A strong variant of the ER=EPR conjecture based on Planck wormholes and redefining both big G and Planck constant

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Abstract (and main abbreviations)

This paper proposes a strong variant of ER=EPR conjecture (**svEEC**) based on Planck wormholes (**PWs**) (and partially assuming Einstein's General Relativity), which svEEC helps redefining both big G and Planck constant, potentially explaining both the accelerated expansion of our universe (**OU**) and the highly variable experimental values of big G. 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**].

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1. A strong variant of the ER=EPR conjecture (svEEC)

In this paper, we propose a *strong variant of ER=EPR conjecture* (**svEEC**) (based on EEC, first launched by Maldacena and Susskind in 2013[**25**] and progressively developed until present[**26**]), also based on Einstein's General Relativity (**EGR**) (partially assumed by svEEC), which states the followings subconjectures (numbered next):

(**1**) No matter if black holes or not, no matter if entangled or not, any two elementary particles (**EPs**) of our universe (**OU**) are interconnected by at least one "generic" Planck wormhole (**PW**), so that the 4D spacetime vacuum (**4DSTV**) of OU is redefined (differently from EGR!) as being actually an infinitely large "conglomerate" composed from an infinite number of interwoven PWs;

(**2**) a PW is (re)defined (by this svEEC) as a cylindrical 4D brane (possibly infinite in length!) composed from a cylindrical 3D hypersurface (possessing its own 3D volume) circularly enclosing a 4th dimensional (**4thD**) cylindrical (and relatively empty!) core with compact topology possibly infinite in length (but conjectured to have a finite and non-infinitesimal transverse diameter $d_{PW}\left(\cong l_{Pl}\right)$ comparable to Planck length l_{Pl}): our observable 3D space is conjectured to be actually composed from the sum of all 3D hypersurfaces of all (4D cylindrical) PWs;

(**3**) all PWs of OU are stated to be under huge tensions (thus highly stretched!) with a tension average T_{PW} close to Planck force so that $T_{PW} \cong F_{Pl}\left(=c^4/G \cong 10^{44}N\right)$ (as other author also interpreted F_{Pl} as "a tension constant of the spacetime fabric" [**27**]);

(**4**) each PW is stated to oscillate at Planck frequency (mostly or with highest amplitude in the 4thD core) and this kinetic energy fully generates/explains the phenomenon of "rest mass" (**RM**) of that PW, which RM may be infinite: however, PWs are stated to also posses a finite average linear massic density ρ_{PW} close to Planck linear density so that $\rho_{PW} \cong \rho_{Pl(lin)}$ $\left(=c^2/G \cong 10^{27}kg/m\right)$, with most of its RM (and ρ_{PW} implicitly) concentrated in its 4thD core (explaining why we only detect a very small massic density of the 4DSTV in our observable 3D space, at least at macroscopic scales);

(**5**) given their huge $T_{PW}\left(\cong 10^{44}N\right)$ and $\rho_{PW}\left(\cong 10^{27}kg/m\right)$, these PWs are in fact incredibly rigid, more like "pipes" that may vibrate with very low amplitudes (but up to very high frequencies), so that svEEC (re)uses Vincenzo Galilei's classical simplified formula[2] (valid only for those string vibrations of small amplitude) to derive the speed of gravity v_g as $\boxed{v_g \overset{\leq}{\cong} v_{\max} = \sqrt{T_{PW}/\rho_{PW}}}$ (defined as the speed of gravitational waves, which are also redefined as very small amplitude transverse waves traveling on PWs): consequently, the universal gravitational constant $G\left(\cong 10^{-10}m^3kg^{-1}s^{-2}\right)$ is redefined by svEEC as an indirect measure of both T_{PW} and ρ_{PW}, so that:

$$\boxed{G \overset{redef.}{=} T_{PW}/\rho_{PW}{}^2 = v_g{}^2/\rho_{PW}} \quad (1)$$

(**6**) photons are also defined by svEEC as quantized transverse waves traveling on the same PWs with speed $\boxed{c = v_{\max} = \sqrt{T_{PW}/\rho_{PW}}}$: the quantized character of photon is conjectured (by svEEC) to be explained by the finite (and non-infinitesimal!) PW diameter $d_{PW}\left(\cong l_{Pl}\right)$ which limits those transverse vibrations up to an inferior 4D hypervolumic limit $\boxed{V_{\min} \overset{def.}{=} 4\pi^2 d_{PW}{}^4}$ (a small 4D cylinder with a minimum 3D hyper-area $A_{\min} \overset{def.}{=} 4\pi^2 d_{PW}{}^3$ and minimum 4thD length $l_{\min} \overset{def.}{=} d_{PW}$), so that Planck constant is geometrically redefined by svEEC as:

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[2] a formula defining the (maximum) velocity $v_{\max[m/s]} = \sqrt{T_{[N]}/\rho_{[kg/m]}}$ of the wave formed in a vibrating string with linear density $\rho_{[kg/m]}$ and tensioned by a force of tension $T_{[Newtons]}$

$$\boxed{h \overset{redef.}{=} \sqrt{T_{PW}\rho_{PW}V_{\min}}} \quad \textbf{(2)}$$

(**7**) Gravitational waves are also conjectured to be quantized at Planck scales by the same $V_{\min}$ so that svEEC predicts that hypothetical gravitons truly exist but only as excitations of PWs at Planck scales.

(**8**) Gluons are alternatively defined as non-quantized torsional waves traveling on the same PWs, with their non-quantized character explained by the fact that $d_{PW}\left(\cong l_{Pl}\right)$ doesn't limit torsions at Planck scales, but only transverse waves traveling on PWs.

(**9**) quantum entanglement is conjectured by svEEC to be mediated by various known/unknown EPs that may travel through the 4thD cores of PWs between various points of our 4DST.

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2. svEEC may explain the accelerated expansion of our observable universe

Based on G redefinition (equation 1) and considering the case of a simple gravitational system consisting of two masses in vacuum (m_1 and m_2) at distance d from one another and reciprocal relative rest (with d being much larger than the linear sizes of the two masses and being traveled by light in a time interval $\Delta t = d/c$) and emitting (experimentally demonstrated) gravitational waves (**GWs**) towards one another traveling with speeds $v_{g1}\left(\overset{\leq}{\cong} c\right)$ and $v_{g2}\left(\overset{\leq}{\cong} c\right)$ respectively (according to Einstein's General Relativity [**EGR**]), v_g is defined as a geometrical mean such as $v_g = \sqrt{v_{g1}v_{g2}}$ and the scalar of the Newtonian gravitational attraction force $\left(F_g\right)$ between m_1 and m_2 is also redefined such as:

$$\boxed{F_g = G\frac{m_1m_2}{d^2} = \frac{v_g^{\,2}}{\rho_{PW}}\frac{m_1m_2}{d^2}} \quad \textbf{(3)}$$

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We also define v_g to be reference-frame-dependent so that, for a mass m that emits a GW towards an observer O while moving away from that same O with speed v_x, the emitted GW will have a resultant speed $v_r = v_g - v_x$ when measured by O. In the case of the same simple gravitational system consisting of two masses in vacuum (m_1 and m_2) that depart from one another with relative speed v_x (while emitting GWs with resultant relative speed $v_r\left(= v_g - v_x\right)$ towards one another), we generalize the redefined G and the scalar of F_g such as:

$$\boxed{G_x = v_r^{\,2}/\rho_{PW} = \left(v_g - v_x\right)^2/\rho_{PW}} \quad \textbf{(4a)}$$

$$\boxed{F_{g(x)} = G_x\frac{m_1m_2}{d^2} = \frac{\left(v_g - v_x\right)^2}{\rho_{PW}}\frac{m_1m_2}{d^2}} \quad \textbf{(4b)}$$

$F_{g(x)}$ predicts that, when acting with any finite and non-infinitesimal (no matter how weak!) non-zero constant force $\vec{F} = m_1 a$ (with acceleration $a = v_x/\Delta t_x$) on a mass m_1 (which moves with an increasing speed $v_x = a\Delta t_x$ in respect to a relatively static mass m_2 to which it is initially found at distance d_0 at instant t_0) on the same axis but opposite direction to $\vec{F}_{g(x)}$, the two masses will attract each other (in every specific time instant for which $v_{x2} > v_{x1}$) *with a slightly weaker than expected gravitational force* for $d_{x2} \overset{>}{\cong} d_{x1}$:

$$\boxed{\frac{\left(v_g - v_{x2}\right)^2}{\rho_{PW}}\frac{m_1m_2}{d_{x2}^{\,2}} < \frac{\left(v_g - v_{x1}\right)^2}{\rho_G}\frac{m_1m_2}{d_{x1}^{\,2}}} \quad \textbf{(5)}$$

For this specific reason, the resultant force $\vec{F}_r = \vec{F} - \vec{F}_{g(x)}$ (acting on this $m_1 \& m_2$ system) and its scalar $F_r = F - F_{g(x)}$ will be *slightly larger in magnitude than expected* in every specific time instant for which $v_{x2} > v_{x1}$ just because $G_{x2} < G_{x1} < G$ implying $F_{g(x2)} < F_{g(x1)}$: in this way and by having $\boxed{F_{g(x)} \propto G_x \propto 1/v_x \propto 1/d_x}\left(\Rightarrow v_x \propto d_x\right)$, the generalized gravitational force scalar $F_{g(x)}\left\{= f\left[\left(v_g - v_x\right)^2\right]\right\}$ may elegantly explain the accelerated expansion (**AE**) of our observable universe *without* needing a "dark energy" concept to explain this AE.

At cosmic scales, the $v_x \propto d_x$ direct-proportionality is actually defined by the Hubble constant $H_0\left[\cong 69.8(km/s)/Mpc\right]$ such as $\boxed{v_x = H_0 d}$, so that both G_x and $F_{g(x)}$ can be rewritten as functions, such as:

$$\boxed{G\left(d\right) = \frac{\left(v_g - H_0 d\right)^2}{\rho_{PW}} \cong \frac{\left(c - H_0 d\right)^2}{\rho_{PW}}} \quad \textbf{(6a)}$$

$$\boxed{F_g(d) = \frac{\left(v_g - H_0 d\right)^2}{\rho_{PW}} \frac{m_1 m_2}{d^2} \cong \frac{\left(c - H_0 d\right)^2}{\rho_{PW}} m_1 m_2} \quad \textbf{(6b)}$$

The variation of the approximation function $G_x(d) = \left(c - H_0 d\right)^2 / \rho_{PW}$ can be graphed for a large spectrum of macroscopic distances $d \in \left[1m, D_{OU}\right]$ up to the (diametric) distance $D_{OU} = 2R_{OU}$ between two physical objects that are located at the margins of our OU (with radius $R_{OU} \cong 4\times10^{26} m$) and diametrically opposed: see next graph.

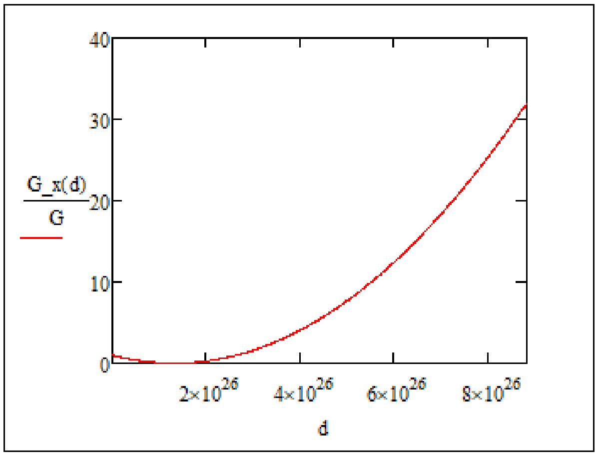

Figure 1. The variation of the ratio $G_x(d)/G$ for $d \in \left[1m, D_{OU}\right]$.

Checkpoint conclusion. The $F_g(d)$ function actually describes an alternative Modified Newtonian dynamics (**MOND**) based on the redefined $G(d)$ which effectively translates the classical (empirically measured) so-called "universal gravitational constant" G in an alternative generalized (and obviously non-constant!) *universal gravitational function*.

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3. svEEC may explain the apparently paradoxal divergence of big G experimental values

svEEC also proposes an alternative plausible explanation to the apparent paradox of the *divergent variation of experimental G values*, „despite" constant improvements in the measurement systems: the redefined $G\left(= v_g^{\ 2} / \rho_{PW}\right)$ varies direct-proportionally (and exponentially!) with the square of v_g and inverse-proportionally with ρ_{PW} AND both v_g and ρ_{PW} may slightly vary when any experiment (of determining big G) takes place on Earth, while Earth moves through various regions of our 4DST (by moving around its axis, around the Sun WHILE simultaneous movement of our solar system in our galaxy etc). More specifically, the distance d between the two (experimentally) tested POs (with masses m_1 and m_2 respectively) is measured using photons at the speed of light c (by using laser-based measurements): that is why, in the G-based scalar $F_g = \frac{v_g^{\ 2}}{\rho_{PW}} \frac{m_1 m_2}{d^2} \left(\cong \frac{v_g^{\ 2}}{\rho_{PW}} \frac{m_1 m_2}{c^2 t^2}\right)$, the squared ratio $\left(v_g / c\right)^2$ may plausibly alter the experimental big G values up to deviations of ±(0.1%-0.2%) (as measured by various highly-accurate experiments in the last decade). Some small variations of ρ_{PW} may also occur in some regions of our 3DS "swept" by Earth in its various movements (concomitant to the big G determination experiments taking place on Earth). **Prediction**. The larger big G experimental values are predicted to correspond to those experiments in which v_g reaches its closest values to c.

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