3}}=9.77*10^{40}\ /\ \mathbf{N^{/1/3}=2.44=\sigma}$$

The ratio of the fundamental mass and the mass of the electron is approximately 119.5. Since the electron has a crucial role in electromagnetism, the assumption is that this value is linked to the inverse fine-structure constant $\dot{\boldsymbol{\alpha}}$ [1]. Let's determine $\xi=\dot{\boldsymbol{\alpha}}/119.5=1.147$ and just like for sigma let's see what xi represents.

The ratio of the classical electron radius and Compton-proton wavelength is:

$$\boldsymbol{\beta=r_e/\lambda_p=2.132525} \qquad \textbf{(6)}$$

and the quotient is: $\boldsymbol{\sigma/\beta=1.147\approx}\xi$

Xi is also the quotient of the **generalized fundamental particle radius** and the classical electron radius:

$$\xi=\mathbf{r_{gf}/r_e=3.23130883E\text{-}15m/2.817940E\text{-}15=1.147} \qquad \textbf{(7)}$$

This method serves only for the check and to show what xi represents, since $\mathbf{r_{gf}}$ in the formula (2) features the mass of fundamental particle and hence cannot be used for determining the its mass.

To sum up, we can define the mass of the fundamental particle through the mass of the proton and electron:

$$m_f=m_p/(2\pi*\beta*\xi)=m_p/(2\pi*r_e/\lambda_p*(R_u/\lambda_p)^{2/3}/[2\pi*(M_u/m_p)]^{1/3})=1.088622E\text{-}28\ kg$$

$$m_f=m_e*(\dot{\alpha}/\xi)=m_e*(\beta\dot{\alpha}/\sigma)=1.088622E\text{-}28\ kg$$

Consequently, it is clear that:

$$\mu=m_p/m_e=2\pi*\beta*\acute{\alpha}=1836.15267245$$

The mass of the fundamental particle has the following relation to the mass of the universe [2]:

$$m_f=M_u\pi'^{-1}2^{-cy/2}\sigma^{1/2},cy=e^{2\pi} \tag{8}$$

Characteristics of the fundamental particle

Let's add a few more formulas.

$$(M_u/m_f)^{3/2}=(R_u/r_{gf})^3=(T_u/t_f)^3=(m_{pl}/m_f)^6=6.3870771837E+121 \tag{9}$$

$$m_f=m_{pl}^{4/3}m_u^{-1/3}=1.088622E\text{-}28 \tag{10}$$

$$r_{gf}*m_f=l_{pl}*m_{pl}=3.517672636E\text{-}43 \tag{11}$$

$$\lambda_p*m_p/2\pi=m_{pl}l_{pl}=3.5176726364E\text{-}43 \tag{12}$$

From (9) we can see that it is the only particle whose mass square root, ***generalized radius*** and time satisfy the relation towards certain parameters of the universe. Here $\mathbf{t_f}$ is the time needed to travel the distance of the Compton wavelength $\boldsymbol{\lambda_f}$, of the mass $\mathbf{m_f}$, traveling at the speed of light**:**

$$t_f=\lambda_f/c=(h/m_fc)/c=h/m_fc^2=6.7723225166E\text{-}23\ sec$$

Therefore:

$$(T_u/t_f)^3=(4.3\times10^{17}/6.7723225166E\text{-}23)^3=6.3870771837E+121$$

Let's check the last relation in (9):

$$(m_{pl}/m_f)^6=(2.17651E\text{-}8/1.088622E\text{-}28)^6=(1.9993264E+20)^6=6.3870771837E+121$$

The relation of the fundamental particle with the Planck mass and the mass of the universe (10) requires a broader analysis of a theoretical physicist. In article [11, p2], instead of the mass of the fundamental particle, the same formula comprises the mass of the neutron, quote:

Substituting this scaling law (4) in the expression $M_U = m_P^4/m_n^3$ and remembering that the Planck mass is $m_P = \sqrt{\hbar c/G}$ we have

The formula (10) can also be written as:

$$\mathbf{m_u = m_{pl}^4/m_f^3 = 1.73944912E+53\ kg} \qquad \textbf{(10b)}$$

I am claiming that the relation (10) refers neither to pion nor to nucleon but to the following fundamental particle which has the mass of $\mathbf{m_f=1.088622E\text{-}28\ kg}$. This is precise and so far the most accurate determination of the relation between the **whole (the universe) and the parts**, which always follow the same pattern. If these simple formulas are inaccurate, we should provide alternatives, but some relation has to exist.

Only the product of the mass of the fundamental particle and its ***generalized radius*** is equal to the product of the Planck mass and Planck length (11), for all the other particles this statement is not true.

From (11) and (12) we get that $\mathbf{r_{gf}*m_f=\lambda_p*m_p/2\pi}$**,** i.e. we can see that the product of the ***generalized radius*** and the mass of the fundamental particle is equal to the product of the Compton wavelength and the mass of the proton divided by $\mathbf{2\pi}$**.** Here we can talk about the fundamental particle as an intersection between the matter, here represented by the proton, and the electromagnetic part of the universe. If in formula (11) we multiply reciprocal values with the mass or the radius of the universe, we get:

$$(R_u/r_{gf})*(M_u/m_f)=\mathbf{(R_u/l_{pl})*(M_u/m_{pl})}=$$
$$3.9973059E+40*1.59784547E+81=\mathbf{7.991919E+60*7.991919E+60}=6.3871E+121=N \qquad \textbf{(13)}$$

i.e. we have again obtained the large number N.

Alfonso-Faus in [3] claims the same after his formula 8:

"It implies that m the gravitational cross section area of a mass, as we have defined it as the effective area for gravitational interaction, is of the order of the square of its generalized Compton wavelength, a quantum mechanical property associated with a generalized $\hbar_m$."

Here we will apply his formula 8 from [3], only with radius instead of area, i.e.

$$\mathbf{r=\hbar/mc=3.2313088E\text{-}15=r_{gf}}$$

Here it is actually shown that formula (2) taken from [3] is true only for the fundamental particle. In place of the author's introduction of $\hbar_m$ in (2), which is dependent on the mass, the Planck constant should remain invariant, while the gravitational radius is being changed.

We can notice, by using (3) and the appendix, that the gravitational radius of the proton in relation to the Compton wavelength of the proton is r_{gp}/λ_p=1.266598E-14/1.3214409E-15=9.585203146=$(2\pi)^{1/2}*\varsigma^{3/2}$. Similarly, for every other particle we can find how big its gravitational radius is in relation to the Compton wavelength.

Generalized radius can also be assigned to masses smaller than $\mathbf{m_f}$ and in those cases it will be smaller than the ***generalized radius of the fundamental particle***, as the smaller the mass the smaller the radius is. So, for example, for the electron it is:

$$r_{ge} = \sqrt{(cT_u)*Gm_e/c^2} = 2.9558641\text{E}-16\,\text{m} \quad \textbf{(14)}$$

meaning that ***generalized radius of the electron*** is 9.533 times smaller than the classical electron radius and additional $2\pi\acute{\alpha}$ times smaller than the Compton wavelength of the electron (8208.5 times).

Let's quote Alfonso-Faus again [5]:

"The quantum of gravitational energy is given by the expression Eg = ħc/R, it has a wavelength of the order of the size of the universe, R, and a momentum pg = ħ/R. Its equivalent mass has a value $m_g = \hbar/cR \approx 10^{-66}$ *grams, a figure found in many different instances in the scientific literature."*

I calculated that mass, let's call it the ***hypothetical mass quantum***, to be exactly:

$m_g = \hbar/cR_u$=1.054571726 e-34/(299792458*1.2917E+26)=2.7233882879E-69 kg **(15)**

We can show that the Planck mass is the geometric mean of the mass of the universe and this mass. For this mass ***generalized radius*** is:

$$r_{gg} = \sqrt{(cT_u)*Gm_g/c^2} = 1.6161988\text{E}-35\,\text{m} = l_{pl} \quad \textbf{(16)}$$

i.e. the ***Planck length is generalized radius of the hypothetical mass quantum***.

Conclusion

Applying the concept that **"Parts are dependent on the whole (Universe) and are also an integral part of the whole, therefore, the whole is also dependent on the parts!"** I determined the relations among fundamental physical constants. The precise values are as accurate as the two physical constants (*inverse fine-structure constant and proton-electron mass ratio*), which I published in my articles at viXra. The confirmation of accuracy of this concept I found in the theory of Ruđer Bošković [7]. I found many contemporary articles that are very close to my concept, but rarely with specific calculations which would back up the theories.

However, the work of Antonio Alfonso-Faus, published at arXiv, features some interesting statements and concrete but mostly approximate calculations which combine cosmological and quantum parameters. I showed that it is possible to accurately determine the relations governing physical quantities, without using redundant parameters such as the *cosmological constant, Numerical constant A*, the Hubble Constant and *generalized* $\hbar_m$. I believe that Alfonso-Faus is wrong for not disregarding the unnecessary constants, although theoretically his views have solid foundations. By eliminating the unnecessary constants, all the paradoxes related to them would also be eliminated.

Instead of the mentioned constants, I introduced concrete and easily calculable constants dependent on the relation between the **whole and the parts**, primarily between the mass of the proton and the universe. Those are the constants represented by sigma, beta and xi. I showed the simplicity of the relations governing the relations among the Planck values, fundamental mass, large number $N \approx 10^{122}$ and the parameters of the proton and the universe.

The concept of unity of the **whole and parts** rejects the use of terms *coincidence, paradox, mysterious and strange*. The so called *coincidences of large numbers* are actually immanent indicators of relations between the **whole and parts**. Paradoxes as consequences of wrong understanding of phenomena simply do not appear here. The Planck values are not mysterious; they are an integral part of the relation between the **whole and its parts**, which is evident from the presented formulas. Why the fine-structure constant has the value that it has was not shown here, but labels mysterious and strange are not being attributing to it either.

The article confirmed Weinberg's assumption about the possible influence of the universe as a whole on the microscopic processes and offered several relations for that.

Novi Sad, December 2013

Appendix

CODATA internationally recommended values of the Fundamental Physical Constants:

h	Planck constant	6.626 069 57 e-34	0.000 000 29 e-34	J s
$\hbar$	Planck constant reduced	1.054 571 726 e-34	0.000 000 047 e-34	J s
l_{pl}	Planck length	1.616 199 e-35	0.000 097 e-35	m
m_{pl}	Planck mass	2.176 51 e-8	0.000 13 e-8	kg
ά	inverse fine-structure constant	137.035 999 074	0.000 000 044	
λ_p	proton Compton wavelength	1.321 409 856 23 e-15	0.000 000 000 94 e-15	m
r_e	classical electron radius	2.817 940 3267 e-15	0.000 000 0027 e-15	m
m_p	proton mass	1.672 621 777 e-27	0.000 000 074 e-27	kg
m_e	electron mass	9.109 382 91 e-31	0.000 000 40 e-31	kg
μ	proton-electron mass ratio	1836.152 672 45	0.000 000 75	
c	speed of light in vacuum	299 792 458	(exact)	m s$^{\wedge-1}$

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