The fundamental significance of time in quantum relativity

Marc Meurens

As measured in the Lunar Laser Ranging experiment, the intra-temporal decrease of the gravitation constant G reveals the quantum relativity according to which the time unit represents the local density of quantum energy causing the expansion as well as the gravitation of the universe.

Time effect

The measurement of the Earth-Moon distance by the Lunar Laser Ranging (LLR) experiment is today the best test to verify the equivalence principle and the gravitation constancy[1]. By its result, that the average distance increases 3.8 cm per year, the test indicates that the fractional decrease of the gravitation constant G of Newton is equal to $\sim 10^{-13}$ part per year. The universe age $\sim 10^{13}$ years calculated from this decrease is about thousand times older than the universe age $\sim 10^{10}$ years calculated from the expansion constant of Hubble[2]. The time discordance between both universe ages is the reason of the present study of the time effect on the gravitation constant.

Intra-temporal relativity

This study is focused on the deciphering of the time effect in two formulae of the gravitation constant G. The first formula, $G' = \text{length}^3 / (\text{time}^2.\text{mass})$ or $G' = l^3 / (t^2.m)$, is the dimensional formula due to Newton. The second formula, $G'' = \hbar .c / m_P^2$, comes from the formula of the Planck mass $m_P = (\hbar .c / G)^{½}$, in which $\hbar = h / 2\pi$ is the reduced Planck constant and c is the speed of light in vacuum. The values of m_P and G'', that are not fundamentally significant, will be replaced further by other values and the fundamental significance of these other values will be explained. The formulae of Newton and Planck are differing by the meaning of their time expression, which is the duration t in the Newton formula and which is the time unit s in the Planck formula. Another difference, to note between both formulae, is that t is in the denominator of the Newton formula and that s is in the numerator of the Planck formula. Consequently, G decreases when s decreases in the Planck formula and, G decreases when t increases in the Newton formula. So in regards of a similar change of G in both formulae, s decreases while t increases. This inverse relation between t and s is considered as an internal relativity of time named intra-temporal relativity. As we will see it, the combination of the

marc.meurens@uclouvain.be

intra-temporal relativity with the general relativity and the quantum mechanics allows to unify these two theories in a new theory for which the name of quantum relativity is proposed.

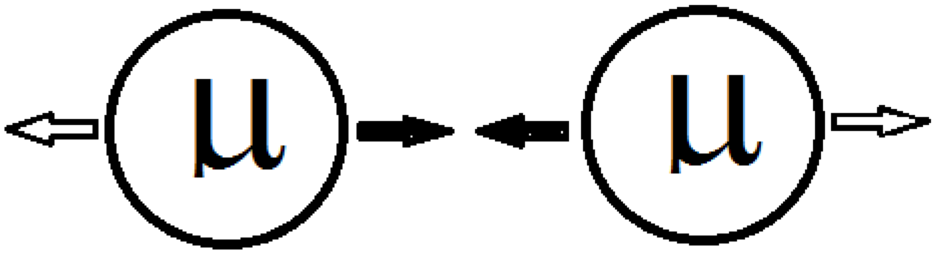
Quantum relativity

The starting claim of the quantum relativity is that there is a gravitational mass in photons that are deviated by gravitation. From this claim, the Planck constant is formulated as h = $\textcircled{u}$ $.c^2.s$ and, the fundamental quantum mass $\textcircled{u}$ is calculated as h / $(c^2.s) = 10^{-51}$ kg. If we compare $m_P = \sim 10^{-8}$ kg with $\textcircled{u} = \sim 10^{-51}$ kg, we observe that m_P is $\sim 10^{42}$ times heavier than $\textcircled{u}$. It is interesting to remark that the ratio $\sim 10^{42}$ between m_P and $\textcircled{u}$ is approximately equal to the ratio $\sim 10^{42}$ between the electromagnetic and the gravitational forces. This ratio similarity indicates that during the evolution of the universe, when $G' = \sim 10^{+32}\ m^3.s^{-2}.kg^{-1}$ was $\sim 10^{42}$ times stronger than $G' = \sim 10^{-10}\ m^3.s^{-2}.kg^{-1}$, the gravitational and electromagnetic forces existed at the same strength level. Moreover, if we develop $\hbar .c$ into $\textcircled{u}.c^3.s$ and, if we replace m_P by $\textcircled{u}$ in the formula $G'' = \hbar .c / m_p^2$, this one becomes $X' = c^3.s / \textcircled{u} = \sim 10^{75}\ m^3.s^{-2}.kg^{-1}$. In that case, how to explain why the universe age, calculated as t from the decrease of $X'' = (l^3 / (t^2.\textcircled{u}$), is not older than $\sim 10^{21}$ seconds whereas the universe age, calculated as 1 / s in $X' = c^3.s /\ \textcircled{u} = \sim 10^{-10}\ m^3.s^{-2}.kg^{-1}$, is $\sim 10^{85}$ seconds? The explanation is that, during the first phase of the universe evolution corresponding to the cosmic inflation, before the genesis of matter, the time unit value s decreased from 1 to 10^{-42} while X' decreased from $\sim 10^{75} m^3.s^{-2}.kg^{-1}$ to $\sim 10^{32}\ m^3.s^{-2}\ kg^{-1}$ and, during the second phase of the universe evolution corresponding to the gravitation age, the time unit value s decreased from 10^{-42} to 10^{-85} while X' and X'' decreased from $\sim 10^{32} m^3.s^{-2}.kg^{-1}$ to $\sim 10^{-10} m^3.s^{-2}\ kg^{-1}$, while the gravitation duration t increased from 1 to $\sim 10^{21}$seconds. In consequence, the total age of the universe can be split in an expansion age or duration $1/s = \sim 10^{42}$ seconds and a gravitation age or duration $t = (1/s)^{1/2} = \sim 10^{21}$ seconds. According to this distinction, $X' = c^3.s / \textcircled{u}$ can be named quantum expansion factor and, $X'' = l^3 / (t^2.\textcircled{u}$) can be named quantum gravitation factor. It is important to note that the quantum expansion factor $X' = c^3.s / \textcircled{u}$ becomes equivalent to the quantum gravitation factor $X'' = l^3 / (t^2.\ \textcircled{u}$), if the numerical value of l^3 remains constantly equal to the value of $c^3.s\ /\ t^{2.} = \sim 10^{-18}\ m^3$ with s fixed at the value $\sim 10^{-42}$and t fixed at the value 1. The equivalence between both factors, due to the constancy of l^3, indicates that the same quantum energy is causing the expansion and the gravitation of the universe.

marc.meurens@uclouvain.be

Significance of time

However, to completely understand completely the significance of the physical time, it remains to answer the question of what is the meaning of the time expressions s and t. According to the quantum relativity, the answer is illustrated by the mechanical model of quantum interaction showing below a collision between two fundamental quanta represented by μ .



When two fundamental quanta collide at the speed c and exchange all their energy, so that they go away into outside still at the constant speed c, the exchange of their energy produces a space increase in the inverse proportion of the time unit decrease corresponding to the decrease of local energy density in the quantum vacuum. At the first instant of the universe, when the time unit s was 1, the local energy density in the quantum vacuum and the quantum YIELD (Yield of Interactive Exchange Locally Determined) were equal to 100% or to the numerical value 1. At the following instants, the time unit, like the energy density in the quantum vacuum and like the quantum YIELD, decreased in inverse proportion of the space unit l so that l . s = c. Therefore, the total universe age, which is the duration of quantum interaction between the first instant and now, has (in seconds) the inverse numerical value of the actual time unit s =~10^{-85}. On the other hand, the material universe age, which is the gravitation age or the gravitation duration between the genesis of matter and now, is the universe age t =~10^{21} seconds calculated from the LLR experiment. So the time unit s and the duration t are the mathematical expressions that, under the form of pure numbers, represent the physical reality of the local quantum energy causing the expansion as well as the gravitation of the universe.

marc.meurens@uclouvain.be

Coherence in physics

Moreover, according to the intra-temporal and quantum relativity, the fundamental significance of the time expressions s and t can explain that the dark matter and the dark energy are illusions. Indeed, as the gravitation constant G of Newton varies in function of time, the concept of dark matter appears now as a mass overestimation due to a too weak gravitation constant used in the mass calculation of stars and galaxies. Indeed likewise, the concept of dark energy is contrary to the claim of the quantum relativity that the same quantum energy is causing the expansion and the gravitation of the universe. The fundamental significance of s and t could also help to solve other great problems of physics[3], such as notably the comprehension of the quantum mechanics. Finally, the spectral signature of time, detected by the LLR experiment, looks like the key for more coherence in physics[4].

1. Murphy, T. *Rep. Prog. Phys.* ***76****, 076901 (2013).*
2. Planck Collaboration *arXiv:1303.5062 [astro-ph.CO] (2013).*
3. Smolin, L. (ed.) *The Trouble with Physics* (Houghton Mifflin Harcourt, 2007).
4. Smolin, L. (ed.) *Time Reborn* (Houghton Mifflin Harcourt, 2013).

marc.meurens@uclouvain.be