A strong zero-energy hypothesis (ZEH) applied on virtual particle-antiparticle pairs (VPAPs) predicting a new type of boson-fermion symmetry/"mass-conjugation", two distinct types of massless neutral fermions and a strong gravity field (SGF) which is well-balanced in strength with an electromagnetic field (EMF) possessing asymptotic freedom at Planck length scales

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DOI: 10.13140/RG.2.2.19726.38721 (URL-RG)
Article version: 1.0 (6.06.2020) (no matter this current paper version, its latest variant can be always downloaded from this URL; version 1.0 released on 6.06.2020)

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Abstract
(with main abbreviations used in this paper)

This article proposes a simple but strong zero-energy hypothesis (**ZEH**), which is essentially an ambitious speculative extension of the famous zero-energy universe hypothesis (**ZEUH**) (updating ZEUH to an "extended ZEUH" version) applied on virtual particle-antiparticle pairs (**VPAPs**) produced by virtual photons or virtual gluons. ZEH ambitiously proposes (and predicts):

(1) **a new type of boson-fermion symmetry/"mass-conjugation"** based on a simple and elegant quadratic equation (with partially unknown coefficients) proposed by ZEH: all known rest masses of all elementary particles (**EPs**) in the Standard model (**SM**) of particle physics are redefined as real solutions of this simple quadratic equation; based on the same quadratic equation, ZEH indicates/predicts an **unexpected profound bijective connection between the three types of neutrinos and the massless bosons** (gluon, photon and the hypothetical graviton); **ZEH also offers a new interpretation of Planck length** as the approximate length threshold above which the rest masses of all known EPs have real number values (with mass units) instead of complex/imaginary number values (as predicted by the same unique equation proposed by ZEH); among other EPs, **ZEH also predicts the existence of two distinct types of massless neutral fermions** (correspondents/conjugates of the neutral Higgs boson and Z bosons) which both move at the speed of light and may be viable candidates for dark matter and dark energy;

(2) a strong quantum gravitational field (**SQGF**) (equaling the predicted strength of the electromagnetic field [**EMF**] at Planck scales, which EMF is also predicted to possess asymptotic freedom, similarly to the strong nuclear field [**SNF**]) implying a quantized spacetime (**ST**) composed from ST "voxels" (**STVs**) resulting in quantized/discrete distances at scales comparable to Planck length scales;

(3) ZEH is essentially a fundamental principle of electro-gravitational strength balance/symmetry at Planck scales, a principle which allows (as a sine-qua-non condition added to Heisenberg's uncertainty principle [**HUP**]) the existence of virtual particle-antiparticle pairs (**VPAPs**) from the first place;

(4) ZEH also conjectures the existence of a unique large (but finite!) maximum density allowed in our universe (**OU**) shared by the electron neutrino and the pre-Big Bang singularity (**pBBS**) (which is thus regarded as a "renormalized" gravitational quasi-singularity) with all the other known/unknown EPs (which are regarded as "crocks" of pBBS);

(5) ZEH also proposes the concept of "practical radius" of any known/unknown EP and a unique formula for calculating this practical radius for any type of EP (associated with a unique big G value formula for any given practical radius/length scale).

ZEH distinguishes by the contrast between its simplicity and the richness/diversity of explanations, correlations and predictions it offers. The author of this paper resonates to Dirac's vision on the importance of mathematical beauty in physical equations: "*The research worker, in his efforts to express the fundamental laws of Nature in mathematical form, should strive mainly for mathematical beauty [...]It often happens that the requirements and beauty are the same, but where they clash the latter must take precedence.*" [URL]; "*A theory with mathematical beauty is more likely to be correct than an ugly one that fits some experimental data"* (as he claimed in 1970 when referring to the renormalization of quantum electrodynamics which was Dirac's paradigm of a mathematically "ugly" theory) [URL].

Zero is not only a number, but the symbol of both Nothingness and Everythingness (because all positive and negative numbers can be regarded as "born" in pairs from the same Zero to which they are symmetrical): furthermore, zero not only plays an essential central role in mathematics, but it also has a central role in physics and is a fundamental link between these two sciences, in the context of a possibly valid zero-energy universe theory (**ZEUT**).

This paper continues (from alternative angles of view) the work of other past articles/preprints of the same author [**1**,**2**, **3**, **4**, **5**, **6**, **7**, **8**, **9**, **10**, **11**, **12**, **13**, **14**, **15**, **16**, **17**, **18**, **19**, **20**, **21**, **22**, **23**, **24**, **25**, **26**, **27**].

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1. A strong zero-energy hypothesis applied on pairs of virtual particles

A strong zero-energy hypothesis (ZEH) assigned to any VPAP of any EM-charged/non-charged EPs. Based on Obs1a, we launch a zero-energy hypothesis (**ZEH**) (essentially an ambitious speculative extension of the famous zero-energy universe hypothesis [**ZEUH**] updating ZEUH to an extended ZEUH variant [**16**]), which ZEH has three co-statements.

ZEH's 1st co-statement (ZEH-1) and its implications. Presuming the gravitational and electrostatic inverse-square laws to be valid down to Planck scales and considering a virtual particle-antiparticle pair (**VPAP**) composed from two electromagnetically-charged EPs (**cEPs**) each with non-zero rest mass m_{EP} and energy

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$E_{EP}=m_{EP}c^2$, electromagnetic charge q_{EP} and negative energies of attraction $E_g=-Gm_{EP}{}^2/r$ and $E_q=-k_e\left|q_{EP}\right|^2/r$, the **first co-statement of ZEH** is expressed as:

$$E_{EPs}+E_g+E_e=0 \Leftrightarrow E_{EPs}=\left|E_g+E_e\right| \quad \textbf{(1a)},$$

which is equivalent to (see below)

$$2m_{EP}c^2{}_{\left(=E_{ph}\right)}=Gm_{EP}{}^2/r+\left|E_q\right| \quad \textbf{(1b)}$$

which, by dividing both terms with $m_{EP}{}^2$, is equivalent to (see below)

$$2c^2/m_{EP\left(=E_{ph}/m_{EP}{}^2\right)}=G/r+\left|E_q\right|/m_{EP}{}^2 \quad \textbf{(1c)}$$

which is equivalent to (see below)

$$m_{EP\left(=2c^2m_{EP}{}^2/E_{ph}\right)}=2c^2/\left(G/r+\left|E_q\right|/m_{EP}{}^2\right) \quad \textbf{(1d)}$$

Because the spectrum of nzrms m_{EP} of all known EPs is quantized (with the left term m_{EP} of the equation 1d [**Eq.1d**] taking only specific discrete values), ZEH automatically implies that both $\phi_g \overset{def.}{=} G/r$ and $\phi_e \overset{def.}{=} k_e/r$ (which compose the right term of **Eq.1d,** with $E_g=\phi_g m_{EP}{}^2$ and $E_q=\phi_e q_{EP}{}^2$) are actually *quantized* and *can only take discrete values*: furthermore, quantized $\phi_g\left(=G/r\right)$ and $\phi_e\left(=k_e/r\right)$ *also imply that* G, k_e, r *(and* $E_{ph}\left(=hc/r\right)$ implicitly) *can only take discrete quantized values.*

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ZEH's 2nd co-statement (ZEH-2) and its implications. ZEH-2 specifically (and ambitiously) interprets the quantized mass m_{EP} *as being actually caused by the existence of the bijective functions* $G_i=f\left(r_i\right)$, $k_{e(i)}=f\left(r_i\right)$. Furthermore, ZEH specifically interprets this implication in the sense that m_{EP} *is quantized in the group of all known nzrmEPs because both* ϕ_g *and* ϕ_e *are actually quantized (because* G, k_e *and* r *can only take reciprocally bijective discrete quantized values) and the rest mass of any nzrmEP* m_{EP} *is actually a function of these two quantized* ϕ_g *and* ϕ_e *ratios*; this important prediction/interpretation of ZEH is assumed as **ZEH's 2nd co-statement** which also defines m_{EP} as the solution of the next simple and elegant quadratic equation with unknown $x\left(=m_{EP}\right)$ (equivalent with ZEH's **Eq.1b** as both derived from **Eq.1a**):

$$\phi_g x^2-\left(2c^2\right)x+\phi_e q_{EP}{}^2=0 \quad \textbf{(2a)}$$

Eq.2a is easily solvable and has two possible conjugate solutions which are both positive reals if $c^4\geq\phi_g\phi_e q_{EP}{}^2\geq 0$:

$$m_{EP}\left(=x\right)\underset{ZEH}{\overset{redef.}{=}}\frac{c^2\pm\sqrt{c^4-\phi_g\phi_e q_{EP}{}^2}}{\phi_g} \quad \textbf{(2b)}$$

The realness condition $c^4\geq\phi_g\phi_e q_{EP}{}^2\geq 0$ implies the existence of a minimum distance between any two EPs (composing the same VPAP) $r_{\min}=\left|q_{EP}\right|\sqrt{Gk_e}/c^2\cong 10^{-1}l_{Pl}$ (for $q_{EP(\cong e)}\in\left\{e,\pm\tfrac{1}{3}e,\pm\tfrac{2}{3}e\right\}$ and with l_{Pl} being the Planck length): obviously, for distances lower than $r_{\min}$ the previous equation has only imaginary solutions $x\left(=m_{EP}\right)$ for any charged EP; by this fact, **ZEH offers a new interpretation of the Planck length, as being the approximate distance under which charged EPs cannot have rest masses/energies valued with real numbers**.

Both conjugate solutions (**2b**) of **Eq.2a** reconfirm that, **because** m_{EP} **has discrete values only,** ϕ_G **(plus** $E_g\left(=\phi_G m_{EP}{}^2\right)$ **implicitly) and** ϕ_e **(plus** $E_q\left(=\phi_e q_{EP}{}^2\right)$ **implicitly) should all have discrete values only**. More interestingly, for all neutral EPs (**nEPs**) with $q_{EP}=0C$ (which implies $\phi_g\phi_e q_{EP}{}^2=0$) and $r\geq r_{\min}\left(>0m\right)$, **Eq.2b** predicts that m_{EP} may take these **two conjugate solutions**: (**1**) a non-zero positive value $m_{EP}=\dfrac{c^2+\sqrt{c^4}}{\phi_g}=\dfrac{2c^2}{\phi_g}\left(>0kg\right)$ (like in the case of all three types of neutrinos, the Z boson and the Higgs boson) AND (**2**) a zero (positive) value $m_{EP}=\dfrac{c^2-\sqrt{c^4}}{\phi_g}=0kg$ (like in the case of the gluon and the photon which both have zero rest mass $m_{EP}\left(=0kg\right)$ and are assigned only relativistic mass/energy by the Standard model (**SM**) of particle physics, implying that both travel with the speed of light in vacuum).

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ZEH's 3rd co-statement (ZEH-3) and its implications. ZEH-3 co-states that the two conjugated elementary mass solutions $m_{EP}=\left(c^2\pm\sqrt{c^4-\phi_g\phi_e q_{EP}{}^2}\right)/\phi_g$ **(of ZEH's main equation) actually define a boson-fermion pair (with conjugated masses) called here "conjugated boson-fermion pair" (CBFP).** ZEH-3 actually conjectures **a new type of boson-fermion**

symmetry/"mass-conjugation" based on ZEH's main quadratic equation (with partially unknown coefficients): ZEH-3 mainly predicts **2 distinct types of massless neutral fermions** (with zero rest mass, which may be the main constituents of dark matter and dark energy) AND an **unexpected profound bijective connection between the three types of neutrinos and the massless bosons** (gluon, photon and the hypothetical graviton) (**see next**).

For the beginning, let us start to estimate the values of ϕ_g for the known EM-neutral EP (**nEP**). For $q_{EP} = 0$, the conjugated solutions (**Eq.2b**) simplify for any nEP such as $m_{nEP} = \left(c^2 \pm c^2\right)/\phi_g$, resulting:

$$\phi_{g(nEP)} = \left(c^2 \pm c^2\right)/m_{nEP} \quad \textbf{(2c)}$$

Focusing on Higgs boson and Z boson and their ZEH-predicted correspondent/conjugated massless fermions. In a first step and noting as $u\left(=m^2 kg^{-1} s^{-2}\right)$ the unit of measure of $\phi_g\left(=2c^2/m_{nEP}\right)$, ZEH directly calculates/estimates $\phi_{g(nEP)}$ for the Z boson (**Zb**) and Higgs boson (**Hb**) which have known nzrm such as: $\phi_{g(Zb)} = 2c^2/m_{Zb} \cong 10^{42}u$ and $\phi_{g(Hb)} = 2c^2/m_{Hb} \cong 8\times10^{41}u$. ZEH-3 states (and predicts!) that both Zb and Hb have two distinct correspondent/conjugated massless neutral fermions called the "Z fermion" (**Zf**) (which shares the same $\phi_{g(Zb)}\left(\cong 10^{42}u\right)$ with Zb) and the "Higgs fermion" (**Hf**) (which shares the same $\phi_{g(\mathrm{Hb})}\left(\cong 8\times10^{41}u\right)$ with Hb) with zero rest masses (calculated by using the previous **Eq.2c**) (thus both moving with the speed of light in vacuum and possessing only relativistic masses instead of rest masses): $m_{Zf} = \left(c^2 - c^2\right)/\phi_{g(Zb)} = 0kg$ and $m_{Hf} = \left(c^2 - c^2\right)/\phi_{g(Hb)} = 0kg$.

Focusing on all three types of neutrinos, photon, gluon and hypothetical graviton. In a second step, ZEH-3 estimates the lower bounds of $\phi_{g(nEP)}$ for all known three neutrinos, as deducted from the currently estimated upper bounds of nzrm of all three known types of neutrino: the electron neutrino (**en**) with nzrm $m_{en} < 1eV/c^2$, the muon neutrino (**mn**) with nzrm $m_{mn} < 0.17MeV/c^2$ and the tau neutrino (**tn**) with nzrm $m_{tn} < 18.2MeV/c^2$: $\phi_{g(en)}\left(> 2c^2/m_{en}\right) > \left(\cong 10^{53}u\right)$, $\phi_{g(mn)}\left(> 2c^2/m_{mn}\right) > \left(\cong 6\times10^{47}u\right)$ and $\phi_{g(tn)}\left(> 2c^2/m_{tn}\right) > \left(\cong 6\times10^{45}u\right)$.

Important co-statement (and prediction) of ZEH-3 on the hypothetical graviton and the possible profound connections by "conjugated symmetry of masses" (CSM) between the known neutrinos and the known bosons plus the hypothetical graviton. However, ZEH-3 additionally co-states that $\phi_{g(ph)}$ and $\phi_{g(gl)}$ may also have very large values (corresponding to incredibly light photon and gluon, with incredibly small nzrm which may create the illusion of massless EPs possessing only relativistic masses/energies, possibly an illusion created by the lack of EMC in the case of both the photon and the gluon), so that these large values (of $\phi_{g(ph)}$ and $\phi_{g(gl)}$) may actually be the same with $\phi_{g(en)}$, $\phi_{g(mn)}$ and $\phi_{g(tn)}$. More specifically and ambitiously, ZEH-3 additionally states that $\phi_{g(ph)} > \phi_{g(gl)}$ and that there also exists a incredibly light/massless graviton (**gr**) defined by $\phi_{g(gr)} > \phi_{g(ph)}\left(> \phi_{g(gl)}\right)$ so that: $\phi_{g(gr)} = \phi_{g(en)}\left(> 1.1\times10^{53}u\right)$, $\phi_{g(ph)} = \phi_{g(mn)}\left(> 6\times10^{47}u\right)$ and $\phi_{g(gl)} = \phi_{g(tn)}\left(> 5.6\times10^{45}u\right)$.

Focusing on the electron, muon, tauon and their ZEH-predicted correspondent/conjugated (super-)heavy bosons. In a 3rd step, ZEH-3 states that W boson and the electron are form a conjugate boson-fermion pair with rest masses $m_e = \left(c^2 - \sqrt{c^4 - \phi_{g(W/e)}\phi_{e(W/e)}q_e^{\,2}}\right)/\phi_{g(W/e)}$ and $m_W = \left(c^2 + \sqrt{c^4 - \phi_{g(W/e)}\phi_{e(W/e)}q_e^{\,2}}\right)/\phi_{g(W/e)}$. The common term $\sqrt{c^4 - \phi_{g(W-e)}\phi_{e(W-e)}q_e^{\,2}}$ of both rest masses (m_e and m_W) disappears when summing $m_e + m_W = 2c^2/\phi_{g(W/e)}$, from which their common/shared $\phi_{g(W/e)}$ ratio can be reversely estimated as $\phi_{g(W/e)} = 2c^2/\left(m_e + m_W\right) \cong 1.25\times10^{42}u$, which is relatively close to $\phi_{g(Zb)}\left(\cong 10^{42}u\right)$ and $\phi_{g(Hb)}\left(\cong 8\times10^{41}u\right)$. The other $\phi_{e(W/e)}$ ratio can be also reversely estimated from both m_W (or m_e) and $\phi_{g(W/e)}$ as $\phi_{e(W/e)} \cong 6.4\times10^{24}NmC^{-2}$.

All the proposed pairs of EP mass-conjugates (as stated by ZEH are illustrated in the **next table (each with their specific assigned ϕ_g and ϕ_e ratios)**.

(Table 1)

Table 1. The pair of conjugated EPs predicted by ZEH (mainly by the sub-hypotheses ZEH-3a, ZEH-3b, ZEH-3c and ZEH-3d)

Boson (/corresponde nt conjugate boson of a known fermion)	**Fermion** (/corresponde nt conjugate fermion of a known boson)	Common/ shared ϕ_g ratio of a conjugated boson-fermion pair	Common/ shared ϕ_e ratio of a conjugated boson-fermion pair
Non-quark EPs as treated by ZEH			
hypothetical graviton (**gr**) (spin-2 neutral boson, with color charge only)	electron neutrino (**en**)	$\phi_{g(gr)} = \phi_{g(en)}$ $\left(>1.1\times10^{53}u\right)$	?
photon (**ph**) (spin-1 neutral boson)	muon neutrino (**mn**)	$\phi_{g(ph)} = \phi_{g(mn)}$ $\left(>6\times10^{47}u\right)$	?
gluon (**gl**) (spin-1 neutral boson)	tauon neutrino (**tn**)	$\phi_{g(gl)} = \phi_{g(tn)}$ $\left(>5.6\times10^{45}u\right)$	?
Z boson (**Zb**) (spin-1 neutral boson)	"Z-fermion" (**Zf**) (predicted neutral massless ½-spin fermion)	$\phi_{g(Zb)}$ $\cong 10^{42}u$	?
Higgs boson (**Hb**) (spin-0/scalar neutral boson)	"Higgs-fermion" (**Hf**) (predicted neutral massless ½-spin fermion)	$\phi_{g(Hb)}$ $\cong 8\times10^{41}u$	?
W boson (**Wb**) (spin-1 charged boson)	electron (**e**)	$\phi_{g(W/e)} \cong$ $1.25\times10^{42}u$	$\phi_{e(W/e)} \cong$ $6.4\times10^{24}F^{-1}$

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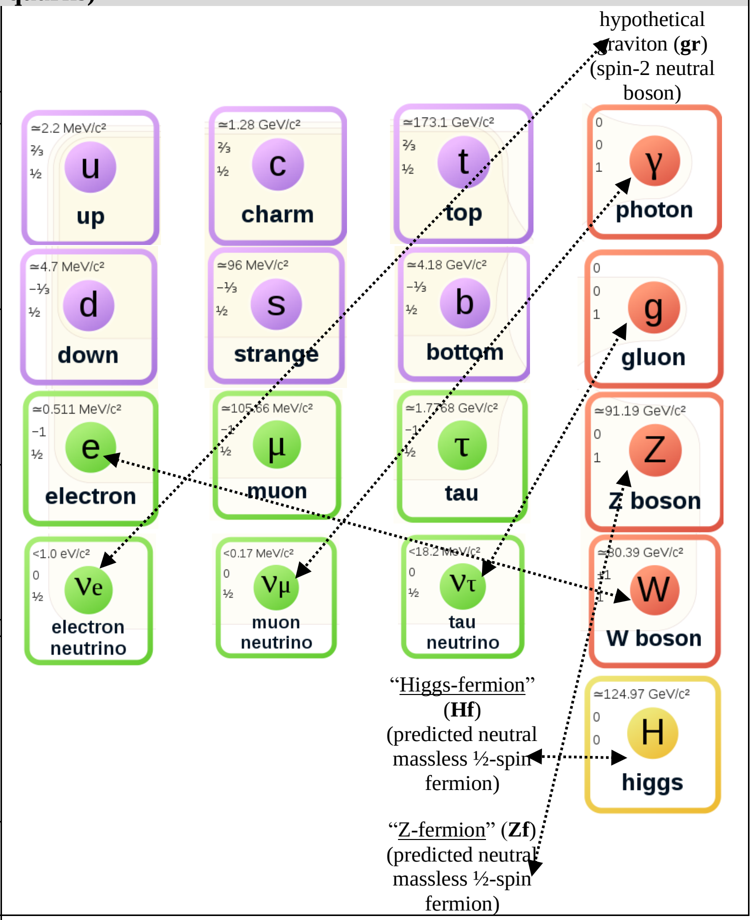
(**Table 2**) All the proposed pairs of EP-conjugates (as stated by ZEH-3a, ZEH-3b, ZEH-3c and ZEH-3d) are also illustrated in the **next table**: as it can be seen from this next table, ZEH-3 transforms the already "classical" 2D table of EPs (from the Standard model [**SM**] of particle physics) in a 3D structure/table in which EPs are grouped NOT ONLY in boson and fermion families/subfamilies, BUT they are also grouped and inter-related by an "underneath" relation of boson-fermion mass conjugation (or fermion-fermion mass conjugation), all based on the same simple semi-empirical quadratic equation proposed by ZEH.

Table 2. The pairing of conjugated EPs predicted by ZEH and marked by interconnecting arrows. Source of image extracts: https://en.wikipedia.org/wiki/File:Standard_Model_of_Elementary_Particles.svg
◄······► (marks each pair of conjugates stated by ZEH, except quarks)



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ZEH's 4th co-statement (ZEH-4) and its implications. **ZEH-4** uses the minimum length/distance $r_{\min}\left(=\left|q_{EP}\right|\sqrt{Gk_e}/c^2 \cong 10^{-1}l_{Pl}\right)$ needed for any virtual particle-antiparticle pair (**VPAP**) to pop out from the vacuum at the first place (as stated and predicted by ZEH for all rest masses to be describable by real numbers with mass units) AND all the ZEH-3-predicted ϕ_g and ϕ_e ratios (briefly listed in the first table of this paper) to predict (**pr.**) the big G and Coulomb's constant k_e values at scales $r_{\min}\left(\cong 10^{-1}l_{Pl}\right)$ comparable to Planck scale as $G_{pr} = \phi_{g(pr)}r_{\min}$ and $k_{e(pr)} = \phi_{e(pr)}r_{\min}$ (**see the next table**)

(Table 3)

Table 3. The predicted big G values $G_{pr} = \phi_{g(pr)}r_{\min}$ and Coulomb's constant values $k_{e(pr)} = \phi_{e(pr)}r_{\min}$ for all pairs of conjugated EPs predicted by ZEH (mainly by the sub-hypotheses ZEH-3a, ZEH-3b, ZEH-3c and ZEH-3d)

Pair of conjugated EPs	Common/ shared ϕ_g and ϕ_e ratios	G_{pr} $\left(=\phi_{g(pr)} r_{\min}\right)$	$k_{e(pr)}$ $\left(=\phi_{e(pr)} r_{\min}\right)$
Non-quark EPs as treated by ZEH			
hypothetical graviton (**gr**) & electron neutrino (**en**)	$\phi_{g(gr)} = \phi_{g(en)}$ $\left(>1.1\times10^{53} u\right)$?	$>2.1\times10^{27} G$	?
photon (**ph**) - muon neutrino (**mn**)	$\phi_{g(ph)} = \phi_{g(mn)}$ $\left(>6\times10^{47} u\right)$?	$>1.2\times10^{22} G$	?
gluon (**gl**) - tauon neutrino (**tn**)	$\phi_{g(gl)} = \phi_{g(tn)}$ $\left(>5.6\times10^{45} u\right)$?	$>1.2\times10^{20} G$	?
Z boson (**Zb**) & "Z-fermion" (**Zf**)	$\phi_{g(Zb)}$ $\cong 10^{42} u$	$\cong 2.1\times10^{16} G$	?
Higgs boson (**Hb**) & "Higgs-fermion" (**Hf**)	$\phi_{g(Hb)}$ $\cong 8\times10^{41} u$	$\cong 1.7\times10^{16} G$	?
W boson (**Wb**) & electron (**e**)	$\phi_{g(W/e)} \cong$ $1.25\times10^{42} u$ $\phi_{e(W/e)} \cong$ $6.4\times10^{24} F^{-1}$	$\cong 2.6\times10^{16} G$	$\cong 10^{-21} k_e$

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Interpretation. From the previous table, one can easily remark that ZEH predicts a big G which may increase (when decreasing the length scale of measurement up to values $G_{pr}\left(=\phi_{g(en)} r_{\min}\right) > 2.1\times10^{27} G$ at $r_{\min}\left(\cong 10^{-1} l_{Pl}\right)$ length scales (comparable to Planck scale): concomitantly (and accordingly to the same table) and interestingly, ZEH predicts that Coulomb's constant k_e may drop down to values $k_{e(pr)}\left(=\phi_{e(W/m)} r_{\min}\right) \cong 10^{-21} k_e$ at the same length scales close to $r_{\min}\left(\cong 10^{-1} l_{Pl}\right)$. **Important observation.** For the electron rest mass $\left(m_e\right)$ at macroscopic scales $r\left(>> r_{\min}\right)$ (for which $G_{pr} \cong G$) for example, the $\frac{k_e q_e^2}{G m_e^2}\left(\cong 4.2\times10^{42}\right)$ dimensionless ratio reaches almost 43 orders of magnitude (in favor of the $k_e q_e^2$ numerator): interestingly, at Planck (**Pl**) scales big G may grow by at least 27 orders of magnitude (up to $G_{\mathrm{Pl}} \cong 10^{27} G$) and k_e may drop by at least 21 orders of magnitude (down to $k_{e(Pl)} \cong 10^{-21} k_e$) which may bring the ratio $\frac{k_{e(\mathrm{Pl})} q_e^2}{G_{\mathrm{Pl}} m_e^2}$ very close to 1; the Coulomb's constant k_e is currently defined as a function of the running coupling constant of the electromagnetic field (**EMF**) $\alpha(E) = \alpha_0 / \left(1-\alpha_0 f(\mathrm{E})\right)$[3] so that $k_e(\mathrm{E}) = \alpha(\mathrm{E})\hbar c / q_e^2$: the currently known $\alpha(E)$ (which is currently predicted by its leading log approximation [**LLA**] to can only grow when approaching Planck energy/length scales E_{Pl}) is thus alternatively predicted by ZEH to actually slightly grow (as described by LLA) at first (when decreasing the length scale) but then to drop significantly down to $\alpha_{Pl} = \alpha\left(E_{Pl}\right)$ so that $k_{e(Pl)} = \alpha_{Pl}\hbar c / q_e^2 \left(\cong 10^{-21} k_e\right)$ which is equivalent to $\boxed{\alpha_{Pl} \cong 10^{-21}\alpha_0}$ (which tends to the value of the gravitational coupling constant $\alpha_G \cong 10^{-43}\alpha_0 \cong 10^{-45}$) and indicates EMF to probably possess asymptotic freedom (like the strong nuclear field was already proved to have).

ZEH-4 main statement. Based on the previous observation, ZEH-4 states (and predicts) that the gravitational field (**GF**) progressively grows in strength when approaching the $r_{\min}\left(\cong 10^{-1} l_{Pl}\right)$ length-scale (up to $G_{\mathrm{Pl}} \cong 10^{27} G$) and the electromagnetic field (**EMF**) slightly grows and then drops in strength (when approaching the same $r_{\min}$ length-scale) up to $k_{e(Pl)} \cong 10^{-21} k_e$ reaching the following equality at $r_{\min}$ scales:

$$\boxed{G_{Pl} m_e^2 \cong k_{e(Pl)} q_e^2 \left(\cong m_e c^2 r_{\min}\right)} \quad \textbf{(3)}$$

As seen from the previous equation, ZEH-4 is essentially a fundamental principle of electro-gravitational strength balance/symmetry at Planck scales, a principle which allows (as a sine-qua-non condition added to Heisenberg's uncertainty principle [HUP]) the existence of virtual particle-antiparticle pairs (VPAPs) from the first place.

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ZEH's 5th co-statement (ZEH-4) and its implications. **ZEH-5** uses the same minimum length/distance $\boxed{r_{\min}\left(=\left|q_{EP}\right|\sqrt{G k_e} / c^2 \cong 10^{-1} l_{Pl}\right)}$ needed for any virtual particle-antiparticle pair (**VPAP**) to pop out from the vacuum at the first place (as stated and predicted by ZEH for all rest masses to be describable by real numbers with mass units) to predict a series of practical (**pr.**) radii $\left(r_{pr}\right)$ for all known EPs and a finite maximum allowed massic/energetic density in our universe (**OU**).

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[3] the leading log approximation of $\alpha(E)$, which is only valid for large energy scales $E >> E_e$, with $f(\mathrm{E}) = \ln\left[\left(E / E_e\right)^{2/(3\pi)}\right]$

The main statement of ZEH-5. For big G values to grow progressively with a decreasing length scale r_{pr}, ZEH-5 proposes/conjectures that BOTH the very large (but finite!) maximum $G_{\max} = G_{Pl}\left(> 2.1\times 10^{27} G\right)$ and very small (but finite!) $r_{\min}\left(\cong 10^{-1} l_{Pl}\right)$ bijectively correspond only to the electron neutrino (**en**) (with very small BUT finite rest mass $m_{en} < 1eV / c^2$) which thus generates **a conjectured maximum (large but finite!) allowed (3D spherical) massic density in our universe (OU) identified with the massic density of en (which is predicted as significantly smaller than Planck density** $\rho_{Pl} = m_{Pl} / l_{Pl}^{\;3} \cong 10^{96} kg\, m^{-3}$):

$$\rho_{OU(\max)} = \rho_{en}\left(\cong \frac{m_{en}}{4\pi/3\, r_{\min}^{\;3}}\right) > 1.6\times 10^{71} kg\, m^{-3} \quad \textbf{(4a)}$$

Furthermore, ZEH-5 ambitiously (and additionally) conjectures that the pre-Big-Bang singularity (pBBS) was NOT infinitely dense (thus wasn't a true gravitational singularity with infinite density!) but had a large-but-finite density ρ_{pBBS} **equal to** $\rho_{en}\left(> 1.6\times 10^{71} kg\, m^{-3}\right)$ **OR in the** $\left[\rho_{en}, \rho_{Pl}\right]$ **closed interval, thus being a quasi-singularity with** $\rho_{pBBS} = \rho_{OU(\max)}$ **or** $\rho_{pBBS} \in \left[\rho_{en}, \rho_{Pl}\right]$ **with all EPs being redefined as remnant "crocks" of this pBBS and sharing approximately the same unique density** $\rho_{EP} \cong \rho_{pBBS}\left(= \rho_{OU(\max)}\right)$ **(ZEH's unique-density conjecture [ZEH-UDC]).**

Based on the previously defined ZEH-UDC, ZEH-5 also proposes a simple formula for calculating the practical radii $r_{pr(EP)}$ **of any known type of known/unknown EP with non-zero rest mass**:

$$r_{pr(EP)} \overset{>}{\cong} r_{\min}\sqrt[3]{m_{EP} / m_{en}} \quad \textbf{(4b)}$$

For example, the previously formula predicts that the Higgs boson (**Hb**) has a practical radius with a lower bound defined by $r_{pr(Hb)} \cong r_{\min}\sqrt[3]{m_{Hb} / m_{en}} \cong 5\times 10^3 r_{\min}$, with all the other known/unknown EPs with non-zero rest masses smaller than m_{Hb} having their practical radii approximately in the closed interval $\left[r_{\min}, 5\times 10^3 r_{\min}\right]$.

ZEH-5 also states that known/unknown EPs with non-zero rest masses larger than m_{en} and practical radii larger than $r_{\min}$ correspond to smaller big G values $G_{EP} < G_{\max}\left(= G_{Pl}\right)$: more specifically, ZEH-5 actually generalizes ZEH-4 for any EP my stating that:

$$G_{EP} m_{EP}^{\;2} \cong 2 m_{EP} c^2 r_{\text{pr(EP)}} \quad \text{(for neutral EPs)} \ \textbf{(5a)}$$

and (**see below**)

$$G_{EP} m_{EP}^{\;2} \cong k_{e(\text{EP})} q_{EP}^{\;2}\left(\cong m_{EP} c^2 r_{pr(\text{EP})}\right) \quad \text{(for charged EPs)}$$

(**5b**)

Based on the previous two equations, the big G values corresponding to each practical radii in part (of each type of EP in part) can be reversely deduced as:

$$G_{EP} \cong \frac{2c^2}{m_{EP}} r_{\text{pr(EP)}} \cong \frac{2c^2 r_{\min}}{m_{EP}}\sqrt[3]{\frac{m_{EP}}{m_{en}}} \quad \text{(for neutral EPs)} \ \textbf{(16a)}$$

and (**see below**)

$$G_{EP} \cong \frac{c^2}{m_{EP}} r_{\text{pr(EP)}} \cong \frac{c^2 r_{\min}}{m_{EP}}\sqrt[3]{\frac{m_{EP}}{m_{en}}} \quad \text{(for charged EPs)} \ \textbf{(16b)}$$

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