Discovery of the fundamental particle
and
theory of the universal temporality

Abstract

The fundamental particle is the elementary particle of which the active mass corresponds to the fundamental quantum of action and to the fundamental time unit equal to the number 1. The universal temporality is the relation between the unit, the course and the duration of the Universe expansion time. The identification of the fundamental particle in the Planck's constant and its integration in the Newton's constant reveal that its interaction simultaneously causes the expansion and the gravitation. The mechanical modelling of this primordial interaction with the Newton's cradle completes the general relativity with the cosmological relativity and the quantum mechanics with the primordial mechanics. In relating the notions of mass, space and time, the discovery of the fundamental particle and its primordial interaction links the mechanics with the relativity. In relating the unit, the course and the duration of the universal time, the theory of the universal temporality demystifies the black energy as well as the black matter. The spectral time signature is the gravitation weakening hidden behind the expansion acceleration in the spectrum of the universal temporality. The Moon distancing measured since 50 years in the Lunar Laser Ranging experiment is a spectral time signature which allows calculate the Universe age with the Newton's constant more easily and precisely than with the Hubble's constant. Together the theory of the universal temporality and the Lunar Laser Ranging experiment unveil the time nature and demonstrates that in its unit, its course and its duration the universal time is an energy ratio between the Universe and the fundamental particle.

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This letter presents the discovery of the fundamental particle in explaining how its identification in the Planck's constant and its integration in the Newton's constant link the quantum mechanics to the general relativity, reveal the physical significance of time, and demystify the black energy and matter.

Fundamental particle

The discovery of the fundamental starts from the idea that the light energy of the stars deflected by gravitation around the Sun (1) possesses a non-inertial mass related to its speed and its time unit in the Planck's constant $h = \sim 10^{-34}$ J.s. This mass designated by μ is identified with the mass of the fundamental particle in attributing the numerical value 1 to the light time unit s in the equation $h = \mu.c^2.s$. Calculated in dividing h by $c^2 = \sim 10^{16}$ $m^2.s^{-2}$ and $s = 1$, $\mu = \sim 10^{-50}$ kg is $\sim 10^{42}$ times smaller than the Planck's mass $m_P = \sim 10^{-8}$ kg calculated with the formula $(h.c/G)^{1/2}$ and $G = \sim 10^{-10}$ $m^3.kg^{-1}.s^{-2}$. In replacing m_P by μ and h by $\mu.c^2.s$ in the equation $G = h.c/m_P^2$, this one is transformed into $G = (c^3/\mu).s.10^{-85}$. In replacing c by λ/τ with $\lambda = \sim 10^8$ m and $\tau = 1$, the formula $(c^3/\mu).(s.10^{-85})$ is transformed into $(\lambda^3/\mu).(\tau.10^{-85})$ and $(\lambda^3/\mu).(\tau.10^{+42})^{-2}$ so as to link the mass μ to the space λ^3 by the two time expressions: $(\tau.10^{-85})$ and $(\tau.10^{+42})^{-2}$. The comparison of the mass $\mu \sim 10^{-50}$ kg, the length $\lambda \sim 10^8$ m and the time $\tau = 1$ with the mass $m_P = \sim 10^{-8}$ kg, the length $l_P = \sim 10^{-35}$ m and the time $t_P = \sim 10^{-42}$ s proposed by Planck as natural units of measurement (2) indicates that $G = \sim 10^{-10}$ $m^3.kg^{-1}.s^{-2}$ used in its formula $(h.c/G)^{1/2}$ of m_P is $\sim 10^{85}$ times too weak to link significantly the notions of mass, space and time. Whatever unit system we use, the fundamental time unit $\tau = 1$ determines the numerical value of the fundamental length unit λ by the equation $c = \lambda/\tau$, determines the numerical value of the fundamental mass unit μ in the equation $h = \mu.\lambda^2/\tau$, and determines

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the numerical relation between the fundamental units of mass and space in the Newton's constant. In other words, the fundamental time unit equal to 1 links the fundamental space unit to the fundamental mass unit in the Planck's constant and links the fundamental mass and space units to the fundamental time unit in the Newton's constant. So the fundamental time unit equal to 1 reveals the fundamental particle by its non-inertial mass μ, its fundamental quantum of action $\mu.c^2.s$, and its fundamental quantum of energy $\mu.c^2$.

Cosmological relativity

The numerical equivalence of the ratios λ^3/μ and λ^{-3}/μ^2 signifying that $\lambda^{-3} = \sim 10^{-25}$ m^3 is the volume of the fundamental particle and that $\lambda^6 = \sim 10^{50}$ m^3 is numerically equivalent to $\mu = \sim 10^{50}$ kg allows transform $G = (\lambda^3/\mu).(\tau.10^{-85})$ and $G = (\lambda^3/\mu).(\tau.10^{42})^{-2}$ into $G = (\lambda^{-3}/\mu).(\tau.10^{-42})^2$ and $G = (\lambda^{-3}/\mu).(\tau.10^{21})^{-4}$. The time expression $\tau.10^{-42}$ corresponds to the energy density of the expanding Universe, and therefore is named time unit of expansion s_{EX}. The time expression $\tau.10^{21}$ corresponds to the energy density of the gravitational Universe, and therefore is named time unit of gravitation s_G. Then $G = (\lambda^{-3}/\mu).(\tau.10^{-42})^2$ and $G = (\lambda^{-3}/\mu).(\tau.10^{21})^{-4}$ can be transformed into $(\lambda^{-3}/\mu).s_{EX}^2 = G = (\lambda^{-3}/\mu).s_G^{-4}$ which is the double cosmological equation of the gravitation constant in which G appears as a proportionality coefficient between the gravitation strength and the expansion energy on the one side and the gravitation energy on the other side. The value $\sim 10^{-42}$ of s_{EX} confirms the large numbers hypothesis of Dirac (3) which suggests that the gravitational strength was as intense as the electromagnetic strength when the energy density of the expanding Universe was 10^{42} times higher than nowadays. The equality between s_G and $s_{EX}^{-1/2}$

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represents the link between the gravitation and the expansion that allows complete the general relativity with the cosmological relativity (4).

Primordial mechanics

The mechanical modelling of the fundamental particle interaction causing the expansion and the gravitation helps to understand why the gravitation energy represented by s_G varies in inverse proportion of the expansion energy represented by s_{EX}. This interaction is primordial because it is at the origin of all the physical interactions. Its mechanical modelling is inspired from the Newton's cradle (5) with only two balls. The primordial interaction causing the expansion is graphically represented by the frontal collision of two balls designated by the mass μ moving freely at the light speed c in vacuum.

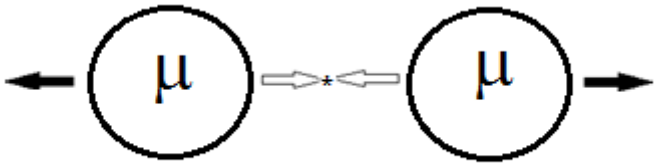

Fig.1 | Primordial interaction causing the expansion.

The white arrows indicate the moving direction of the fundamental particles before the collision, whereas the black arrows indicate their moving direction after the collision. The inversion of their moving direction results from the exchange of their kinetic energy at the moment of the collision. This primordial interaction is expansional because it causes the expansion and is entropic because it increases the Universe entropy (6,7).

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The primordial interaction causing the gravitation is represented by a lateral collision of two fundamental particles at the interface matter/vacuum. The first particle, represented by the grey ball, rotates inside the matter. The second particle, represented by the white ball, comes from the vacuum in a straight line to the interface matter/vacuum.

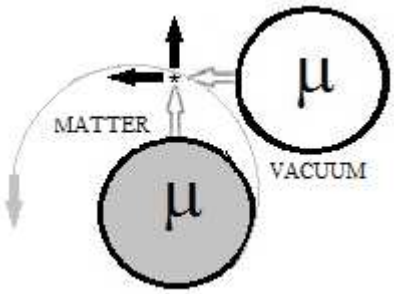

Fig.1 | Primordial interaction causing the gravitation.

At the collision instant the vacuum particle transfers its kinetic energy $½\mu.c^2$ to the matter particle and forces it to continue the rotation which maintains it inside the inertial mass of matter. This primordial interaction responsible of the matter formation and gravitation is considered as being “ectropic” because it concentrates the vacuum energy inside the matter mass and therefore slows down the Universe entropy. The vacuum energy transferred to the inertial matter mass corresponds to the energy of the Englert-Brout-Higgs boson (8). The expansion depression resulting from this energy transfer propagates as the gravitational wave (9) so that the graviton (10) corresponds to a local and temporary lack of fundamental particle in the vacuum space surrounding the matter mass. The energy equation $h\nu = \Sigma\mu c^2$ representing the incorporation of the vacuum energy $h\nu$ in the matter energy $\Sigma\mu c^2$ explains how the primordial mechanics of the fundamental particle interaction completes the quantum mechanics.

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Universal temporality

The union of the primordial mechanics with the cosmological relativity links together the unit, the course and the duration of the expansion time in the spectrum showing the decrease of the time unit of expansion s_{EX} in the course of the universal time between the first instant of the expansion and the last instant of the gravitation.

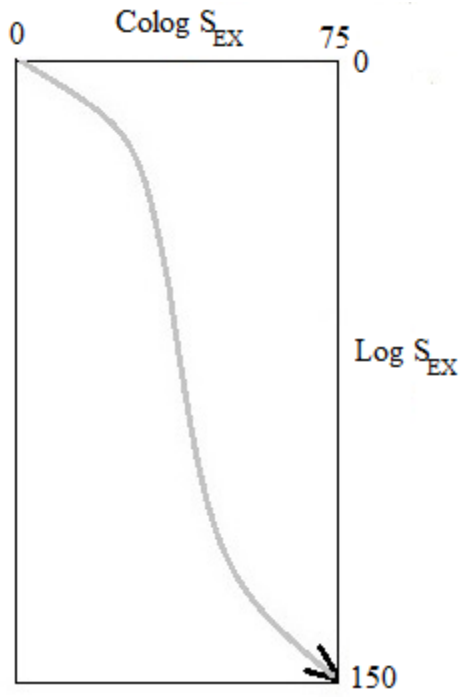

Fig.3 | Spectrum of the universal temporality.

The spectrum profile indicates the time course corresponding to the dispersion of the fundamental particles in the vacuum space by the ratio Colog S_{EX}/ Log S_{EX}. The spectrum arrow pointed on Log S_{EX} ~150 indicates the irreversible direction of the time flow until the matter disintegration. The spectrum head indicates the fast expansion corresponding to the cosmic inflation (11) before and during the

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formation of the first matter elements. The convex spectrum curve indicates the expansion slowing down by the gravitation during the matter transformation. The concave spectrum curve indicates the expansion acceleration due to the weakening of the gravitation until the complete matter disintegration. The spectrum foot indicates the gravitation end at the expansion duration time Colog S_{EX} = ~150. Then the density of the free fundamental particles in vacuum will not be sufficient to maintain the fundamental particles inside the inertial matter mass. The whole spectrum signifies that in its unit, its course and its duration the universal time is always an energy ratio between the expanding Universe and the fundamental particle. The gravitation weakening hidden behind the expansion acceleration in the concave spectrum curve is the sign of the secret time nature, named spectral time signature, which allows demystify the black energy (12) and the black matter (13). This signature demystifies the black energy in signifying that it is the expansion energy of which the acceleration results from the gravitation weakening. This signature demystifies the black matter in signifying that it is the underestimation of the star mass calculated with $G \sim 10^{-10}$ $m^3.kg^{-1}.s^{-2}$ which is very much too weak. Moreover it allows theoretically calculate the Universe Age (UA) $\sim 10^{21}$ s with the Newton's constant and the formula $(\lambda^3.\mu^{-1}.G^{-1})^{1/4}$ of s_G $\sim 10^{21}$. The Moon distancing measured since 50 years by the Lunar Laser Ranging experiment (14) gives also a way to calculate the UA with the Newton's constant and a significant G formula. This G formula is the derivative d(G/G*)/dt corresponding to the measured Moon distancing. The UA $\sim 10^{20}$ s (15,16), calculated from the distancing of 3,8 cm/an, is so close to the theoretical UA $\sim 10^{21}$ s that the Moon distancing can also be considered as a spectral time signature. As the spectral signature of the gravitational waves emitted by the Moon is the same spectral signature of the gravitational waves emitted by the Earth, the stars and the planets, the spectral time signature looks

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like the spectral signature of everything inside the Universe which allows calculate the UA with the Newton's constant more easily and precisely than with the Hubble's constant giving the UA ~10^{21} s. In being also the spectral signature of everything, the spectral time signature signifies that time means an energy ratio between the Universe contents and the fundamental particle. So in relating the time unit, the time course, and the time duration in the spectral time signature, the theory of universal temporality and the Lunar Laser Ranging experiment unveil the nature or physical significance of time.

In conclusion we can say that in linking together the universal notions of time unit, time course and time duration as well as the fundamental units of mass, space and time the discovery of the fundamental particle, the theory of the universal temporality, and the Moon Lunar Ranging experiment link the quantum mechanics to the general relativity, demystifies the black energy and matter, and unveils the nature of time so that it is now possible to solve the five great problems of theoretical physics described by Smolin in his book "The Trouble with Physics" (17).

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