On the nonlocality of quantum mechanics

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Abstract

Essentially, the nonlocality of quantum mechanics is manifested between entangled particles that are far enough apart from each other, such that the measurement of an observable in one of them, for example the spin, is correlated with the other particle. Ruling out the transmission of information between these particles not even at the speed of light. This experimental fact being widely confirmed in all the experiments that have been repeated throughout all these years since the thought experiment of the Einstein-Podolsky-Rosen paradox.It is therefore a problem not resolved by quantum mechanics to explain how the cause-effect of correlation can be produced. Quantum mechanics simply accepts experimental facts without explaining them.We think that there must be an agent that mediates the cause that produces the effect of the correlation. And this agent, we theorize, must be the structure of space. A space of more than four dimensions and that is totally interconnected or intertwined by the own characteristics of this space and that we will show in this article.The main fact would be how this space moves at the same time and in all its extension.

1 Introduction

It is unacceptable, from our point of view, that quantum entanglement and its physical implications are not explained by quantum mechanics, which seems to indicate its incompleteness. Nor does it explain the collapse of the wave function. In all quantum entanglement experiments, apart from the pair of particles, the measuring or observing instruments and the human observer, there is the spacetime itself where the experiments are performed.We know from quantum mechanics itself that the energy states of the quantum vacuum manifest themselves in different forms according to different configurations of particle-objects, intensities of different quantum fields (electromagnetic, strong, weak force, etc.). This shows that the quantum vacuum constituted by virtual fluctuations acts in a real way and is measurable.The non-separability of the space-time-energy system is demonstrated by the Heisenberg uncertainty principle.In such a way that for a certain time interval there is a certain amount of energy with its uncertainty. And also that for a certain length it is accompanied by an uncertainty of an momentum. That is to say: for the virtual vacuum, energy, space and time are non-separable entities.

Returning to the nonlocality of entanglement, the only physical reality that is common to all experiments and as a support, we could say, is space itself. Therefore, we theorize, the key to the agent causing nonlocality lies in the characteristics of spacetime itself. But for this we need to go deeper into the structure of this space. And where, we think, to start is with the quantized Planck parameters: Planck mass, Planck length and Planck time.

1.1 Planck quantum black holes

By the Heisenberg uncertainty principle and knowing exactly the Planck mass, one has: $2\triangle l_{PK} \cdot m_{PK} \cdot c \geq \hbar$

With the above equation and taking into account the minimum uncertainty value, we can define the Planck quantum black hole and its radius according to Schwarzschild black hole by: $r_s\,(Planck = PK) = 2 \cdot l_{PK} = \dfrac{2 \cdot m_{PK} \cdot G_N}{c^2}$

Now if we apply the theory of general relativity and for an observer outside the event horizon, as happens in the entanglement experiments for example, we have that time for this observer is stationary. That is: a clock inside the planck black hole would take an infinite time as seen by the outside observer.

Therefore, and for this observer the energy applying the principle of uncertainty would be: $\dfrac{\hbar}{\triangle t} = \triangle E = 0$

This last equation indicates that for the observer outside the Planck quantum black hole there is no energy and therefore no "frictional" energy of the virtual quantum vacuum. This implies that there is no delay in the displacement due to the non-existence of energy, as seen by this observer.

1.1.1 The gravitational energy between the Planck mass and any other massive particle at the distance of the Planck length.

This gravitational energy is very easy to demonstrate that it would be the same energy of the particle with mass m, and according to Einstein's equation: $m \cdot c^2$

Proof. $\frac{m_{PK} \cdot m \cdot G_N}{l_{PK}} = m \cdot c^2 = \frac{\sqrt{\frac{\hbar c}{G_N}} \cdot m \cdot G_N}{\sqrt{\frac{\hbar G_N}{c^3}}} \longrightarrow \frac{\frac{\hbar c}{G_N} \cdot m^2 \cdot G_N^2}{\frac{\hbar G_N}{c^3}} = m^2 \cdot c^4 \longrightarrow \sqrt{\frac{\frac{\hbar c}{G_N} \cdot m^2 \cdot G_N^2}{\frac{\hbar G_N}{c^3}}} = \frac{m_{PK} \cdot m \cdot G_N}{l_{PK}} = m \cdot c^2 = \frac{\sqrt{\frac{\hbar c}{G_N}} \cdot m \cdot G_N}{\sqrt{\frac{\hbar G_N}{c^3}}}$ □

The above equation seems to indicate clearly that the Planck quantum black hole is as if it emits (or evaporates) in particle-antiparticle pairs.Once it evaporates, another Planck quantum black hole emerges. So space would be more deterministic or rigid than one might think.

As we have already demonstrated without a doubt, in our opinion, in our previous articles, space is quantized as hyperspheres in 8 dimensions and has the characteristics of the R8 lattice. We do not want to repeat ourselves but it is fundamental and crucial for this research to highlight the 240 information states that characterize this lattice. This allowed us to obtain the value of the cosmological or global virtual quantum vacuum, the density of baryons, etc. Read the articles [2][1]. And applying the information theory of equiprobable and non-equiprobable states.A predictive example of the information derivable from these 240 states is the mass of the Higgs boson, taking into account the equiprobable states (particle-antiparticle pairs). We already mentioned the mass of the electron as a privileged reference scale.

$\Omega_b = 0.045839537445$

$$\left(\ln\left(m_h/m_e\right) - \ln\left(\Omega_b\right)\right)^2 = 240 \longrightarrow \exp\sqrt{240}\cdot\Omega_b = \frac{m_h}{m_e} = 245076.3541... \longrightarrow m_h = 125.233759\ Gev \tag{1.1}$$

1.2 Characteristics of the R8 lattice

This lattice is characterized by the existence of 240 hyperspheres in 8 dimensions that all touch a central one, the 241 hypersphere (8d).This number of hyperspheres, 241, are not factorizable in subsets, since 241 is a prime number. Another important characteristic is the packing density. For 8 dimensions we have: $\rho(8d) = \frac{\pi^4}{384}$

All these characteristics indicate without a doubt a form of non-factorizable entanglement. Recall that a pair of entangled particles cannot factorize their probabilities or their probability amplitudes.

In dimension 2 and 3 this phenomenon of non-factorizable entangled spheres also occurs. In two dimensions there are six spheres that all touch a central or seventh (prime number). In three dimensions there are twelve spheres that all touch a central or thirteenth (prime number). On the other hand, in four dimensions there are twenty-four spheres that all touch a central or twenty-five (non-prime number).

Let us also observe that the combinations of 10 dimensions taken by seven and three dimensions counting particle-antiparticle pairs gives the result of these 240 states.

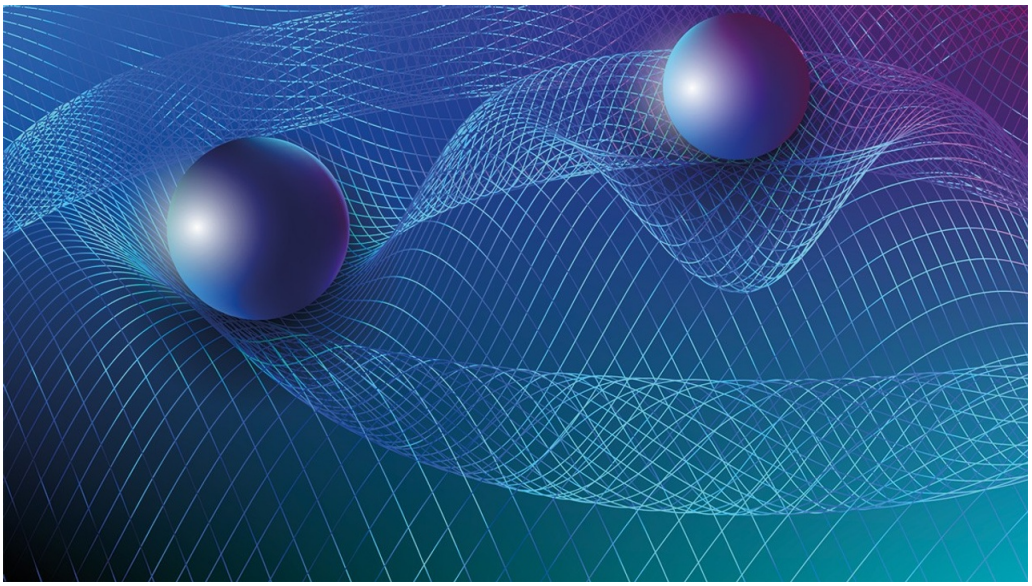
$$2 \cdot \left(\frac{10!}{7! \cdot 3!} \right) = 240$$

1.3 From global movement of space to non-locality

As in general relativity, in which a mass produces a spatial curvature, as when a sphere is dropped into an elastic fabric and it curves globally instantly, assuming the absence of any friction.The nonlocality and the change that would occur in the observable of the other particle when the first one is measured or observed, is due to a global transmission motion of space by means of these hyperspheres entangled in eight dimensions and not factorizable (241).

We emphasize that for an observer far from the Planck scale, time is stopped and the energy at that scale is zero. These 241 hyperspheres exist mutually connected and thus repeat throughout space. Mathematically, how this global movement of space and transmission is expressed can only be answered by a quantum theory of gravity, or rather: a theory of unification of all forces.

Although qualitative concepts are often just as important as equations, we will give an example that demonstrates the predictive power of this model of the lattice in R8 and its characteristics.



1.4 The 240 information states of R8, its packing density: The Higgs vacuum and the value of the GUT theory unification scale

As we already demonstrated in other previous works, these 240 states contain all the information of different states of the vacuum. All from the perspective of information theory. In order not to be prolix, we will only give two examples that demonstrate without a doubt the reality of these eight dimensions of R8 or the E8 group. The first example is based on equiprobable states (sum of dimensionless circular curvatures or probabilities) at the GUT theory unification scale and the sum of non-equiprobable states at the Higgs vacuum scale. We will take into account an indeterminacy due to the state of lowest energy given by the electron (See articles)

$$240 - \frac{240 \cdot \pi^4}{384} - 2 \cdot \ln\ln\left(m_{PK}/m_e\right) - \frac{1}{\frac{2 \cdot 240 \cdot \pi^4}{384}} = \ln^2\left(V_H/E_e\right) \tag{1.2}$$

$$2 \cdot \ln\left(M_X/M_Z\right) = \frac{240 \cdot \pi^4}{384} + 2 \cdot \ln\ln\left(m_{PK}/m_e\right) \tag{1.3}$$

1.5 A seven-dimensional sphere, inverse constant fine structure as radius: Higgs vacuum (mass)

$$\frac{m_{PK}}{\left[\alpha^{-1}(0)\cdot\sqrt{2}+\ln\ln(2\pi)\right]^{7}\cdot(16\pi^{3}/105)\cdot\left(1+\dfrac{1}{\alpha^{-2}(0)\cdot 2\cdot\ln(2\pi)}\right)^{-1}}=m_{VH} \tag{1.4}$$

Inverse fine structure constant $=\alpha^{-1}(0)=137.035999084$

$\alpha(0)\cdot\lambda_e=r_e$ Classical radius of the electron and wavelength of the electron

2 Conclusions

We think after everything we have explained that the theory of a space intertwined with global movement can be an accurate response to non-locality and non-local transmission. We will continue studying both qualitatively and mathematically this path that we think may be, very possibly correct. A space compacted into eight-dimensional hyperspheres based on the lattice model in R8.

But for this study it is essential to find a gravitational mathematical theory of space at the Planck scale and linked to quantum mechanics.

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