THE ENERGY IN VIRTUE OF THE PRINCIPLE OF COMPENSATION

Russell Bagdoo

mberbag@videotron.ca
rbagdoo@gmail.com

ABSTRACT

The theory of Relation is based on the existence of two structures going in opposite directions and, throughout the cosmological time, on a real conversion of the negative energy of the structure of expansion into the positive energy of the structure of condensation. The negative energy-mass, inversed in virtue of the principle of Compensation, gives the positive energy-mass. The theory explores the situation of the quantum vacuum which contains a minimum energy at the surface of an ocean of negative energy, fueling the ordinary positive matter above. Under the principle of Compensation, the energy fluctuations of the vacuum are spontaneously materialized not only in numerous short-lived virtual particles but also in real particles. There would be a "gravicolored" field, superimposed on the vacuum, which would provide the necessary density of gravitational energy to materialize the virtual state. Two sorts of mass and energy are so connected. The process of this transformation throughout the expansion involves an irreversible arrow of time.

As mentioned before [1], the theory of Relation is based on the existence of two structures going in opposite directions and, throughout the cosmological time, on a real conversion of the negative energy of the structure of expansion into the positive energy of the structure of condensation. According to the theory of Relation, there would have been a beginning in our current universe, but it would represent only the continuation of a previous state. The previous universe at first would have split up during big bang to create our embryonic universe and this process would continue throughout our expansion (which is at the same time the uncompleted process of contraction of the previous universe), whence it follows a continuous creation.

Einstein said that the idea that there are two independent structures of the space, one of gravitational metric, the other one electromagnetic, was intolerable to the mind of the theorist [2]. Its general relativity describes a universe populated with matter, which, by its presence, creates gravity. But this matter becomes a curvature of the space which leaves no room for energy, or electromagnetic field. This seemed equally intolerable. He tried in vain to include matter and electricity in its extended geometrical structure [3].

We admit the existence of two separate structures and consider that our universe is dual. Having concomitantly an expansion and a condensation of the matter obliges us to consider that our universe is constituted of two interpenetrated spacetimes. One is the electromagnetic Maxwell-Lorentz spacetime (linear) and the other one is the gravific Einsteinian spacetime (curved.) The first provides the energy that decreases with cosmological time: it is the dark energy, or the variable cosmological constant [4], of the theory of Relation. It is manifested by a repulsive expansion (slowing down) which would lose density, energy and heat. As cosmological time goes by, this loss would be recovered by an attractive condensation and would give ordinary and dark matters. Both opposite and complementary structures would be incorporated in a four dimensions universe – three of space, one of time. The space, matter (energy-mass), gravity, electromagnetism and other forces would be confined in a three dimensional volume [5].

ENERGY AND PRINCIPLE OF COMPENSATION
POSITIVE MASS AND NEGATIVE MASS

We suppose an EM mass for the negative energy mass (dissipative behaviour) and a gravific mass for the positive ordinary energy-mass (cumulative behaviour); quantum gravity on the side of expansion and classical gravity on the side of condensation. The negative energy-mass inversed ($[\,]^{-1}$), in virtue of the principle of Compensation, gives the positive energy-mass

$$\overrightarrow{-\,[E = mc^2]^{-1}} \quad = \quad \overleftarrow{+\,[E = mc^2]}. \qquad (1)$$

Each member of the equation, like a closed system, depends of the principle of Equivalence. This transformation is linked with Dirac's first version of particle/antiparticle, before W. Heisenberg declares that the antiparticle were not real but virtual [6]. The theory of Relation embodies the energy equation and Dirac's equation calling for positive and negative energy. Both structures are symmetrical with respect to energy, as are the forces of physics. We think that, according to the principle of Compensation, the negative energy-mass with positive (repulsive) forces decreases on the structure of expansion, while the negative (attractive) forces between unlike charges − such as gravitation, the strong nuclear force, and the Coulomb force − increases on the structure of condensation. We can say that the kind of matter in the form of energy acts contrary to the kind of matter in the form of mass. The first, which is kinetic, shrinks with the expansion while the second increases its potential with the condensation, which leads us to postulate that the matter lost by one is recovered by the other. So we have a negative matter and a positive matter.

We write $E = mc^2$. We should write $\pm E = \pm mc^2$. We sometimes write $E = \pm mc^2$ by mathematical trick, without giving any physical reality to negative sign. We have the energy (boson) $E = mc^2$, which is the ordinary matter with the electromagnetic Lorentz spacetime. In this lorentzacian world, matter seems to be missing. On the other hand, we have $E = mc^2$ which is dependent on the electromagnetic matter with the gravific spacetime. In this world of mass/matter, energy seems absent. We can write:

Expansion structure	&	Condensation structure
Negative matter	&	Positive matter
$[E^{-1}]^{-1}$	=	$[E^{+}]$
(negative energy-mass)$^{-1}$	=	(positive energy-mass)
$[E^{-1}]^{-1} = [(m^{-1})(c^2)^{-1}]^{-1}$	=	$[E = mc^2]^{+}$
$[E^{-1}]^{-1} = [(mc^2)^{-1}]^{-1}$	=	$[E = mc^2]^{+}$ (2)
negative infinite $\downarrow$		positive infinite $\uparrow$.

Applied to our present universe:

$$[E^{-1}]^{-1} = [(m^{-1})(c^2)^{-1}]^{-1} \quad = \quad [E = mc^2]^{+}$$

$$[(3.333333 \times 10^{-54}\,\text{kg})(1.11265 \text{ x } 10^{-17})]^{-1} \quad = \quad (3 \times 10^{53}\,\text{kg})\,c^2$$

$$[3.70883353 \times 10^{-71}\,\text{j}]^{-1} \quad = \quad 2.6962655 \times 10^{70}\,\text{j}$$

So the negative energy-mass of the first member of the equation belongs to the structure of the expansion, while the positive energy-mass is connected with the structure of the condensation. Both energy-mass are going in opposite infinite direction and are related by the principle of Compensation: the repulsive EM negative energy-mass is converted during the expansion into the GR positive energy-mass. There is a constant transformation from one kind of matter to another. The term "matter" means the relationship between mass and energy (it is not just mass/matter.) The conversion of mass to energy is a change into a same kind of matter. The conversion of the EM negative energy-mass into the GR positive energy-mass, and conversely, is a mutation from one kind of matter into another [7]

$$[E^{-1}]^{-1} = [(m^{-1})(c^2)^{-1}]^{-1} - x \quad = \quad [E = mc^2] + x \qquad (3)$$

$$[E^{-1}]^{-1} \downarrow \quad = \quad [E^{+}] \uparrow.$$

MECHANISM OF CONVERSION OF ENERGY INTO MATTER

The process of conversion of the electromagnetic negative mass-energy into gravitational positive mass-energy throughout the expansion is accomplished through "commutation rules for field operators." These rules follow the principle of causality, which prevents particle to propagate faster than light in vacuum and which requires that creation of a particle necessarily precedes annihilation. This last constraint necessitates the existence of particles mathematically described as particles running backward in time. But if we accept that the time has same flow for all particles, then those particles that seem to run backward in time are reinterpreted as antiparticles running forward in time [8].

Imagine a particle in the vacuum as an unseen sea of particles with negative energy. This particle would be rather a boson composed of a particle and an antiparticle, and the vacuum would correspond to dark energy [4]. If, traditionally, it is strictly forbidden to leave the liquid, the uncertainty principle of quantum mechanics enables it to borrow easily to the negative "empty" sea (a full tank of negative energy in relation to the classical positive energy above the ocean) an amount of energy for a certain period of time. However, if the boson forms a microscopic "white hole" the size of an elementary particle, the "burst" of energy may be enough for the particle to move a distance greater than the radius of the horizon. The result of the operation is a loss of energy from the sea of the vacuum energy (which is full) by escape of a particle-boson. The particle-boson has not borrowed a "tunnel," it rather actually jumped over the horizon’s infinitely high wall, like a particle which jumps from the fundamental energy level determined by the Pauli exclusion principle to a higher level excited by the uncertainty principle.

The uncertainty principle between time and energy allows understanding why the quantum vacuum is populated. During a very short period of time, *the vacuum energy can fluctuate of a certain amount and under the mass-energy equivalence, materialize in elementary particles*. In 1928, Paul Dirac discovered that every elementary particle has a corresponding antiparticle with the same mass, with "mirror" properties. So, the electron carrying the negative elementary electric charge has an antiparticle, called the positron, which has the same mass but the opposite electric charge. The photon, which has no mass, is its own antiparticle. If a particle and its antiparticle meet, they annihilate and transform their mass into energy. The combination of a particle and its antiparticle represents therefore a certain amount of energy, equal to twice the rest mass, and reciprocally, a certain amount of energy can be virtually regarded as a set of particle/antiparticle pairs. It is for this reason that the quantum vacuum, restlessly agitated by energy fluctuations, can be likened to a "Dirac sea" inhabited by particle/antiparticle pairs which emerge spontaneously from the vacuum and are destroyed immediately after.

It happens all the time in particle accelerators which convert energy into subatomic particles, for example by colliding electrons and positrons. Some of the kinetic energy in the collision goes into creating new particles. It is not possible, however, to collect these newly created particles and assemble them into atoms, molecules and bigger structures that we associate with ordinary "matter." We claim that by virtue of the principle of Compensation the energy of the vacuum is materialized not only in numerous short-lived virtual particles but also in real particles. We shall object that the vacuum is not easily polarizable and that a big density of energy is necessary to succeed in separating the virtual couples of particles and materialize them. Yet this energy would be gravitational. According to the theory of Relation, there would be a "gravicolored" field superimposed on the vacuum. When a virtual particle/antiparticle pair looms up on the vacuum, the particle is deflected in one direction while the antiparticle is deflected in the opposite direction. If the gravicolored field is strong enough, the particles of the pair move apart by such a distance that they become unable to come together again and annihilate each other. The vacuum polarize, virtual particles become real particles.

The gravicolored charge would not have stopped increasing throughout the universal expansion and it is this that ensures a stable conversion of energy into matter. The charge also increases with the distance and explains the Pioneer effect: vacuum induced the gravity while the light of the dark energy vacuum is getting "tired" all along the cosmological spacetime [1].

Rising from the "empty" space, virtual pairs are constantly being created and destroyed. For a brief moment, a particle and its antiparticle separate [9]. There are then four possibilities: (process I) both partners meet again and annihilate; (process II) the antiparticle falls into the Dirac sea and the particle with positive energy materializes in the outside world; (process III) the particle is captured and his partner escapes; (process IV) both partners dive into the Dirac sea. Depending on the state of the ordinary matter we can deduce that the process II is predominant. The quantum space would be polarized by the gravitational energy of the more or less intense gravicolored field prevailing in the vicinity of the Dirac sea. The energy balance would thus be the following one: by capturing preferentially particles, the ordinary matter would gain spontaneously some energy, the mass. For its part, the sea evaporates: the negative energy is more and more converted into gravitational positive energy.

RELATIONSHIP BETWEEN TWO STRUCTURES; TWO SORTS OF MASS AND ENERGY CONNECTED

Even if the two antagonistic structures of the theory of Relation may be disconcerting, they are nevertheless at the image of theoretical physics today which is divided into two fundamentally irreconcilable corpus: quantum on one side, relativistic (i.e. gravitational) on the other. The theory of Relation investigates the quantum "vacuum" which contains a minimum amount of quantum fluctuations. This energy between sea and air establishes a bridge between the two opposite structures.

With general relativity: $t_o c_{EM} = GM^o / c^2 = G^oE / c^4$; with the principle of Equivalence, when M^o decreases, E decreases. With quantum mechanics: $t_o c_{EM} = h / m_\gamma c = hc / E$; with the principle of Equivalence, when m_γ decreases, E decreases. Both theories are incompatible. We have two sorts of masses and two sorts of energies, one being the opposite of the other. We cannot have simultaneously the positive energy E of GE / c^4 which decreases with the negative energy E of hc / E.

In Relation theory, $t_o c_{EM}$, the electromagnetic (EM) wavelength of negative energy, is related to the classic gravity as well as to the quantum gravity:

$$t_o c_{EM} = GM^o / c^2 = h / m_\gamma c; \qquad (m_\gamma c^2 = h\nu;\ m_\gamma cc = h / t;\ tc = h / m_\gamma c)$$

$$GM^o / c^2 = h / m_\gamma c.$$

We have two masses inversely proportional, a classic one, and a quantum one: when one increases the other decreases. hc / G is a constant

$$M^o\ m_\gamma = hc / G. \qquad (4)$$

We consider that the ordinary mass M^o belongs to the matter on the structure of the condensation, while the quantum mass m_γ belongs to the structure of the expansion.

In the current era, if we assume that $M^o = 2 \times 10^{53}$ kg is the mass of our universe, then m_γ will be 1.5×10^{-68} kg (hc / G = 3×10^{-15}.) From the viewpoint of energy, we also have two inversely proportional energies:

$$\underset{E^+}{M^o c^2} \qquad \underset{E^-}{m_\gamma c^2} \quad = \quad hc^5 / G. \qquad (5)$$

With $M^o = 2 \times 10^{53}$ kg, the positive energy will be 1.8×10^{70} j. With $m_\gamma = 1.5 \times 10^{-68}$ kg, the negative energy will be 1.35×10^{-51} j ($hc^5 / G = 2.4 \times 10^{19}$.)

In Planck era, we have $GM^o / c^2 = h / m_\gamma c$; $M^o m_\gamma = hc / G$; the constant hc / G = 2.977×10^{-15} kg. It is the Planck mass. $(hc / G)^{1/2} = 5.45 \times 10^{-8}$ kg for M^o and m_γ, which are two different kinds of mass, one belonging to the positive structure of condensation with ordinary matter and the other belonging to the structure of expansion with the negative energy and quantum matter. Both masses are going in opposite direction. Today $M^o = 5.45 \times 10^{-8}$ kg of the beginning became the mass (2×10^{53} kg) of the present universe, while $m_\gamma = 5.45 \times 10^{-8}$ kg of the beginning became the photon (1.5×10^{-68} kg) of the empty space.

We have two opposite masses and two opposite energies. But they are related and inversely proportional, so when one increases, the other decreases, in virtue of the principle of Compensation of the theory of Relation.

Finally, we will say that this relationship occurs at the intersection of these two structures which are equivalent to the two universes of Paul Dirac of negative and positive energy, or, expressed by the Schrödinger's wave mechanics, equivalent to superimposed states universally present − so called "state vectors" − which also involve two universes: one microscopic and one macroscopic. These paradoxical, disturbing situations, deemed impossible and ridiculous, begin to be solved by the "decoherence" theory which explains how macroscopic objects seem to behave in accordance with the classical physics laws, while the microscopic constituents have a quantum behaviour [10].

THE IRREVERSIBLE COSMOLOGIC TIME AND ENERGY

The process of this transformation throughout the expansion involves an irreversible arrow of time. To speak of a time that flows inexorably from the past to the future means to speak of the problem of the direction of time. Most theories do not distinguish the past from the future, to begin with Newtonian mechanics for whom, to predict the future of a system from its current situation or to go back to the past from the present, the procedure is the same. The relative positions of the particles allow invariance and time symmetry [11]. For its part, special relativity transforms space into time and its "spacetime continuum" is the opposite of a universal time. General relativity, the basis of the "standard" model, introduced the concept of a relationship between spacetime and matter but it is conceived essentially symmetric: the presence of matter determines a curvature of spacetime and this one dictates matter how to move.

When the laws of the physics take into account the flow of time, they ignore its sign; positive or negative time plays the same role. This mathematized time is related to the first law of thermodynamics which concerns the energy conservation. The relativity of things, whether macroscopic or microscopic level, chained to the reversible time reassures physicists since it leads to the symmetry of the equations and to the invariance of the laws. But it creates at the same time an unbearable tension because they cannot deny that at the macroscopic scale nothing seems to escape this temporal asymmetry: time always follows the same trajectory, from the past to the future, a system can only evolve from order to disorder.

How do physicists today conciliate this antagonism? Most continue to ignore or deny the arrow of time. They even oppose the "fundamental" physics laws against the phenomenological descriptions of the other sciences which, them, do not accept that time is only an illusion or a relic of some approximate property of a particular quantum state that have been left over from the big bang. Some consider the irreversibility of the second law of thermodynamics as being an exceptional case of the first principle, since the Newtonian theory of motion and general relativity do not give sense to irreversibility.

How can we then define a unique time that flows across the entire universe? The answer is far from obvious. Nevertheless most of the models that cosmologists build to describe the universe, and in particular the big bang model, invoke such a cosmic time, at least in a operational way, which may help to explain the gigantic production of entropy which marked the birth of our universe [12].

The theory of Relation suggests a cosmological scenario where the "singularity" of the big bang (i.e. the moment when several physical quantities would have become infinite) is replaced by a "big bounce," a contraction phase which suddenly turns into expansion without any physical quantity exceeding the limits dictated by the finite dimensions of the Planck constant. This phase of rebounding becomes an initial instability which makes our universe the product of a breaking symmetry between, on one hand, the disintegration of the space-time-matter of a universe with a negative energy and, on the other hand, the creation of the space-time-matter of a universe with a positive energy. The birth of our matter universe with gravific spacetime is then situated under the sign of the most radical irreversibility, that of the energy loss of the smooth fabric of electromagnetic spacetime engendering both entropy and ordinary matter [11].

COMPLEMENTARY REMARKS

1) Note that the theory of "Relation" has nothing in common with the term "relation" used in the context of loop quantum theory or string theory. It seems that for the latter, time is an illusion. They oppose "relationism," which is merely an artificial device to describe how physical objects are related, to a sort of "substantivalism" in which space and time exist independently of stars, galaxies and their other contents. For the theory of Relation, there is an irreversible universal time, part of a space-time-matter set which follows the arrow of the expansion and there is, in the background, a "duration" – or absolute time – which exists independently of the contents of the matter [13].

2) Einstein's formula $E = Mc^2$ reflects the universal equivalence between mass and energy. Its empirical content is provided by the experience: whenever a body changes mass, it changes the internal energy; every time it changes the total energy, it changes inertia. It contains the structural constant c which is approximately 300 000 km/s, which has the dimensions of a velocity and acquires a physical sense by identifying a speed limit, unsurpassable. Is a coefficient, whose meaning is chronogeometric, which allows users to convert seconds to meters, years (time) in light years (distance.) This is the speed of light, and it seems that light is composed of photons, and propagates with this speed limit.

However, experiments could reveal the existence of particles whose mass is null (in the einsteinian sense of the mass), which would move more or less at the speed limit, meaning that the "speed limit of light" is approximately valid. Furthermore, what is the role of light when we apply the formula in nuclear physics, for example? In this area, mass, thus the energy, is changing by the play of the specific nuclear forces inside the atomic nucleus, forces that have nothing to do with electromagnetic interactions whose light is the agent. In fact, the light is in no way involved in most physical situations where we use the formula $E = Mc^2$. In this formula, c is not the speed of light, and should rather be called "speed limit" or, better, "Einstein constant" [14].

3) The widespread conception today makes of the genesis of the universe a free event. Tryon in 1973 took back a former idea of Jordan and proposed the hypothesis of a genesis of our universe of matter by creation *ex nihilo*, by definition incompatible with the laws of nature. Indeed, the energy in the universe is in two forms: the energy bound with gravity, which is a force of attraction with a negative sign (–1), and the energy bound with the mass by Einstein's formula, $E = mc^2$, with a positive sign (+1.) In total, we could assert that there is no energy difference between our material universe and an empty universe, identified with the universe of Minkowski on which special relativity rests. A null energy balance may also be the result of the sum of two zeros (empty universe: 0 + 0 = 0) than the sum of two equal and opposite signs (matter universe: –1 + 1 = 0.) The universe, concludes Tryon, could be just another expression of nothingness and thus could arise spontaneously from nothingness: its creation by a *free lunch* would not raise any contradiction from the point of view of energy and there would be no price to pay for moving from non-existence to existence. The birth of the universe would be then considered as a spontaneous fluctuation of the vacuum [11].

However, from this point of view, the theory of Relation considers that the zero of the balance indicates a transition between a negative energy and a positive energy, not a null result meaning the nothingness. Like a 0 degree latitude, earthly or heavenly, means moving from one hemisphere to another. In fact, this zero is the essential expression of the beginning of a creative mechanism which converts the entropy generated by the expansion into the formation of massive particles of the structure of condensation, the latter being the material universe with its spacetime curvature. The energy associated to the structure of expansion has a negative sign, while the energy related to the structure of the condensation occurs with a positive sign. In the balance, and off this time not of the physical laws but of mathematics, we would have –1 + 1 = 1 or ± 1, the birth of the universe being then treated as a spontaneous fluctuation of a "full energy," which would be in fact a big bang which connects, in a intrinsic way, the irreversibility of the expansion and the creation of the condensed matter.

4) This "full energy" would be the "engine power" of the structure of the expansion. Now the "engine power" of this negative material system is not preserved. It is the *usable energy* which decreases, which degrades and is transformed into positive material system of the structure of the condensation. Degradation and conservation appear as two aspects of the general law of energy transformations: loss of quality of a system for the benefit of the other one and maintaining quantity. This double law of the transformations of the energy so represents, by its two aspects, applied to both structures, what we call: *the two principles of thermodynamics*. The second principle is precisely the one in question in the structure of the expansion: this is the principle discovered by Carnot, rectified by Clausius, and which, generalized, became the *principle of heat dissipation* or *degradation energy.* According to the principle of Compensation, it could be argued that the form and the waste heat of the expansion structure are compensated by the shape and the work produced by the condensation structure. Roughly mathematized:

Expansion: 1 – 1 = 0. 1 ; 0.9 ; 0.8 ; 0.7 ; 0.6 ; 0.5 ; 0.4 ; 0.3 ; 0.2 ; 0.1 ; 0
Condensation: 0 + 1 = 1. 0 ; 0.1 ; 0.2 ; 0.3 ; 0.4 ; 0.5 ; 0.6 ; 0.7 ; 0.8 ; 0.9 ; 1. Total: 1.

Matter remains and the first principle, the one of the conservation of energy, is intact, because, in virtue of the principle of Compensation, there is finally equivalence of heat and work. For the indicated reasons, it appears that the Compensation principle is complementary to the equivalence principle. Its role is the conservation of energy by an original creative mechanism that converts the dissipated energy of the expansion into condensed matter [15].

5) The arrow of time corresponds to the idea that a system can only evolve from order to disorder, that the time always follows the same trajectory from the past to the future. At the macroscopic scale, nothing seems to escape this temporal asymmetry. The time of the theory of Relation is precisely this time, that of the spacetime expansion. It is not the reversible time of the spacetime of Minkovski – which does not distinguish the past from the future – but as the latter, it contains the concept of spacetime as replacement of the separated classical concepts of space and time. Lengths and durations are dependent of the expansion frame of reference in which they are calculated.

The first mathematization of the physical time consisted in saying that it has only one dimension – a single number is sufficient to determine an instant – and it is continuous. This figuration of time by a straight line drawn from the left to the right leads to assimilate the time to a flow composed of instants infinitely close traveled one after the other. Events are ordered in an irretrievable chronological sequence, from past to the future. This linear field obeys the principle of causality, which in its classic formulation, states that the cause of a phenomenon is necessarily prior to the phenomenon itself.

The disconcerting contradiction between the majority of theories that do not distinguish the past from the future and the principle of causality, essential to physics, has not stopped the physicists to reconcile this antagonism by making vary the principle of causality in various ways: in classical physics, it is expressed by the fact that time is assumed linear with a well-defined direction that does not permit to reach the past by going towards the future; in special relativity, by the impossibility to transmit energy or information at a speed greater than the speed of light, which prohibits the time travels and the reversals of chronology [16, 17].

With its unique dimension, time provides a second topological variant, the circle or the curve, which allows to go backward in time, while obeying the principle of causality. We can also imagine a cyclic time, in which to go towards the future means going back in time, so that what we call the cause could be as well the effect, and *vice versa*. The principle of causality appears to prohibit time travel, because these would in principle allow to retroact in past to modify a sequence of events having already taken place.

The real time is represented as a straight line from left to right, but we can also consider another direction of time, from bottom to top. This is the time said "imaginary" at right angle of real time. As it behaves like space, some new possibilities are opening with its use, one of them is that the quantum spin, which reminds a celestial body in rotation, is associated with the direction of imaginary time. The loss of dark energy throughout the expansion can bring all three spatial directions and the direction of imaginary time to make a loop on them. Dirac particle, whose axis of spin turns 360°, is found embodied in the condensation structure (to recover its initial state it should be rotated 720°.) The non annihilated particles take a direction spatially opposite, curve and their proper time is reversible even if they follow the cosmic course of time. So is made throughout the expansion, by virtue of the principle of Compensation, the process of the conversion of the electromagnetic negative energy-mass in gravitational positive energy-mass [18, 19].

CONCLUSION

Our theoretical physics today is divided into two great irreconcilable physical theories, general relativity and quantum mechanics. When the effects of one are acting, those of the other play no role. At least two exceptions implying both theories were explored: the environment of black holes and the physics of the remotest moments of cosmic evolution. The theory of Relation investigates another situation, that of the quantum "vacuum" which contains a minimum amount of quantum fluctuations above an ocean of energy. According to the theory of Relation, the vacuum is polarized by a gravitational energy associated with a hypothetical gravicolored charge. The latter ensures a stable conversion of energy into matter and would not have stopped increasing throughout the universal expansion. We use the cosmological time determined by the evolution of the universe; this operational "physical time" is automatically connected to the cosmological arrow. We suppose a gravicolored charge to understand the origin of matter and the properties of the energy with the hidden hope of gravity or quantum cosmology, which would operate in a frame where time is defined at the outset.

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