An informational approach of Newton's law of gravity by using the Bekenstein bound and predicting a universe with at least 5 spatial dimensions

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Andrei-Lucian Drăgoi[1,2]
(independent researcher)

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Abstract
(with some abbreviations further used in this paper)

This paper proposes an informational approach of Newton's law of universal gravitation (**NLUG**) by using the concept of physical information (including the concept of gravitational signal) as measured by Bekenstein bound (**BB**): the informational gravity hypothesis (**IGH**) launched in this paper predicts that our universe has probably at least five spatial dimensions (with the 5th dimension being a large/bulk dimension) as also predicted by Randall-Sundrum models, in the context of string theory and M-theory (which predict up to eleven spatial dimensions).

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**, **28**].

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I. The main section of this paper

The informational gravity hypothesis (IGH). If any two masses m_1 and m_2 (at relative rest and distance r from one another) attracted to each by a gravitational force (with scalar $F_g = Gm_1m_2/r^2$ and $G \cong 6.674\times10^{-11} m^3 kg^{-1} s^{-2}$ being the universal gravitational constant) interchange any physical information (**PI**) by gravitational signal (**GS**), then we propose the following *informational gravity hypothesis (**IGH**) containing four statements*:

(**1**) each mass in part perpetually emits a GS (carrying PI) which is dispersed radially and uniformly in the surrounding 3D space of that mass, so that the GS emitted simultanously by both masses (m_1 and m_2) is dispersed on the doubled spherical area $A_r = 4\pi r^2$ so that F_g is actually inversely-proportional to this $2A_r$ so that:

$$\boxed{F_g = G_r \frac{m_1 m_2}{2A_r}}, \text{ with } \boxed{G_r = 8\pi G} \quad (\mathbf{1})$$

(**2**) The quantity of PI (I) (measured in bits) contained in each sphere centered in m_1 and m_2 respectively (considered to contain just these two masses, with each mass being considered tangential thus NOT contained in the sphere centered in the other mass) has an upper limit defined by the Bekenstein bound (**BB**) $B(\geq I)$ (also measured in bits) which puts an upper bound to the PI-quantity $I(\leq B)$ stored in an energy quantity $E = mc^2$ (contained in a sphere with radius r). BB is also a function of the reduced Planck constant $\hbar = h/(2\pi)$ $(\cong 1.055\times10^{-34} Js)$ and the speed of light in vacuum $c(\cong 2.997\times10^8 m/s)$, such as:

$$\boxed{B = \frac{2\pi r E}{\hbar c \ln(2)}} \text{ (with } I \leq B\text{)} \quad (\mathbf{2a})$$

with $\boxed{B_1 = \frac{2\pi r(m_1 c^2)}{\hbar c \ln(2)}}$ and $\boxed{B_2 = \frac{2\pi r(m_2 c^2)}{\hbar c \ln(2)}}$ (**2b, 2c**)

thus $\boxed{m_1 = \frac{B_1 \hbar \ln(2)}{2\pi r c}}$ and $\boxed{m_2 = \frac{B_2 \hbar \ln(2)}{2\pi r c}}$ (**2d, 2e**)

(**3**) By replacing $m_1 = f(B_1)$ and $m_2 = f(B_2)$ in the previously redefined F_g scalar, we obtain:

$$\boxed{F_g = G_r \frac{1}{2A_r} \frac{B_1 \hbar \ln(2)}{2\pi r c} \frac{B_2 \hbar \ln(2)}{2\pi r c}} \quad (\mathbf{3a})$$

which is equivalent to (**see below**)

$$\boxed{F_g = \frac{G_r}{c^4} \frac{B_1 B_2 [\hbar c \ln(2)]^2}{2A_r (2\pi r)^2}} \quad (\mathbf{3b})$$

which is equivalent to (**see below**)

$$\boxed{F_g = \frac{\kappa}{6\pi} \frac{B_1 B_2 [\hbar c \ln(2)]^2}{2A_{r(5D)}}} \quad (\mathbf{3c}),$$

with $A_{r(5D)} = \frac{8\pi^2 r^4}{3}$ being the surface area of a 5D sphere (with radius r) and $\kappa = G_r/c^4 (= 8\pi G/c^4)$ being the Einstein's constant.

(**4**) "Unifying" all constants in a single one and keeping the pattern of the initial scalar $F_g (= G_r m_1 m_2/(2A_r))$ we obtain:

$$\boxed{F_g = G_B \frac{B_1 B_2}{2A_{r(5D)}}} \quad (\mathbf{4a}),$$

[**1**] **Email**: dr.dragoi@yahoo.com
[**2**] **Main pages**: dragoii.com (CV: cvrg.dragoii.com); rg.dragoii.com; academia.dragoii.com; vixra.dragoii.com; gsj.dragoii.com

$$\text{with } \boxed{G_B = \frac{\left[\ln(4)\right]^2}{3}\frac{G\hbar^2}{c^2} \cong 10^{-95} m^5 kg\, s^{-2}} \quad \textbf{(4b)}$$

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Prediction and conclusion. In conclusion, IGH predicts that the informational GS actually disperses on the 4D area of a 5D sphere, which suggests that our universe probably has at least 5 spatial dimensions (with the 5th dimension being a bulk/large extra-dimension), as also predicted by string theory and described by Randall-Sundrum 5D universe models: if the hypothetical gravitons truly exist (as carriers/propagators of GS thus PI), they probably disperse in this predicted 5th bulk dimension and that may easily explain why gravity is perceived so weak in our 4D spacetime (defined as a 4D brane by M-theory), naturally solving the notorious hierarchy problem; this fact also indicates that big G may be much larger at scales close to Planck scale at which only a small fraction of the emitted hypothetical gravitons manage to escape our 4D brane in the 5D bulk.

Final note. There are some Planck units (like Planck density, specific volume, power, angular acceleration and radiant intensity) which are functions of $c^5\left[m^5 s^{-5}\right]$ factor also suggesting the spread of GS with the speed of light on at least 5 distinct dimensional axes orthogonal to one another, thus a radial dispersion in a 5D hypervolume: there are also some Planck units (like Planck time, frequency and angular speed, Planck energy and temperature etc.) which are functions of $\sqrt{c^5}$ factor also suggesting the spread of GS in a 5D hypervolume. Interestingly, there are also Planck units which are functions of c^7 (Planck energy density, pressure etc), c^8 (Planck intensity, radiance) and $\sqrt{c^n}$ (with integer exponent $n \in \left[6,12\right]$), a fact which suggests that our universe may have even more than 5 dimensions, up to twelve spatial dimensions (as predicted by string theory and M-theory).

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