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New strength to Planck's length choice

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1. In scientific research, analogies are everywhere. Here we simply apply one of them, following one of the best Planck’s intuitions: using the laws of Quantum Mechanics for large systems mainly ruled by General Relativity (like our Universe at large scale is). **In other words, we try to establish a link between the microcosm and the macrocosm.**

2. Planck applied a similar process in the elaboration of his “special” length lp, the only length that can be obtained combining General Relativity constants (*c* and G) together with the Quantum Mechanics constant ħ:

$$lp = sqrt(\hbar G/c^3) \sim 10^{-35}\, m$$

3. Actually the physical meaning of lp is not clear. In our opinion the reason must be searched in the lack of direct experimental data related to a such small length. Here we simply show that such experimental data exist, they have only be searched in the large scale.

4. In fact, if we calculate the maximum mass of a theoretical spacetime in which: a. Heisenberg’s Uncertainity Principle (HUP) is valid; b. the maximum speed is the speed of light in vacuum (*c*) and c. the minimum length is lp, we obtain:

$$\Delta x \Delta p = \hbar/2$$
$$m \Delta x \Delta v = \hbar/2$$
$$m = (\hbar/2)/\Delta x \Delta v$$

For maximizing the obtained expression for m, we choose lp as “smallest possible length”.
Besides we used the “best case” version of HUP, i.e. the one in which the = sign appears instead of the ≥.

For maximizing the obtained expression for m, we choose lp*H as “smallest possible speed”. Why? Because, if v=s/t, then v_{min} is s_{min}/t_{max} and so lp/Ua (Ua is the age of the spacetime). If H is the Hubble constant, then 1/H is a good approximation for Ua.

$$m = (\hbar/2)/(lp*(lp*H))$$

$$m = (c^3)/(2GH) \sim 10^{52}\ Kg$$

(Using the values of our Universe for *c*, G and H)

5. If we take the WMAP NASA spacecraft data about the density of our Universe, we can see that the described spacetime is not so theoretical. Using 2008 consolidated data, in fact, we can see that our Universe density is equal to its critical density calculated by the Friedmann equations, i.e. $3(H^2)/8\pi G$.

6. This fact confirmed also the Euclidean geometrical structure for our Universe, leading to an extimation of Universe mass based on the assumption that its volume could be calculated as the volume of a sphere, i.e. $V=(4/3)\pi(r^3)$. In other words:

The selection of the value for the radius r can be done considering the space travelled by a ray of light for the entire duration of the Universe (Ua), i.e. r = c*Ua = c/H.

$$m = \rho V$$
$$m = ((H^2)(r^3))/(2G)$$

$$m = (c^3)/(2GH) \sim 10^{52}\ Kg$$

Same value obtained before only by theoretical means!

So it is possible to affirm that the physical meaning of the Planck’s length is the following: lp is the value of an observer-independent scale of minimum length for which a spacetime in which HUP is valid and in which *c* is the maximum speed has a theoretical mass equal to the one of the visible portion of our Universe measured by WMAP.

In other words, in our Universe an observer-independent scale of length exist and its value is lp.

(Besides we think that a similar approach could be used for other quantities, and it could lead to interesting developments, in order to understand some physical “strange” phenomena, like superluminal speeds, dark matter & energy, etc.).