A property of the space-time: space-time occupied by a particle is an inverse function of its mass

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ABSTRACT

There are two great theories in physics: the theory of relativity and quantum theory. The theory of relativity studies large scale phenomena (planets, stars, galaxies...). Quantum theory studies the behavior of elementary particles and atoms, i.e. very small scale phenomena. Although these two great theories have each been confirmed by experimental studies, nevertheless, they are not compatible. They contradict each other in the space-time description. Thus, this is logically that some theories that are trying to merge quantum mechanics and the theory of relativity, explore the conception of space-time. These theories explore particularly the structure of space-time. Almost all the theories (theory of relativity, quantum mechanics, loop quantum gravity, string theory) are concordant that space-time no longer constitutes a simple inert screen on which natural phenomena are projected. The unanimity shown by these models should encourage to explore more advantage the fundamental properties of space-time. Also, on the basis on the observations that quantum mechanics shows that the electron seems to follow several trajectories simultaneously and the theory of relativity which shows that the trajectory of a planet is very well defined, we postulate the following principle: ***In a space-time, the smaller the mass of a particle is, the bigger the space-time occupied by the particle is***.

Example if we consider three particles without internal structure of sizes of an electron, a tennis ball and the planet earth, respectively. With this principle, one can say that the electron particle occupies

more space-time than the tennis ball, which itself occupies more space-time than the planet earth particle.

This principle raises a number of questions. Most significantly is it compatible with the inertial mass and gravitational mass and how do interactions (weak, strong, electromagnetism and gravitational) influence this principle. An initial analysis indicates the compatibility between the principle and the inertial or gravitational masses. The question of the influence of interactions (weak, strong, electromagnetism and gravitational) on this principle remains central. If these influences are proven and of the same order of magnitude, then they can constitute a fundamental basis for a merger of these interactions.

Space-time is the fundamental basis of Science. That they were the humanities and social sciences (history, sociology, psychology ...) or the exact sciences (mathematics, physics, chemistry ...). The phenomena or laws that locate or predict these sciences are projected in space-time. The latter is no doubt fundamental in physics that studies the external world and the laws of its variation and evolution in space and time. Specifically, there are two great theories in physics: quantum theory and the theory of relativity.

Quantum theory studies the behavior of elementary particles and atoms, i.e. very small scale phenomena [1] (Mehra & Rechenberg, 2002). The theory of relativity studies large scale phenomena (planets, stars, galaxies...) [2] (Hobson et al. 2010).

Although these two great theories have each been confirmed by experimental studies, nevertheless, they are not compatible. They contradict each other in the space-time description. The theory of relativity considers a space-time continuum, i.e. continuous, smooth but deformable while quantum theory predicts a space-time foam. This glaringly contradiction or incompatibility may legitimately lead to think that these two theories cannot both be just. However, great theories as relativity and quantum mechanics that on the one hand have repeatedly been verified by many measurements and observations: [3-8] (Bohr 1913; Bohr 1913; Compton 1923; Aad et al. 2012; Chatrchyan et al. 2012; Bevan et al. 2014) for quantum theory and [9-12] (Dyson et al. 1920; Pound & Rebka 1959; Hulse & Taylor 1974; Abbott et al. 2016) for theory of relativity. On the other hand, these theories are at the base of the significant progress of science (for quantum theory: nuclear energy, Magnetic Resonance Imaging, integrated circuit, laser… and for theory of relativity: Global Positioning System, CRT screen, electricity generators…). Therefore, these theories can by no means be false, at worst, they can only be insufficient as Rutherford-Bohr model, Galileo-Newton's mechanics and special relativity have been before.

Nevertheless, the incompatibility between the theory of relativity and quantum mechanics must lead to question on the conception of space-time of these two theories. Also, our understanding of space-time deserves to be better investigated. Thus, this is logically that some theories, Loop Quantum

Gravity and String Theory that are trying to merge quantum mechanics and the theory of relativity, explore the conception of space-time. These theories explore particularly the structure of space-time: with Loop Quantum Gravity who tries to get rid of the time and, most importantly, that space presents a discrete structure [13, 14] (Rovelli 1998; Rovelli 2015). String Theory assumes the existence of the multiple universes and included especially more than 4 dimensions [15, 16] (Tong 2009; Greene 2000).

Almost all the theories (theory of relativity, quantum mechanics, loop quantum gravity, string theory) are concordant that space-time no longer constitutes a simple inert screen on which natural phenomena are projected. The unanimity shown by these models, on this property of space-time, is experimentally highlighted within the scope of validation of the general relativity [9, 12] (Dyson et al. 1920; Abbott et al. 2016). This evidence should encourage to explore more advantage the fundamental properties of space-time.

The main objective of this present drafting and to postulate a new property of space-time. On the basis on the observations that quantum mechanics shows that the electron seems to follow several trajectories simultaneously and the theory of relativity which shows that the trajectory of a planet is very well defined, we postulate the following principle:

*« **In a space-time, the smaller the mass of a particle is, the bigger the space-time occupied by the particle is** »*

Example if we consider three particles without internal structure of sizes of an electron, a tennis ball and the planet earth, respectively. With this principle, one can say that the electron particle occupies more space-time than the tennis ball, which itself occupies more space-time than the planet earth particle.

In this principle, at least 6 legitimate questions may be worth addressing:

- ✓ The inverse function is of what type: proportional, polynomial, exponential…?

- ✓ How is the structure of this space-time occupied: is it a space-time with more than 4 dimensions, a space without time, a time without space, a zone without space-time...?
- ✓ By which process the mass occupies the space-time, is it by the support of a field...?
- ✓ Is it the inertial mass, gravitational mass or another form of mass?
- ✓ This principle, is it compatible with the inertial mass and gravitational mass?
- ✓ How do interactions (weak, strong, electromagnetism and gravitational) influence this principle?

The question of the influence of interactions (weak, strong, electromagnetism and gravitational) on this principle remains central. If these influences are proven and of the same order of magnitude, then they can constitute a fundamental basis for a merger of these interactions. But the compatibility between this principle and the inertial and gravitational masses remains the primary question to be explored.

The principle affirms that the smaller the mass of a particle, the bigger the space-time occupied by the particle is. As a result, the particles of very small size, especially at the atomic and subatomic scale (elementary particles, atoms...), occupy more space-time than particles comparable to a material point (cartridge, tennis ball, star...).

It can be stated that, the space-time in which the atomic and subatomic particles manifests itself, is bigger than that in which the particles described by a material point manifests itself. So, it takes more space-time to properly identify the atomic and subatomic particles that it is necessary to properly identify the particles described by a material point.

After all, as the space-time occupied by a particle is an inverse function of its mass, on the one hand, it is possible for a particle, with a very small mass, to occupy sufficient space-time for an investigation on the particle depends, in whole or in part, on the space-time occupied. On the other hand, a particle can have enough mass to occupy a sufficiently small space-time and be very well

localized. Thus, it can be assumed that an investigation on the particle is independent, in whole or in part, of the space-time occupied.

Compatibility with the inertial mass:

The inertial mass is a property of matter which manifests itself by the bodies's inertia. In an inertial movement of a particle case, if an investigation on the particle depends, in whole or in part, on the space-time occupied, only a wave approach will allow to properly identify the space-time occupied by the particle. This conclusion that some particles behave as a wave, is in perfect agreement with the experimental observations and the theoretical models which show that, in an experiment where the energy of the particles is conserved, the atomic and subatomic particles (atoms, elementary particles ...) behave like waves.

In the case where the particle can have enough mass to occupy a space-time sufficiently small and to be very well localized. Thus, at any moment, the position of the particle can be determined in an inertial movement case. Also, this conclusion is in perfect agreement with the experimental observations and the theoretical models which show that particles described by a material point have a trajectory well determined.

Compatibility with the gravitational mass:

The gravitational mass is a property of matter which manifests itself by the universal attraction of bodies.

General relativity states that the gravitation is not a force but the manifestation of the curvature of space-time. This curvature is due to the distribution of energy, in the form of mass or kinetic energy. The new principle states that the space-time occupied by a particle is an inverse function of its mass. As a result, the atomic and subatomic particles manifests itself in a large space-time and an investigation on these particles depends on this space-time. As a consequence, the distribution of the atomic and subatomic particles energy is more spatial and therefore a lower curvature. However,

the material point particles manifest itself in a very small space-time and are well localized. So, the distribution of the material point particles energy is more concentric and therefore a stronger curvature.

If we consider two particles of mass m1 and m2, with m1 greater than m2 (m1 > m2). The principle says that the mass particle m2 occupies more space-time than m1. Assuming an interaction between m1 and m2 leading m1 to acquire an energy from the m2 mass. And that the interaction process occurs through an exchange of a mediator or interaction vector. This exchange of energy results in a variation of masses m1 and m2. And appear as an interaction between two new particles of masses m1 + dm2 and m2 - dm2. With the principle, the particle of mass m1 + dm2 will occupy a space-time smaller than that of m1. And the particle of mass m2 - dm2 occupies a space-time greater than that of m2. Also, the curvature of the space-time due to the mass m1 + dm2 is stronger than that due to m1. This variation of the curvature, i.e. an increase in curvature around m1 + dm2 and a decrease in curvature around m2 - dm2, can accelerate the interaction between m1 + dm2 and m2 - dm2. And if the interaction between the particles continues at the end there will remain only a particle of mass m1 + m2, which will occupy a space-time smaller than occupied both masses at the beginning. In addition, a much stronger space-time curvature around m1 + m2.

The predictions derived from this new principle concerning the behavior of inertial or gravitational masses are in agreement with the experimental observations and the theoretical models. They show above all the compatibility between the principle and the inertial or gravitational masses.

It can be concluded that, the principle that the space-time occupied by a particle is an inverse function of its mass is an intrinsic properties of the space-time.

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