

THE NATURE OF GRAVITATION

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ABSTRACT: Newton discovered the law of universal gravitation in 1665 after observing the fall of the legendary apple. Einstein's General Relativity in 1916 linked the gravitational field with the curvature of, and gravity waves with the ripples in, the 4-dimensional spacetime continuum. In Unified Theory gravitation is an interactive attraction of the test mass-body with the ambient sharmon medium and through it with all other mass-bodies, the gravitational mass of the elementary cosminos (positrino & negatrino) composing the mass bodies as well as the sharmons of the sharmon medium thus serve as both the cause and mediator of the gravitostatic force and field operating within and through the sharmon medium. Every mass body is composed by electrons, protons & neutrons each having 10^{20-23} cosmino-sharmon constituents thereby allowing for inherent compositional fluctuations via emission and absorption of small cosmino-sharmon units. The 1.6×10^{-33} cm diameter sharmons of the sharmon medium pass through inter-atomic spaces and between orbital electrons to enter a mass-body for intimate gravitational interaction between the cosminos composing the mass-body and the surrounding sharmon medium and through it with all other mass-bodies. Action-at-a-distance is thus ruled out. The gravitational wave energy comprising 0-spin sharmons is propagated as a Wave-Quantum UNIT of one cycle and one wavelength length in the sharmon medium via contiguous mechanism through 2-spin gravitons, which do not move from their mean positions but provide a physical carrier. Since 0-spin sharmons compose all forms of neutral mass and energy the identity of gravitational and inertial masses follows naturally. General-relativity's equation for bending of light in a gravitational field is re-deduced from sharmon medium.

1. From unknown to known to unknowable

The ever-existing phenomenon of gravitation was discovered for the first time on a fine morning in the year 1665 AD when the legendary apple fell from a tree in front of Sir Isaac Newton. And Newton asked: "*Why did the apple move only 'down', and did not go up or to the left or to the right?*"

Newton propounded the 'Theory of Universal Gravitation' and described the motion of the terrestrial projectiles and the planetary orbits with equal ease. He theorized that any and every body with mass universally experiences a gravitational attraction with other body/bodies irrespective of their physical and/or chemical state/properties. The gravitation of the earth and other heavenly bodies is given a particular name: "gravity". The apple fell 'down' due to earth's gravity attracting it, and all other mass bodies, towards the center of the earth.

According to Newton, a gravitational field exists in space due to the distribution of physical bodies with mass. But he did not specify any physical medium for it or for light, since the light corpuscles in his Corpuscular Theory could jolly well move in an empty space. His 'universal gravitation' thus involved 'action-at-a-distance'.

The subject of gravitation, nay of the whole of Physics & Cosmology strayed into the unknowable realm of unreality in the twentieth century when light [1], gravitational field [2] and gravity wave [3, 4] were all postulated to exist in the non-existent mathematical four-dimensional spacetime continuum. The curvature of the mathematical 4-D spacetime represents the gravitational field and ripples in the curved spacetime are the gravity waves.

1.1 *Unreality of the spacetime continua*

In Unified Theory (UT) [5] the space and time are not real physical entities having substance but are mere concepts evolving from the direct human perceptions of successive motions and changes in the surrounding objects. The concept of space evolves from the successive perceptions of ‘there, here, there’ and that of time from successive ‘then, now, then’, all arising from the successive motion & changes in the surroundings. Movement of the ‘time arrow’ only forward and never backward arises because of the *irreversibility* of the underlying natural processes of change. Any one born and brought up in a motionless, changeless all standing still surroundings will have no concepts of space and time. These two concepts of space & time are too intangible and abstract to fuse into any tangible spacetime continuum. In fact any multidimensional continuum, if existent would retard the motions of material bodies, planets and galaxies &c, through it. And there would have been no free motion, not even of the photon to propagate light across it. But none of such speed retardations has ever been actually observed to contradict Newton’s first law of motion. Moreover, a non-composite static spacetime cannot undulate to propagate the transverse light wave. Therefore all the various spacetime continua of 4, 5, 10, 11, ...32 dimensions are mere mathematical constructs bereft of real physical existence and theories of relativity and others based on them are unrealistic.

1.2 *The ‘sharmon medium’ in space is real*

James DeMeo [14] gives a comprehensive and up-to-date review of the experimental work on measuring the ether drift. Interestingly DeMeo cites Dayton Miller:

"The effect [of ether-drift] has persisted throughout. After considering all the possible sources of error, there always remained a positive effect." — Dayton Miller (1928)

Dayton Miller's '*positive*' results yielded more-than-zero ether drift as evidence for the existence of ‘ether’ or a light-propagating physical medium in space.

The work of Young and Fresnel by 1827 and of Sagnac in 1913 on interference and/or diffraction of light established the wave nature of light suggesting a physical medium to propagate it.

Numerous observations of the inter-conversions of various forms of energy among themselves and/or with mass and the equation $E=mc^2$ compellingly force the inescapable conclusion about the existence in real Nature of a '**Basic Substance**' composing all forms of energy and mass, otherwise E & m could not inter-convert. Since the electromagnetic radiation or light is a wave propagated in a physical space-medium and compositionally a wave and its medium are one and the same, the light propagating '*Sharmon Medium*' emerges as the all-composing & all pervading **Basic Substance**. Since light is a transverse EM wave, sharmon is polarizable and composed by a positive (+ve) *positrino* and a negative (-ve) *negatrino*, the two non-composite elements, which compose all forms of energy, mass, energy quanta, particles of matter and antimatter in the Cosmos, hence given the common name '*cosmino*'. The Sharmon Medium marks the end of subtlety and cosminos the end of divisibility & subtlety. It is a conceptual improvement over the extremely rigid classical ether to propagate high speed light wrongly assumed to be a longitudinal wave akin to the elastic sound wave. Relativity's 4-dimensional and other multidimensional spacetime continua are mere mathematical constructs bereft of physical existence. Wave-Quantum theory's physical vacuum of unclear content has to provide for the bottomless Dirac sea of negative energies, for spontaneous creation of particle-antiparticle pairs (from nothing) and to super-conduct the unrealistic “weak current”.

A cosmino has the diameter Planck length $l_p = 1.6156 \times 10^{-33}$ cm, mass = 2.596×10^{-48} gm, electric charge = $\pm 1.3729 \times 10^{-30}$ esu, and spin = $\pm 1/2$. The direction of spin is not specific of the kind of charge. A cosmino can have a right handed +ve or left handed -ve spin. Two positrinos or negatrininos of opposite spin can yield a 0-spin Cooper pair ‘diad’.

The neutral sharmon of mass 5.192×10^{-48} gm is composed by a +ve positrino and a -ve negatrino. The opposing $1/2$ -spins of the constituent cosminos produce its 0-spin scalar state and the co-directional $1/2$ -

spins yield the 1-spin vector sharmon. The oppositely charged cosminos in the sharmon do not mutually annihilate, unlike the electron-positron pair, because the cosminos themselves are the indivisible non-composite micromost elements. Therefore both the scalar 0-spin sharmon and the vector 1-spin sharmon are stable and dynamic structures and can inter-convert.

The constituent +ve & -ve cosminos of the sharmon having mass and electric charge not only spin but also vibrate along the common axis, imparting an electric as well as an orthogonal magnetic dipole moment to the sharmon. The gravitational and electromagnetic properties of the sharmon generate those of the material particles, of the photon and of the sharmon medium, which they compose.

The Bosonic condensation of sharmons is supported by the close distance gravitational and electric attractions among constituent \pm ve cosminos and imparts gregarious properties to sharmons, which can aggregate to compose energy and neutral mass of material particles. The neutral mass is composed by the 0-spin sharmons and electrically positive or negatively charged mass of the charged particles is composed by the respective positive or negative cosminos. No particle or energy quantum is therefore massless, sizeless or "virtual" (i.e. unreal). The neutron, proton, electron, neutrinos, photon, graviton &c have more-than-zero definite mass and size, as against Special Relativity.

The sharmon medium is irremovable from any enclosed space by any means since the tiny sharmon of $\sim 10^{-33}$ cm diameter can pass through spaces not only between molecules and atoms of even the densest solid but also between orbital electrons.

Due to its nature as a kinetic gas, the sharmon medium approximates as a '**kinetic continuum**' effectively obliterating the interstices between randomly moving constituent sharmons in fleeting contacts. It fills all space leaving no 'vacuous space' with 'nothing inside' and rules out the existence of absolute vacuum for any significant period of time. Its time-averaged inter-sharmon distance of $\sim 10^{-5}$ cm compares with the Mean Free Path for the real gasses (e.g. for Hydrogen 1.12×10^{-5} cm, Oxygen 0.64×10^{-5} cm, Nitrogen 0.595×10^{-5} cm).

The sharmon medium contains $\sim 10^{15}$ sharmons per cm^3 . And its average mass density is 5.192×10^{-33} gm.cm^{-3} , vis-a-vis 3×10^{-31} gm.cm^{-3} for the Steady State Cosmology and 1.293×10^{-3} gm cm^{-3} for air. The sharmon medium is viscous, with a viscosity constant $\eta = 0.57 \times 10^{-22}$ dyne.sec/cm².

2. Electromagnetic versus gravitational force/field

The sharmon particle, which composes the sharmon medium in space, is itself composed by the two elementary cosminos, positive *positrino* and negative *negatrino*. The cosminos have two basic charges, electric (+ve & -ve) and gravitational (mass). The cosminos composing the sharmon can vibrate and also spin, generating a magnetic dipole moment as well as a magnetic field in association with the sharmons in the sharmon medium.

The electrostatic force and field are mediated via the electric charge on the cosminos composing the sharmons in the space medium. The gravitational mass of the sharmons mediates the gravitostatic force and field, which operate within and through the sharmon medium. The electric charge and magnetic poles of similar kind repel each other but dissimilar ones attract. Two mass bodies experience attractive force acting through the sharmon medium.

2.1 Photon versus Graviton

The photon propagates electromagnetic wave and graviton the gravitational wave. Why?

The photon is an energized 1-spin sharmon with co-directional $\frac{1}{2}$ -spins of the constituent +ve positrino and -ve negatrino. The constituent positrino and negatrino also vibrate along the common axis. It gives rise to the electric and magnetic dipole moments and varying magnetic and electric fields associated with the photon to propagate electromagnetic wave.

The graviton is an energized pair of two 1-spin sharmons with co-directional spins, the +ve positrino of one sharmon opposing the -ve negatrino of the other. Effectively the graviton behaves as an electrically neutral mass-particle with zero electric and magnetic dipole moments. Therefore the graviton effectively mediates only the gravitational wave and plays no role in the propagation of the electromagnetic wave.

3. Physical mechanism of gravitational attraction

The *dynamic* cosmino-sharmon compositions of electron, proton and neutron have been worked out [5]. The electron is a dynamic composition of 3.50×10^{20} negatrinons plus 3.94×10^{17} 0-spin sharmons. The proton comprises 1.75×10^{20} +ve 0-spin diads plus 2.619×10^{23} sharmons. The number of +ve diads in the inner region or -ve diads in the outer region of the neutron is 7.06×10^{18} . The numbers of sharmons bound to the diad-sharmon units (+ve in the inner and -ve in the outer) are 5.984×10^{20} and 2.6139×10^{23} respectively, and that of free sharmons in the outer region is 6.0559×10^{22} . With such a large number of constituents the cosmino-sharmon compositions of electron, proton and neutron, and hence of the physical bodies they make up, cannot remain rigidly and unchangeably fixed but allow emission and absorption of small sharmon-cosmino units.

Sharmon medium is a kinetic gas comprising $\sim 10^{15}$ sharmons per cm^3 . The cosminos have mass and electric charge (+ve & -ve). All tiny sharmons of the sharmon medium have mass and are associated with electric and magnetic dipole moments and fields and can enter physical bodies for close distance interaction with their constituent sharmons, *ruling out action-at-a-distance*.

The cosmino-sharmon compositions of all the physical bodies fluctuate, emitting and/or absorbing small cosmino-sharmon and diad-sharmon units. All physical bodies continue *dynamic* exchanges with the *kinetic* sharmon medium and through it with all other physical bodies. The mediator bosons are the sharmon aggregates of mass energy ΔE . The mediated force is $\Delta E/\Delta x$. This force acts both ways on two interacting bodies.

The gravitational force is attractive because the physical bodies experience a mutual attraction with the surrounding sharmon medium and through it with all other bodies.

Since the all-composing cosminos have mass and electric charge the above physical mechanism also underlies the genesis of the electrostatic and magnetostatic interactions. Thus gravitostatic, electrostatic and magnetostatic forces and fields have common cause or origin in the cosminos composing the test body as also the common mediator in the cosminos composing the sharmons of the all-pervading ambient sharmon medium

4. The gravitostatic field in the sharmon medium

Newton published a simple law of universal gravitation in his *Mathematica Principia* of 1687. Accordingly the force F_g of gravitational attraction between any two particles of mass m_1 and m_2 , whose centers are separated by a distance r , is given by

$$F_g = G (m_1 \cdot m_2)/r^2.$$

The Newton's law comprises two sub-laws:

(a). According to the *law of direct mass product*, the intensity of the force F_g is directly proportional to product of the two masses m_1 and m_2 , which is consistent with expectations of common sense.

(b). According to the *inverse square law*, equally applicable to the gravitostatic, electrostatic and magnetostatic fields, the force F_g is inversely proportional to the square (r^2) of the distance (r) between the centers of the two charge bodies. In our Unified Theory (UT) it arises from the sharmon medium. The detectable activity or intensity of the force F_g at a distance r from the test point mass is uniformly distributed over the surface area $4\pi r^2$ of the sphere with its center at the test point particle.

Here G is called the *gravitational constant* whose magnitude depends on the system of units of measurement and the nature of the intervening medium. In Newton's theory $G = 6.5592 \times 10^{-9}$ cgs unit, for the vacuum. For our Unified Theory, however, G is a physical parameter of the sharmon medium through which the gravitational force acts. But the nature of the sharmon medium as a kinetic gas provides for local variability in its number density of sharmons/ cm^3 , mass density and hence also of the constant G .

5. Dynamic gravitational field

A dynamic gravitational field involves transmission of gravitational energy from one part of the field to other(s). This happens via a propagated wave. The gravitational wave can either be transverse or

longitudinal. The former propagates the wave energy quantum of one cycle as a Wave-Quantum UNIT via the carrier 2-spin boson 'gravitons', akin to an electromagnetic wave. Its velocity $V_g = (e_r/d)^{1/2}$ equal to the light velocity c , is determined by the shear elasticity e_r and density d of the sharmon medium.

The longitudinal gravitational wave comprising compression and rarefaction in the sharmon medium are expected to be initiated during a large-scale mass disturbance like a supernova explosion. These can also be taken as the '*cosmic sound*' whose velocity $V_s = (e_a/d)^{1/2}$ is set by the volume elasticity e_a (in place of shear elasticity e_r) and the density d of the sharmon medium. Since the volume elasticity e_a of the sharmon medium is expected to slightly exceed its shear elasticity e_r , the longitudinal gravitational wave moves faster than light.

6. Propagation of the wave-quantum unity in a dynamic gravitational field

The physical bodies have a spontaneously fluctuating dynamic cosmino-sharmon composition and sharmon medium is a kinetic gas. The bodies are in dynamic exchange equilibrium with the ambient sharmon medium through which they interact with other bodies. As in electromagnetic waves so here, the gravitational energy is propagated as a wave-quantum UNITY in the sharmon medium.

The wave-energy quantum, of the 2-spin graviton, comprising 0-spin sharmons, moves along the corresponding transverse gravitational wave contiguously via energized 2-spin sharmons in the sharmon medium, which do not physically move from their equilibrium positions but provide a physical carrier. This propagation of the gravitonic energy is mediated via the 2-spin sharmon-pairs in the medium.

The first 0-spin sharmon-pair of the medium receiving the gravitonic energy from the source and thereby getting thus energized rises to the 2-spin state. It returns to the 0-spin state on passing the energy quantum on to the contiguous pair, which in turn is raised, to the 2-spin state. Finally, 2-spin graviton transfers to the target, the wave energy quantum comprising 0-spin sharmons, and the carrier 2-spin sharmon pair returns to the 0-spin state. During transmission at any and every instant the energized 2-spin sharmon pair is the graviton. *Only the gravitonic energy comprising 0-spin sharmons is emitted, propagated and absorbed but NOT the energized 2-spin graviton as a whole.*

Similar physical mechanism applies to the electromagnetic wave. The transverse electromagnetic wave propagates as a wave-quantum unity in the sharmon medium contiguously from sharmon to sharmon in their 1-spin state. Its velocity $c = (e_o \cdot \mu_o)^{-1/2}$ is set by the electric permittivity e_o and magnetic permeability μ_o of the sharmon medium. It carries the electromagnetic energy propagated contiguously via 1-spin sharmons, which do not move physically from their mean positions but only provide a physical carrier. On transferring the photonic energy to the contiguous neighbour in the sharmon medium the propagating 1-spin sharmons return to the 0-spin state. The last 1-spin sharmon transfers wave energy quantum to the target and returns to its 0-spin state.

6.1 Unification of the Gravitational & Electromagnetic Forces & Waves

The two mediator bosons (photon & graviton) for the two infinite-range forces (electromagnetic & gravitational) are composed by multiple sharmons. And hence carry more-than-zero finite mass, say m , and momentum p .

The total energy E of the propagator boson consists of kinetic energy pc , mass energy mc^2 and wave energy $h\nu$ at frequency ν of the transverse wave of the respective charge in the sharmon medium. Therefore the famous empirical relation for the total energy of a moving particle

$$E^2 = (pc)^2 + (mc^2)^2$$

in Unified Theory becomes

$$E^2 = (pc)^2 + (mc^2)^2 + (h\nu)^2 .$$

It with $E = i\hbar\partial/\partial t$, $p = -i\hbar\nabla$, $\nabla = (\partial/\partial x + \partial/\partial y + \partial/\partial z)$ yields:

$$(\square + m^2 c^2 / h^2 + 4\pi^2 v^2 / c^2) \Phi = 0$$

where the d'Alembert operator

$$\square = (\partial^2 / \partial x^2 + \partial^2 / \partial y^2 + \partial^2 / \partial z^2 - 1/c^2 \cdot \partial^2 / \partial t^2).$$

7. Riemannian differential geometry & general relativity

The operations of differential geometry can apply only to a continuum. The theory of General Relativity, as a theory of gravitation, uses the Riemannian differential geometry of the 4-dimensional spacetime continuum. It is a flaw of this theory because the 4-D spacetime continuum has been shown as non-existent and unrealistic [5].

8. The principle of equivalence, general relativity & Unified Theory

In an inertial reference frame, the free motion of a mass body, not subjected to external force, is uniform and in a straight line. In a gravitational field, all bodies move with the same acceleration. And freely moving bodies, when viewed from a uniformly accelerated non-inertial frame, appear to have an equal and opposite acceleration. That non-inertial reference frame, therefore, is equivalent to a "certain" gravitational field. This is the "Principle of Equivalence" [2].

It may, however, be emphasized [6] that the fields to which non-inertial frames are equivalent are NOT completely identical with actual gravitational fields. For example, a disc of radius r rotating with uniform angular velocity w is a non-inertial frame having outward centrifugal acceleration $+w^2 r$. Relative to it, all free bodies have the same inward centripetal acceleration $-w^2 r$. However, the actual gravitational acceleration $g = Gm/r^2$ due to a body of mass m decreases but both the above accelerations $\pm w^2 r$ increase with increasing distance r from the source at the center.

Moreover, the fields to which non-inertial systems are equivalent vanish on transformation to an inertial system. But actual gravitational fields cannot be eliminated by any choice of the non-inertial reference frame. This is exemplified by the difference between the rotating frame and a gravitational field due to a mass body, mentioned above.

In the Special Relativity, one could use, as coordinate system, an aggregate of bodies at relative rest. In the General Relativity it is impossible, because the metric of space itself depends on time. So the bodies constituting any reference system cannot be at relative rest, as their mutual separations and/or velocities of relative motion are not fixed, but vary with time. The system of reference is constituted by an infinite number of bodies filling all of space and individually linked with clocks recording their own times. Separate clocks even on the same reference frame cannot be synchronized [6]. This scenario is bewildering enough to benumb all visualizations.

The Unified Theory does not need the Principle of Equivalence, but develops the theory of gravitational fields from neoclassical first principles.

9. The rotating disc, general relativity & Unified Theory

As a prelude to the General Theory of Relativity Einstein [2] applied the Special Relativity's contraction of length to the case of a rotating disc, viewed from other rotating frames. The lengths of infinitesimally small measuring rods laid along the radii remain unaltered but those along the circumference contract, changing the circumference-to-radius ratio to more than 2π , and making the geometry of space non-Euclidean. But in Unified Theory the objectively actual length of the circumference does not contract even if and when viewed from other rotating frames. So, the circumference-to-radius ratio still remains 2π and the geometry of the 3-dimensional objective space is still Euclidean.

10. The Mach principle, general relativity & Unified Theory

For the development of the theory of gravitation as the General Theory of Relativity [2] Einstein was greatly influenced and motivated by the thinking of German philosopher Ernst Mach who had modified Newton's ideas on gravitation. In the relation $f = m_i a$ for his second law of motion, Sir Isac Newton (1660) had assumed that the inertial mass m_i is an absolute quantity.

Two centuries later Mach argued that the inertia (m_i) of a body is not absolute but depends on, and rather arises from, the matter distribution in the rest of the universe, through gravitational interactions. Mach did not elaborate the mechanism of the gravitational interaction at a distance but implied that the galaxies and other bodies in the universe interact with the test body through the intervening space and that in a matter-free universe the body will have zero inertia.

General Theory of Relativity as a theory of gravitation further showed that the test mass (inertial mass $m_i =$ gravitational mass m_g) also interacts with surrounding space and hence a ray of light follows a curvilinear path in a gravitational field as was later verified by Eddington in 1919. Einstein, like Mach, also did not elaborate the underlying physical mechanisms.

The Unified Theory goes farthest to assert the unity and continuity of the interactions and compositions of all physical bodies with and through the all-composing, all-pervading and irremovable, omnipresent kinetic sharmon medium. That is, every mass body interacts with the surrounding sharmon medium and through it with all other bodies in the universe. The same micromost basic cosminos that compose the particulate content of the kinetic sharmon medium also compose all forms of energy and mass, and all are in a state of dynamic interaction.

Since both mass and energy have inertia the total inertial mass $m_i = m_g = (m + mV/c^2)$ of a body in a gravitational field of potential V has two components: m and mV/c^2 . The matter distribution in the rest of the universe generates the gravitational potential V to determine mV/c^2 . In a matter-free universe ($V=0$), the mV/c^2 component will vanish, leaving m unaffected. For this finer detail, Unified Theory improves upon the Mach principle wherein even m also becomes zero in a matter-free universe.

Formula for the bending of light in a gravitational field through Unified Theory's sharmon medium is the same as in Relativity [7].

11. Gravitational vs inertial mass in general relativity & Unified Theory

Einstein [2] had noted a remarkable property of the gravitational field. The gravitational force $f_g (= m_g a_g)$ imparts the same acceleration a_g to all bodies independent of the material composition and physical state of the gravitational mass m_g . Similarly, mechanical force $f_m (= m_i a_i)$ produces the same acceleration a_i independent of the composition of the inertial mass m_i . The gravitational mass m_g and the inertial mass m_i were therefore equated.

In Unified Theory, however, the gravitational mass m_g and inertial mass m_i are two different manifestations of one and identically the same mass m of the composing cosminos and/or sharmons. Any externally impressed force f produces the same acceleration 'a' given by Newton's second law of motion $f = ma$, which is independent of the composition and physical state of mass m and also independent of whether the external force is gravitational or inertial.

In Unified Theory the gravitational field's above property, which Einstein specially noted to develop General Theory of Relativity [2], arises from the proportionality of the gravitational force ($-m \text{ grad } V$) to the gravitational charge or mass m , V being the gravitational potential. This leads to the equation of motion

$$dv/dt = a_g = -\text{grad } V,$$

which is independent of the mass m .

The 0-spin sharmon composed mass manifests as 'gravitational mass' when it feels and is felt by a gravitational force/field. The same 0-spin sharmon composed mass in accelerated motion manifests as 'inertial mass' under the action of an external force, which changes the body's state of uniform motion to produce acceleration. The kinetic and potential energy, like mass, also have the gravitational and inertial effect. The identity of gravitational and inertial mass follows naturally as each of them is the same 'basic

substance'.

However, the electric force $-e \text{ grad } V_e$ also is similarly proportional to the electric charge e , V_e being the electric potential. But it does not yield an equation of motion independent of e or m . Identity, not mere equality, of the gravitational mass with the inertial mass imparts the special property to the gravitational field noted by Einstein, since the gravitational field or force does not interact with the electric charge.

12. Unification of energy & mass in general relativity & Unified Theory

The radiant energy E composed by 0-spin sharmons is associated with mass and the momentum $E/c = (E/c^2) \cdot c = \text{mass } (E/c^2) \times \text{velocity } (c)$, relating E with radiant mass $m=E/c^2$ or giving $E=mc^2$ for the equivalence and inter-convertibility of energy E (erg) and mass m (gm). Einstein [8] generalized this relation and included the rest mass energy mc^2 in the relativistic total kinetic energy $E = c (p^2 + m^2c^2)^{1/2}$ to predict the existence in Nature of massless ($m=0$) particles like photon moving at light velocity c with energy pc . But it was not clarified why for $m=0$, the momentum $p=mc$ and energy $E=pc$ are not zero. However, this pointed to the existence in real Nature of some physical entities "*subtler than energy & mass*" but common and continuous with all forms of energy E and mass m , otherwise various forms of energy among themselves and/or with mass could not inter-convert. Einstein did not go beyond his mathematics to inquire conceptually into the physical nature of these subtle entities, nor did any other scientist. These subtle entities are still unknown and undiscovered in modern Physics.

But in Unified Theory, these are the **most basic elements** viz. the two cosminos, positrino and negatrino. A cosmino is the basic quantum of mass (2.596×10^{-48} gm) and electric charge (1.37×10^{-30} esu). Sharmon is the basic quantum of energy (4.66×10^{-27} erg or 2.90×10^{-15} eV). The radiant energy (photon) is composed by 0-spin sharmons, so is the kinetic energy or the potential energy. The 0-spin sharmons also compose the neutral mass of material particles whose positively charged mass is made of positrinos and negatively charged mass of negatrininos. *Thus Unified Theory raises the mathematical equality of the eqn. $E=mc^2$ to the status of the physical identity of the composition of E and m by the same cosminos and sharmons.*

Thus, there is a basic unity or continuity in all forms of energy and mass of matter and antimatter as the grandest unity of composition in Unified Theory. The transformations among different forms of energy and inter-conversions of mass and energy or of mass plus energy of material particles occur via the rearrangements and reorganizations of the totality of their composing sharmons and/or cosminos. This explains the production of new particles from the kinetic energy as their source substance when accelerated charged particles collide, as for instance reported by D-Zero [9] and CDF [10] collaborations. Modern Physics offers no physical mechanism or palatable explanation except the relation $E = mc^2$.

The equivalence and inter-convertibility of mass and kinetic energy imply that for a physical body of rest mass m moving at velocity v , with kinetic energy $\frac{1}{2}mv^2$, the total kinetic mass is

$$m' = m + \frac{1}{2}mv^2/c^2 = m (1 + \frac{1}{2}v^2/c^2).$$

This is the Unified Theory expression to which the Relativity's expression

$$m' = m (1 - v^2/c^2)^{-1/2}$$

approximates for $v \ll c$.

At $v = c$, m' is infinite in Relativity. That is why Relativity prohibits particles with non-zero mass to have a velocity $= c$. But in Unified Theory, it equals $1\frac{1}{2}$ times the rest mass m at $v = c$ and is NOT infinite even for $v > c$.

An important basic point arises here. The kinetic energy moving with the particle has inertia and hence the kinetic mass should be

$$m'' = m + \int \frac{1}{2} m (v + dv)^2/c^2 = m (1 + v^2/c^2).$$

If a body of rest mass m is situated in a gravitational field of potential V , its potential energy is mV and total potential mass is

$$m' = m + mV/c^2 = m(1 + V/c^2).$$

When the body of rest mass m carries an electric charge q and is situated in an electric field of potential V_e , its total potential mass is

$$m' = m + qV_e/c^2.$$

For the motion of a charged particle in an electric field, the Newton's second law of motion is modified to include the electric potential energy in the inertial mass. That is,

$$\text{Force} = (m + qV_e/c^2) \times \text{acceleration}.$$

And in a gravitational field,

$$\text{Force} = m(1 + V/c^2) \times \text{acceleration}.$$

12.1 Kinetic mass of kinetic energy of a moving particle

The above discussion leads to the following three relations for the (kinetic mass/rest mass) = m'/m ratio at a velocity v of the moving particle:

$(1 + \frac{1}{2} v^2/c^2)$, $(1 + v^2/c^2)$ under Unified Theory
and $(1 - v^2/c^2)^{-1/2}$ under Special Relativity.

Specifically for $v/c = 90\%$, 99% , 99.5% the m'/m ratios for the above three relations are: 1.405, 1.81, 2.294; 1.49, 1.98, 7.088; 1.495, 1.990, 10.0125.

Newton's second law of motion for the kinetic mass of a moving particle gives:

$$\text{kinetic mass} = \text{force/acceleration}.$$

The Geneva based Large Hadron Collider can easily incorporate a software to record the (force vs acceleration) trace curve for the kinetic mass rising with the velocity v to check which of the above three relations fits the actual observation.

13. Bending of light in gravitational, electric & magnetic fields

According to Unified Theory, the light ray should bend in all these three fields as they all affect the sharmons of the light propagating medium and also the photon, which itself is composed by sharmons. These derivations were first given in the 1990-book: **Unified Physical Theory** (COSMO. New Delhi).

13.1 In a gravitational field

A photon comprising sharmons of non-zero mass, experiences the acceleration due to gravity $g = GM/R^2$ of the heavenly body of mass M and radius R . Light from a distant star goes past the body in time $t = 2R/c$, to fall by the distance $s = \frac{1}{2}gt^2$ and bends by the angle $\theta = s/R = \frac{1}{2}(GM/R^2)(2R/c)^2/R = 2GM/Rc^2$ radian. Or

$$\theta = 2GM/Rc^2 \text{ radian}.$$

This is exactly the formula given by Einstein [6] earlier. Later 2 was changed to 4 and tested by

Eddington during the total solar eclipse on May 29, 1919. Our derivation shows that 'photon' has gravitational mass and the sharmon medium propagates light and mediates gravitational field.

Since the gravity of the heavenly body extends far beyond its periphery the 'influence time' exceeds the transit time $t = 2R/c$ to suggest that the actual light bending is much larger than $2GM/Rc^2$ radian. This is consistent with Einstein's later revision of the above equation to $4GM/Rc^2$.

13.2 In an electric field

Let a non-uniform electric field of intensity E and gradient $b = dE/dx$ act at right angles to the direction of propagation of a ray of electromagnetic radiation of frequency ν . The number of sharmons in the energy packet $h\nu$ is $h\nu/m_s c^2$ where m_s is the sharmon mass and c the light velocity. The electric charge on the electric dipole in the $h\nu$ packet due to separation of positrino-negatrino pairs is $qh\nu/m_s c^2$, q being the cosmino charge. The force on the $h\nu$ packet is $F = e_0 r b q h\nu/m_s c^2$, where e_0 is the electric permittivity of the sharmon medium and r is the arm of the dipole or the sharmon radius. The $h\nu$ packet of mass $h\nu/c^2$ will have an acceleration $f = e_0 r b q/m_s$ at right angles to the direction of motion. If the ray traverses a distance D in time $t = D/c$ through the electric field the angle θ of deviation would be $\theta = \tan \theta = \frac{1}{2} f t^2 / c t = \frac{1}{2} f t / c$. The angle of deviation θ for traversing a distance D in an electric field of intensity E and normal gradient $b = dE/dx$ is

$$\theta = \frac{1}{2} e_0 D b r q / m_s c^2 \sim D b \cdot 10^{-37} \text{ radian.}$$

Here r is radius, m_s the mass and q the dipole charge of sharmon. Here θ is independent of the frequency ν . Hence there will be no dispersion.

13.3 In a magnetic field

In a non-uniform magnetic field H with normal gradient $b' = dH/dx$, strength of the induced magnetic dipole is proportional to the field H , the magnetic permeability μ_0 and the polarizability r^3 of the sharmon. Its multiplication with the gradient b' of the field gives the force on the $h\nu$ packet. Rest of the calculations are the same as for the electric field above. The deviation angle θ for the light of wavelength λ (\AA) is given by

$$\theta = \frac{1}{2} \mu_0 D H b' \lambda r^3 / h c \sim D H b' \lambda \cdot 10^{-92} \text{ radian.}$$

Here a dispersion of wavelengths λ is also present.

The bending of light in the electric and magnetic fields, though too small and difficult for experimental verification, are important conceptually because no other theory has them.

14. Motion of a particle in a gravitational field

Let a material particle of mass m move at a velocity v in a gravitational field of potential V . The Lagrangian L consists of the kinetic energy $\frac{1}{2} m v^2$, the rest mass potential energy mc^2 and the gravitational potential energy mV . That is

$$L = \frac{1}{2} m v^2 - (m c^2 + m V) = -m c^2 + \frac{1}{2} m v^2 - m V.$$

But since $v \cdot dt = dr$, the action function is

$$\begin{aligned} S &= \int L dt \\ &= -m c \int ((c + V/c) dt - \frac{1}{2} v/c \cdot dr). \end{aligned}$$

Comparing this with the relativistic action function

$$S = -m c \int ds,$$

we have

$$ds = (c + V/c) dt - \frac{1}{2}V/c \cdot dr.$$

This, on squaring and dropping the second order v^2/c^2 terms, gives

$$\begin{aligned} ds^2 &= (c^2 + 2V) dt^2 - V dt \cdot dr \\ &= (c^2 + 2V) dt^2 - (dx_1^2 + dx_2^2 + dx_3^2). \end{aligned}$$

Here $V dt \cdot dr = dr^2 = (dx_1^2 + dx_2^2 + dx_3^2).$

Thus we have $g_{44} = 1 + 2V/c^2$, $g_{11} = g_{22} = g_{33} = -1$, and the rest of all other elements as zero. The matrix g_{mn} is

$$\begin{matrix} -1 & 0 & 0 & 0 \\ & 0 & -1 & 0 & 0 \\ & & 0 & 0 & -1 & 0 \\ & & & 0 & 0 & 0 & 1+2V/c^2. \end{matrix}$$

It differs from the matrix below, for a finite region of Special Relativity only in the element g_{44}

$$\begin{matrix} -1 & 0 & 0 & 0 \\ & 0 & -1 & 0 & 0 \\ & & 0 & 0 & -1 & 0 \\ & & & 0 & 0 & 0 & +1. \end{matrix}$$

15. Detecting the gravitational waves

There are two ongoing parallel schemes to detect gravitational waves by using Laser Interferometer [11] or Resonant Mass Detector [12]. The former technique works on the assumption that gravity wave is a transverse wave like light and the latter assumes it to be a longitudinal wave like sound. But both the approaches have their own difficulties and limitations.

15.1 Laser interferometer method

Worldwide efforts by using the earth based laser interferometer are being made at Hannover, Germany; LIGO (Laser Interferometer Gravitational Wave Observatory), Hanford (WA) & Livingston (LA), USA; Tokyo, Japan and Pisa, Italy. The technique assumes transverse nature of gravity wave (GW).

The LISA (Laser Interferometer Space Antenna) Project [11] is a planned space mission, adopted by ESA and NASA, to deploy 3 satellites in solar orbit forming a large equilateral triangle with a base length of 5×10^6 km. The center of the triangle formation will be in the ecliptic plane 1 AU from the sun and 20 degrees behind the earth. The main objective of the LISA mission is to observe low frequency (10^{-4} Hz to 10^{-1} Hz) gravitational waves from galactic and extra-galactic binary systems, including gravitational waves generated in the vicinity of the very massive black holes found in the centers of many galaxies. The three LISA spacecrafts flying in formation will act as a giant Michelson interferometer, measuring the distortion of space caused by passing GW. Each spacecraft will contain two free-floating "proof masses". Lasers in each spacecraft will be used to measure changes in the optical path lengths with a precision of 20 pm. The project was to start in the year 2005 with a planned launch in 2008.

The interference fringes, which the proposed interferometers propose to detect, are formed by transverse waves like those of the electromagnetic radiation. However, for low frequency (10^{-4} Hz to 10^{-1} Hz) GW as compared to light, the energy $h\nu$ is expected to be lower and the wavelength larger by several orders of magnitude. The detection of the interference fringes therefore is to be very difficult, if not impossible. But if successful, the experiment will suggest that gravity waves are transverse in nature. Till Feb.'08 GW remain undetected: CERN Courier Feb'08:

<http://cerncourier.com/cws/article/cern/32912>.

15.2 Resonance mass detector method

This research facility is being developed [12] at Institute of Physics, Academia Sinica, Beijing; Louisiana State University, Moscow State University, Stanford University, University of Maryland, University of Rome, University of Tokyo, University of Western Australia, Zhongshan University, Guangzhou. The cryogenic detector at Stanford, Rome (CERN) and Louisiana State University may also be mentioned. The Stanford University research center [12] uses Aluminum bar weighing 4800 Kg for detecting strains $\sim 10^{-18}$.

This technique is based on the *assumption* that gravity wave is a pressure wave like longitudinal sound wave. However, the velocity $V_g = (e_a/d)^{1/2}$ of the longitudinal gravity wave is determined by the volume elasticity e_a and the density d of the sharmon medium. For the sharmon medium composed by tiny sharmons and having very low density, the volume elasticity e_a exceeds e_r only slightly. Therefore for ease of presentation and without any fear of gross error we take the two as equal.

It is shown above that the sharmon medium has its rigidity or shear elasticity $e_r = 4.68 \times 10^{-12}$ dyne/cm² and mass density $d_s = 5.19 \times 10^{-34}$ gm/cm³. The density of air is $d_a = 1.293 \times 10^{-3}$ gm cm⁻³ and the atmospheric pressure is $p = 1.0132 \times 10^6$ dyne cm⁻². Arbitrarily assuming that the stress propagated within a wave is proportional to the mass density of the medium, the stress in a gravity wave $S_{gw} = p \cdot d_s / d_a = 4.86 \times 10^{-25}$ dyne cm⁻². Therefore the strain within the sharmon medium $S_{ts} = S_{gw} / e_r = 1.059 \times 10^{-13}$. Taking the rigidity of Aluminum as $R_{Al} = 2.67 \times 10^{11}$ dyne cm⁻², the strain expected to be produced in the detection bar is $S_{Al} = S_{ts} / (R_{Al} / e_r) = 1.85 \times 10^{-36}$. This negligible strain ($\sim 10^{-36}$) in the detecting bar is far beyond the planned capability ($\sim 10^{-18}$) of proposed Resonant Mass Detectors [12].

Therefore it is feared that neither the Laser Interferometers [11] (based on earth or in space) nor the Resonant Mass Detectors [12] would be able to detect the gravity waves.

15.3 Cosmic redshift would detect gravity wave

Large-scale mass disturbances, as in a supernova explosion, would emit strong gravity waves accompanied by local burst of sharmon showers, which will raise the density and viscosity η of the surrounding sharmon medium. This will result in the increased redshift Z of the light of wavelength λ emitted by the stellar source

$$Z = 6\pi r \eta D \lambda / h.$$

Here D is the distance of the source, r the radius of photon energy quantum and h is the Planck constant. This will indirectly detect the gravity waves emitted by the stellar source. The observation [13] on the type Ia supernova, if interpreted thus, would not create 'amazement and horror' among the astronomers.

16. Gravitational Lenses

Einstein's General Theory of Relativity was the first to predict the phenomena of gravitational lensing, which have since been actually observed with Hubble telescope. It however, unrealistically postulates that the gravitational field exists and produces a curvature in the non-existent spacetime continuum.

The area density of the gravitational lines of force emanating from a massive body, and hence the intensity of its gravitational field, varies inversely as the square of the distance from its center. And the ray of light or gravitation from a distant source passing past the massive body deviates towards the body due to the action of its gravity field on the sharmon aggregate composing the energy quantum of the transmitter boson (photon, graviton). Massive body, in effect, therefore acts as the center of a gravitational convex lens.

However, two massive bodies are joined, one to the other, by the gravitational lines of force, whose area density is maximum around both the bodies and decreases inward away from them to become lowest at the midway point. A beam of light or gravitation passing through the space between them will diverge,

the outer rays bending away from the center towards the two bodies. The two bodies together thus act as a gravitational concave lens with telescopic effect.

A distant source viewed through it will appear nearer, smaller and brighter, enabling to peep deeper into the space. A cluster of galaxies therefore can produce a variety of refracting spaces and act as a combination of gravitational lenses. When the beam of light (or gravitation) passes through the cluster from an object situated behind it, the beam can be bent and focused to produce an image or images of the source. The image may be minified, magnified, distorted, or multiplied, depending upon the nature of the lensing system and the position of the source with respect to the lensing mass bodies.

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