

EINSTEIN MASS-ENERGY RELATION, EVOLUTION OF LIFE AND COSMIC DYNAMICS

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Recent experiments have shown that the mass of a thermodynamic system partially composed of living matter can go increasing with the increasing of the numerical order of material changes happening in physical space. This peculiarity means that space plays an active role into life; it is difficult to explain in the usual conception of thermodynamics, because it occurs even when the system taken under consideration is isolated. By contrast, it seems to be more easily understandable through an extended conception which consists in connecting the classical laws of thermodynamics with the Einstein mass-energy relation. This extended thermodynamic conception can be utilized to provide a coherent interpretation both of the evolution of inert matter and of the evolution of living organisms. The evolution of inert matter towards higher entropy and the evolution of living organisms towards smaller entropy can be seen as parts of a one universal process.

Keywords: a-temporal physical space, frequencies of vibration, entropy, evolution, life.

1. INTRODUCTION

On the basis of elementary perception there is no experimental evidence about the movement of material objects in time. One can say that time exists only as a stream of irreversible changes of matter in an a-temporal physical space. This is a different point of view from that conventionally adopted in physics, but perhaps is more correct and appropriate because it is more coherent with experimental facts (Sorli A. and Sorli I, 2004a). According to an a-temporal view of general relativity, gravity is transmitted by the density of the four-dimensional a-temporal space and its effect is to produce modifications in the geometry of the a-temporal space. This new interpretation of general relativity, which can be defined also a-temporal gravitation theory, implies that matter makes physical space dense and that material particles move in the direction where the density of physical space is increasing.

The a-temporal view suggests that universe as a whole can be considered an a-temporal phenomenon with no beginning and no end: universe is a system in dynamic equilibrium that recreates itself. The increase of the entropy of matter is only temporary; it is renewed through the cyclic transformation “matter-space-matter-space...” happening in the active galactic nuclei (AGN-s) (Sorli and Fiscaletti, 2005).

Loop quantum gravity introduces the idea that at the most fundamental level, namely at the Planck scale, space is not indefinitely divisible: this theory suggests that the elementary grains of space are nodes of spin networks and that their volume is given by a quantum number that is

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associated with the node in units of the elementary Planck volume, $V = (\hbar G/c^3)^{3/2}$, where \hbar is Planck's reduced constant, G is the gravitational constant and c is the speed of light (Rovelli, 2003). On the ground of this theoretical result, one can assume that the fundamental constituents of universe are quanta of space (QS) having the size of Planck length.

According to the model presented here, QS as "elementary packets" of energy have not been created and can not be destroyed (on the ground of the first law of thermodynamics). QS are a-temporal in the sense that for their existence no change (travel) of particles in a-temporal physical space (ATPS) is needed (Sorli A. and Sorli I., 2005a).

QS constituting ATPS and QS composing matter vibrate with different frequencies and are endowed with different states of entropy. QS constituting ATPS vibrate at the "basic frequency" $0.19 \cdot 10^{44} s^{-1}$, have a "basic energy" given by $1.26 \cdot 10^{10} J$, and change their electrical charge from positive to negative in a Planck time ($5.39 \cdot 10^{-44} s$). QS which build up ATPS have no entropy, their potential energy is constant. For these reasons, QS of ATPS are not perceivable to our senses (Fiscaletti and Sorli, 2005/2006).

Instead, QS composing subatomic particles vibrate at appropriate frequencies (lower than the basic one) and are endowed with entropy. Finally, QS composing electromagnetic waves vibrate at the frequencies of the electromagnetic spectrum, and are endowed with entropy too.

The a-temporal model of the universe developed by our group suggests that the wavefunction ψ of the generic quantum of space composing physical universe satisfies the following general equation:

$$(\nu - \nu_{em}) \cdot (\nu - \nu_{ma}) \left(R_{\mu\eta} - \frac{1}{2} g_{\mu\eta} R \right) \psi + |\nu - \nu_p| \left(\bar{\nabla}^2 - \frac{1}{c^2} \frac{\partial^2}{\partial \mu_4^2} - \frac{|\nu - \nu_{em}| l_p^2 m^2}{\hbar^2} \right) \psi = 0 \quad [1]$$

or even better the equivalent equation

$$(\nu - \nu_{em}) \cdot (\nu - \nu_{ma}) \left(R_{\mu\eta} - \frac{1}{2} g_{\mu\eta} R \right) \psi + |\nu - \nu_p| \left(\bar{\nabla}^2 - \frac{1}{c^2} \frac{\partial^2}{\partial \mu_4^2} - \frac{|\nu - \nu_{em}| l_p^2}{c^2} \frac{\delta Q}{\delta \psi} \right) \psi = 0 \quad [2]$$

where ν is the frequency of vibration of the quantum, ν_{em} is a frequency of the electromagnetic spectrum, ν_{ma} is a frequency of a subatomic particle, ν_p is the "basic frequency", l_p is Planck length,

$\left(R_{\mu\eta} - \frac{1}{2} g_{\mu\eta} R \right)$ is Einstein's gravitational tensor, m is the (eventual) mass of the quantum, c is the

speed of light, and Q is the quantum potential. From equs. [1] - [2] it follows that it is the frequency of vibration that determines the peculiar features of the quantum of space. In fact, we have a quantum of space composing ATPS and satisfying thus equation $\left(R_{\mu\eta} - \frac{1}{2} g_{\mu\eta} R \right) \psi = 0$ if $\nu = \nu_p$; we have a

material quantum, satisfying equation $\left(\bar{\nabla}^2 - \frac{1}{c^2} \frac{\partial^2}{\partial \mu_4^2} - \frac{|\nu_{ma} - \nu_{em}| l_p^2}{c^2} \frac{\delta Q}{\delta \psi} \right) \psi = 0$, if $\nu = \nu_{ma}$; and we have a

quantum of space composing electromagnetic waves, which satisfies equation $\left(\bar{\nabla}^2 - \frac{1}{c^2} \frac{\partial^2}{\partial \mu_4^2} \right) \psi = 0$,

in the case $\nu = \nu_{em}$. Therefore, one can say that the fundamental physical entity which determines the change in the value of the energy (and which can determine, eventually, also the change in the entropy) of a quantum of space is its frequency of vibration. According to equ. [1] - [2], the frequency of vibration of QS is the "driving force" which determines the features of the objects present in the universe (Fiscaletti and Sorli, 2007a).

In the universe one can observe only the increase of the entropy of inorganic matter, there is no evidence of increasing of the entropy of ATPS. ATPS is a non-entropy state of energy, inorganic

matter is an entropy-state of energy. “Alive matter” is a negentropic state of energy. The process of evolution can be seen as a continuous stream of material change where organization of organic molecular systems increases towards the non-entropy state of ATPS.

2. EXPERIMENTAL RESULTS ABOUT LIVING SYSTEMS

According to some recent research the difference between inert matter and living organisms lies in the fact that, while as regards inert matter the evolution goes towards a decrease of mass, an increase of internal energy and an increase of entropy, instead as regards living systems the growing phase is characterized by an increase of mass, an increase of internal energy and a decrease of entropy.

Several experiments suggest that functioning of living organisms is related to the gravitational field and thus to the universal space. In particular, experiments carried out by Amrit Sorli at the university of Lubiana in 1987-1988 with Californian earthworms show that gravity works on a living organism stronger than on the same dead organism. The weight of the living organism is bigger than the weight of the same dead organism. This means just that there is an active relation between life and gravitational force of physical space. Gravitation works stronger on the living neurones than on the same dead neurones (Sorli, 2001).

Let us recall briefly the description of some of these experiments. A first type of experiment has been performed in June 1987 using six test-tubes filled with three milliliters of a water solution composed by meat and sugar. Four test-tubes were used and a fungus was put into two of the test-tubes. All the test-tubes were welded airtight. The weight difference of between test-tubes was measured for ten days. After three days of growth, the mass of test-tubes with the fungus increased on average 34 microorganism while in the following seven days remained unchanged.

In another experiment, two test-tubes were filled with 5 grams of Californian worms with distilled water. All the test-tubes were then welded airtight. The result of this experiment was that for the first three hours there was an increase of mass of 4.5 micrograms on average, while the mass remained stable for the next two hours. This experiment was repeated from August to September 1988 and gave always identical results. Moreover, it is important to underline that Kaoru Kawada in 1998 obtained similar results in Japan using rats as living organisms.

Analyzing the thermodynamic context of all these experiments, the first consideration one can make is that here we have always an isolated system inside which there are initially a determined mass of living matter (for example, worms) and a determined mass of inert matter; the result is that the mass of the whole system always tends to increase during a first time interval and remains constant in a second time interval.

The fact that during the first step we have an increase of the mass of an isolated system cannot be explained in the standard interpretation of the thermodynamic theory: the increase of mass of an isolated system partially composed by living matter is not possible inside the standard interpretation of the thermodynamic theory because the mass of an isolated system should be always constant.

On the ground of these experimental results we can write the following relation between the mass of a living system and the mass of the same dead system:

$$m_{\text{living}} = m_{\text{dead}} + dm \quad [3]$$

where dm is a positive quantity. As a consequence, we can say that a living system has got a bigger free internal energy than the same dead system, according to the formula

$$m_{\text{living}}c^2 = (m_{\text{dead}} + dm)c^2. \quad [4]$$

The difference in the mass, and thus in the internal energy, between a living system and the same dead system can be interpreted as an “additional density” of physical space in a living organism (living matter). It seems that physical space plays an active role into evolution of life.

3. A-TEMPORAL GRAVITATION AND ITS ROLE IN THE EVOLUTION OF LIVING SYSTEMS

According to a-temporal gravitation theory, gravitational interaction is carried directly by the density of ATPS and is a-temporal (in the sense that no particle or wave is needed for its acting). The density of space in a given volume of space situated at distance r from the centre of a material object depends on the amount of matter into it, precisely is given by the formula

$$D = \frac{mG}{r^2} \quad [5]$$

where G is the gravitational constant and m is the mass of the object. Now, if according to experimental results the mass of a living system is bigger than the mass of the same dead system, on the basis of equation [5] also the density of physical space is bigger in the region occupied by a living system than in a region occupied by the same dead system. The additional density of physical space in the region occupied by a living system (with respect to the same region occupied by the same dead system) is given by the relation:

$$dD = D_{\text{living}} - D_{\text{dead}} = \frac{(m_{\text{living}} - m_{\text{dead}}) \cdot G}{r^2}. \quad [6]$$

One can say that it is as a consequence of this additional density that a living system has a bigger mass and a bigger internal energy than the correspondent dead system.

Let us draw now some considerations as regards entropy. In the a-temporal view, universe is a system in dynamic equilibrium that recreates itself through the cyclic transformation “matter-space-matter-space...” happening in AGN-s. The AGN-s are the renewing points of the universe, have the role to keep the universe young, in the sense that renew old matter with high entropy with new matter with low entropy. As a consequence, the total entropy of the universe tends to zero with the increase of material changes happening in physical space. This means that the sum of the entropy of matter, of the entropy of space and of the entropy of living organisms is equal to zero:

$$S_{\text{matter}} + S_{\text{space}} + S_{\text{living}} = 0. \quad [7]$$

Taking the differential of this relation, we obtain that the sum of the variations of the entropy of space and of the entropy of living systems is equal and opposite to the variation of the entropy of matter:

$$\Delta S_{\text{space}} + \Delta S_{\text{living}} = -\Delta S_{\text{matter}}. \quad [8]$$

Therefore, taking into account that space is the non-entropy state of energy (i.e. its total entropy is constant and equal to zero: $S_{\text{space}} = 0$) and that the entropy of inert matter tends to grow on the basis of the second law of thermodynamics (namely $\Delta S_{\text{matter}} > 0$), it derives the following result:

$$\Delta S_{\text{living}} = -\Delta S_{\text{matter}} < 0, \quad [9]$$

the entropy of living systems tends to decrease with the stream of material changes happening in a-temporal physical space and this diminution is of the same entity of the increase of the entropy of matter.

The decrease of entropy of living systems is tied to gravity, to the fact that in living systems the density of physical space is bigger than in the same dead systems. If the entropy of living organisms tends to decrease and physical space has no entropy, evolution of life can be seen as a continuous negentropic process which develops towards the non-entropy state of physical space.

The evolution of living systems can be expressed and studied also taking into consideration that at the deepest level, all universe is composed by elementary packets of energy, called quanta of space (QS), having the size of Planck length and endowed with different vibrations (and, as a consequence, of different "states" of energy). Living organisms, according to our research, are composed by QS which tend to develop and evolve towards the non-entropy state of ATPS (with the increase of the stream of material changes happening in cosmic space). This means that the mean frequency of vibration of the QS composing a living system is bigger (and thus closer to the basic frequency of ATPS) than the mean frequency of the QS composing the same dead organism.

In fact, if we indicate with N the total number of the QS composing a given living system (or the space occupied by the same dead system), we can write the following two relations as regards the frequency and the internal energy in a living system and in the same dead system. As far as the living system is concerned we will have

$$m_{\text{living}}c^2 = Nh\nu_{\text{living}}, \quad [10]$$

where h is Planck constant, and thus the mean frequency of vibration of the QS composing the living system will be:

$$\nu_{\text{living}} = \frac{m_{\text{living}}c^2}{Nh}. \quad [11]$$

As regards the same dead organism, we will have:

$$m_{\text{dead}}c^2 = Nh\nu_{\text{dead}} \quad [12]$$

and thus the QS composing it will vibrate at the mean frequency

$$\nu_{\text{dead}} = \frac{m_{\text{dead}}c^2}{Nh}. \quad [13]$$

It derives therefore the following relation between ν_{living} and ν_{dead} :

$$\nu_{\text{living}} - \nu_{\text{dead}} = \frac{(m_{\text{living}} - m_{\text{dead}})c^2}{Nh}, \quad [14]$$

i.e. taking into account equation [3]:

$$\nu_{\text{living}} - \nu_{\text{dead}} = \frac{dmc^2}{Nh}, \quad [15]$$

where dm is a positive quantity. Equation [15] shows just that the mean frequency of vibration of the QS composing a living system is bigger (and thus closer to the basic frequency of ATPS) than the mean frequency of the same QS composing the same dead organism. This result implies that the evolution of living organisms goes just towards an increase of the mean frequency of the QS composing them. The results of our research seem to imply that, in a certain sense, for the human being there is no choice: his evolution is determined by ATPS and, in particular, goes towards the basic frequency of ATPS.

4. THE EXTENDED THERMODYNAMIC CONCEPTION AND THE ENTROPY OF LIVING SYSTEMS

We know that one of the fundamental postulates of thermodynamics lies on the idea that the mass and the energy of an isolated system cannot change with time. On this basis, any process occurring within an isolated system is interpreted as an increase in entropy, while the energy and mass of the system remain constant.

In order to point out that this classical conception is not totally convincing, let us imagine an isolated system consisting of two parts separated by a mobile piston. We suppose that part 1 contains a gas whose initial pressure is P_1 and part 2 also contains a gas, so that its initial pressure is a positive number P_2 . If the piston, which is supposed initially locked, is liberated, we know that there is an exchange of volume between part 1 and part 2 and thus a change of work for the whole system. Knowing that the exchange of volume between part 1 and part 2 implies the condition $dV_2 = -dV_1$, the change in work for the whole system is $dW_{\text{sys}} = (P_1 - P_2)dV_1$ [16]. It can be noted that the term dW_{sys} is always positive, since the condition $P_1 > P_2$ leads to a positive value for dV_1 , and the condition $P_1 < P_2$ to a negative value for dV_1 .

Since the whole system taken into consideration has been supposed isolated, if we admit the classical conception of thermodynamics, we have to write $dU_{\text{sys}} = 0$, where U_{sys} represents the internal energy of the system which has been defined as isolated. As a consequence, equation

$$dU = dQ + dW, \quad [17]$$

which expresses the first law of thermodynamics takes the following form:

$$0 = dQ_{\text{sys}} + \text{a positive term.} \quad [18]$$

The problem is that this expression implies a negative value for dQ_{sys} , a condition which means that this system would loss heat and thus would not be isolated. The situation is evidently the same for the expansion of a gas in vacuum, which corresponds to the particular case where $P_2 = 0$ in equation [16]. Therefore, something is not satisfactory in the usual conception of the thermodynamic theory.

At first glance such a conclusion seems unthinkable, knowing that the efficiency of the thermodynamic tool has been verified for a long time. As the reader will see now, this efficiency is not at all contested by the new conception illustrated in this chapter. The suggested revision deals with an extension of the theory which consists in connecting the Einstein mass-energy relation to the laws of thermodynamics.

The difficulty encountered above can be eliminated if we admit that a system defined as isolated (yet being the seat of internal exchanges of energy) does not obey the condition $dU_{\text{sys}} = 0$, but the condition $dU_{\text{sys}} > 0$. Introducing the idea that an energy can be created inside a system, this conception needs that, in the general case of a non isolated system, we do not use the same symbol dU whether we refer to the energy created (or eventually destroyed) inside the system and the energy that the system exchanges with its surroundings.

Several choices are possible. In particular, Tane suggested in some papers (Tane, 2000; Tane, 2001; Tane, 2002, Tane, 2003, Krasnoholovets and Tane, 2006) that it is possible to give to the basic equation of thermodynamics the form

$$dU^* = dU_{\text{ext}} + dU_{\text{int}}. \quad [19]$$

This expression means that, for a thermodynamic system, the total change in energy (labelled dU^*) is the sum of the energy exchanged with the surroundings (external energy labelled dU_{ext}) and of the energy created inside the system (internal energy labelled dU_{int}).

As regards equation [19], for a rapid and synthetic view of the topic, the important points to underline are the following:

1) In the usual conception of thermodynamics, the term dU_{int} (which has the dimension of an energy) is not taken into account. It is substituted by the term dS_i (which has the dimension of an entropy). As it can be seen through equation

$$dS=dQ/T_e+dS_i, \quad [20]$$

a change in entropy is nothing but a change in energy per unit of temperature. The basic information, implicitly present in this equation, is that a change in entropy is necessarily associated to a change in energy. In a similar way, equation [16] means that a change in volume is a change in energy referred per unit of pressure.

2) When the laws of thermodynamics have been stated in the XIXth century, it was quite impossible for their authors to introduce in their reasoning the idea that an energy could be created within a system. The main principles governing this field of physics at that time were the law of conservation of energy and the similar - but totally independent - law of conservation of mass.

3) The situation is different now since, in the meantime, the possibility has been revealed by Einstein that, within a system, an increase in energy can be generated by a decrease in mass and conversely. The law of conservation is maintained, but its signification is extended.

It is evidently the argument evoked here (and in the references of Tane already quoted) to explain the origin of the energy represented by the term dU_{int} in equation [19]. Remembering that the Einstein relation is $E=mc^2$, its differential form is $dE=c^2dm$, which can be better written, for inert matter, as $dE=-c^2dm$, to transcript the fact that an increase in energy is correlated to a decrease in mass and conversely.

Adding this data to that already given leads to the idea that equation [19] has the more precise signification

$$dU^*=dU_{ext}-c^2dm. \quad [21]$$

4) In conventional thermodynamics, since the energy dU_{ext} is not taken into account, a confusion is made between the energies dU^* and dU_{ext} which are designated under a same symbol, generally denoted dU . This is certainly the reason of the conceptual difficulties often encountered in learning (and teaching) thermodynamics, difficulties which disappear in the extended theory originally proposed by Tane and summarized here. We have to be careful with the fact that the term usually written dU , and classically called the "change in internal energy", corresponds to the term dU_{ext} of equation [19], not to the term dU_{int} whose existence is not recognized. This is the reason why the designation dU_{int} is sometimes substituted by dU_{add} (additional energy) in some of the papers of Tane referenced.

5) The concepts of reversibility and irreversibility, which are known to play a great role in thermodynamics are closely related to equations [19] and [20]. The correspondence lies in the fact that these equations can also be written in the equivalent form

$$dU_{irr}=dU_{rev}+dU_{int} \quad [22]$$

that is

$$dU_{irr}=dU_{rev}-c^2dm. \quad [23]$$

6) We have briefly seen above why dU_{int} can be assimilated to $-c^2dm$. The reason why dU_{ext} is equivalent to dU_{rev} can be explained as follows.

Concerning a work exchange, the general relation is equation

$$dW=-P_e dV \quad [24]$$

in conditions of irreversibility (i.e. when the external pressure P_e is different from the internal pressure P_i) while becomes

$$dW=-P_i dV \quad [25]$$

in conditions of reversibility (i.e. when $P_e=P_i$). Thus we have

$$dW_{\text{irr}} = -P_e dV \quad [26]$$

and

$$dW_{\text{rev}} = -P_i dV. \quad [27]$$

Since P_e can always be written $P_e = P_i - P_i + P_e$, equation [16] can be given the form

$$dW = -P_i dV + (P_i - P_e) dV \quad [28]$$

whose meaning is therefore

$$dW_{\text{irr}} = dW_{\text{rev}} - c^2 dm. \quad [29]$$

Concerning a heat exchange, the situation is similar. In the classical conception, the general equation governing this kind of process is presented under the form $dS = dQ/T_e + dS_i$ [20]. All the terms of this relation have the dimension of an entropy, but we have already noted that a change in entropy is necessarily linked to a correlative change in energy. This is equivalent to say that the extended expression of equation [20] is

$$T_e dS = dQ + T_e dS_i \quad [30]$$

whose precise meaning is

$$dQ^* = dQ_{\text{ext}} + dQ_{\text{int}} \quad [31]$$

that is:

$$dQ_{\text{irr}} = dQ_{\text{rev}} - c^2 dm \quad [32]$$

namely

$$T_e dS = dQ_{\text{rev}} - c^2 dm. \quad [33]$$

In conventional thermodynamics, since the term dQ_{int} is not recognized, the terms dQ^* (whose precise meaning is dQ_{irr}) and dQ_{ext} (whose precise meaning is dQ_{rev}) are considered as representing the same energetic quantity, denoted dQ . For example, when we read in a thermodynamic table that the heat capacity of one mole of liquid water is 75,19 J, this value is usually considered as representing indifferently dQ_{irr} or dQ_{rev} . Indeed, it represents dQ_{rev} which is not equivalent to dQ_{irr} (even when the process is done at constant pressure or at constant volume).

Now, it is important to underline that equation $T_e dS = dQ_{\text{rev}} - c^2 dm$ [33] can be utilized in order to describe the evolution both of inert matter and of living systems (in the case of living systems some supplementary conditions must be added in order to take into account the results obtained in chapter 3). More precisely, according to the extended thermodynamic conception, the evolution of inert matter can be described by the equation

$$T_e dS_{\text{matter}} = dQ_{\text{matter}}^{\text{ext}} - c^2 dm_{\text{matter}} \quad [34]$$

or better, for a unit of temperature, by the equivalent equation

$$dS_{\text{matter}} = dQ_{\text{matter}}^{\text{ext}} - c^2 dm_{\text{matter}}. \quad [35]$$

As regards inert matter the mass tends to decrease, dm is negative: as a consequence, equation [35] implies that the entropy of inert matter tends to increase.

In analogous way, the evolution of living systems can be described by equation

$$dS_{\text{living}} = dQ_{\text{living}}^{\text{ext}} - c^2 dm_{\text{living}}. \quad [36]$$

In this equation dm is a positive quantity and thus the entropy of living systems tends to decrease. The internal energy of living systems is bigger than the internal energy of the same dead system according to the formula $m_{\text{living}}c^2 = (m_{\text{dead}} + dm)c^2$ [4] and this implies thus that, on the basis of equation [36], the entropy of a living system is lower than the entropy of the same dead system. Moreover, as regards equation [36] some further considerations are needed. In fact, as we have seen in chapter 3, the variation of the entropy of living matter is equal and opposite to the variation of the entropy of the inert matter namely

$$dS_{\text{living}} = -dQ_{\text{matter}}^{\text{ext}} + c^2 dm_{\text{matter}}. \quad [37]$$

Therefore, substituting equation [37] into equation [36] we obtain the following relation

$$dQ_{\text{living}}^{\text{ext}} - c^2 dm_{\text{living}} = -dQ_{\text{matter}}^{\text{ext}} + c^2 dm_{\text{matter}} \quad [38]$$

namely

$$dQ_{\text{living}}^{\text{ext}} + dQ_{\text{matter}}^{\text{ext}} = c^2 dm_{\text{living}} + c^2 dm_{\text{matter}} \quad [39]$$

and thus

$$dQ_{\text{total}} = c^2 dm_{\text{total}}. \quad [40]$$

Moreover, in order to obtain coherence between the extended thermodynamic conception applied to living systems and the results of a-temporal gravitation theory, another important implication derives. In fact, the condition $dS_{\text{living}} < 0$ implies that for a living system it must be

$$dQ_{\text{living}}^{\text{ext}} < c^2 dm_{\text{living}}, \quad [41]$$

namely a living system gives a heat quantity that is lower than the internal energy it acquires because of the additional density of the region of physical space that it occupies.

We can conclude that the extended thermodynamic conception applied to the living systems (and synthesized in equation [36]) can be considered compatible with the experimental results concerning the difference of mass between a living system and the same dead system, if it is accompanied by two supplementary conditions, that is to say relations [39] and [41].

5. BASIC FREQUENCY OF ATPS AND CONSCIOUSNESS

Basic frequency of QS constituting ATPS is here considered as consciousness. This view of consciousness is compatible with the research done by Penrose and Hameroff. In fact, even it sees consciousness as a non local phenomenon that is not only the result of the processes of the brain. Their research suggests that the force of quantum gravity acting on the mass of neurones within the brain may be responsible for the emergence of consciousness. The process is fundamentally related to the influence of quantum gravity on microtubule networks within the neurones (Penrose, 1994; Hameroff, 1994). As we have underlined in chapter 2, there are several experiments which suggest

that functioning of living organisms is related to the gravitational field and thus to the universal space, that gravitation works stronger on the living neurones than on the same dead neurones (Sorli, 2001).

When human brain enters in “tune” with the “basic frequency” of ATPS one enters into “conscious experience” of the world. One experiences time and space directly, without elaboration of the mind (Sorli A. and Sorli I, 2005b).

Man’s “tuning” with consciousness is a part of cosmic dynamics. We have to develop beyond all the mind identifications that are the source of religious, racial and political tensions. Discovery of consciousness is a “natural protection” against destruction. A man that is in tune with consciousness can only create things that support life and development of human race.

6. EVOLUTION OF LIFE, ENTROPY AND BASIC FREQUENCY OF ATPS

As regards the understanding of the nature of evolution, the most popular idea is that there exists an “upward” tendency in evolution, i.e. from simplicity to complexity (Allegrini, Giuntoli, Grigolini and West, 2004). It seems that there are two main trends in evolution: one is thermodynamic concerning matter, evolving downwards, i.e. towards higher entropy, and one concerns life and consciousness, evolving upwards, i.e. towards higher organization. About this second trend in the evolution, Grandpierre has showed that the increase of the organizational state, and therefore the consequent decrease of entropy, of the living organisms, is determined by the biological electromagnetic radiation, by biological photons. He computed the entropy content of the human being tied to *in vivo* radiation, showing that it is larger than the standard physical entropy of the materials of the living organism (Grandpierre, 2004). In this chapter, on the basis of the conception of the self-renewing universe, we propose the idea that these two main trends of the evolution can be considered parts of a one universal process.

In the self-renewing universe, evolution of life can be considered as a consistent part of cosmic evolution, as a continuation of the evolution of the universe. From this point of view, evolution on the planet Earth is a part of a wider universal process. All over the universe, life is developing towards the conscious species. In all the areas that have similar physical circumstances to the Earth, the development of life and its consequent evolution towards the conscious species can happen. Evolution of life can be understood as a process that is continuously developing towards a total entropy that tends to zero.

In the whole observable space there have been discovered the basic organic molecules necessary for the development of life (Mason, 1991). Besides, astronomical observations show that the whole observable space is permanently in a phase of chemical evolution. This means that biological evolution and chemical evolution are in a certain sense parallel processes. In other words, one can say that chemical evolution is the beginning of the negentropic process of biological evolution: the formation of cellules, pluricellular beings and living organisms happens together with the process of the chemical evolution.

Because of the cyclic transformation “space-matter-space...” which takes place in the AGN-s, each arbitrary region of the universe has got an entropy that tends to zero with the increase of the stream of material changes happening in ATPS. For this reason, it is possible to introduce a new formula for the entropy of the generic region of the universe (which goes to substitute the Boltzmann formula of classical physics); this new formula will allow us to explain and reproduce both the increase of entropy concerning matter and the decrease of entropy concerning the evolution of living organisms. Self-renewing universe with a total entropy that tends to zero suggests that the relationship between the entropy S of a generic region composing physical universe and the stream of material changes μ_4 happening in ATPS can be expressed through the following formula

$$S = (K \ln P) \mu_4 v_p \exp\left(-\frac{\mu_4}{A}\right) \quad [42]$$

(where $\mu_4=0$ is conventionally chosen in correspondence to the beginning of the transformation, in AGN-s, of physical space into matter, i.e. after fresh gas begins to come out of AGN-s). In this

equation K is Boltzmann constant, P is a parameter which indicates the disorder degree existing in the positions and motions of the material particles present in the region (and practically depends on the number of these particles), V_p is the basic frequency and A is a parameter strictly related to the maximum value that entropy can reach in the region during the evolution.

Equation [42] is similar to the Boltzmann equation with the adding multiplicative term $\mu_4 \exp\left(-\frac{\mu_4}{A}\right)$ (related to the stream of material changes happening in ATPS). Equation [42] allows

us to explain and reproduce the increase of entropy of matter after fresh gas begins to come out of AGN-s (i.e. during the evolution of the universe corresponding to the formation of nuclei, atoms, stars and planets); at the same time, it allows us to explain and reproduce the decrease of entropy concerning the evolution of life and conscious species in the regions of the universe which have similar physical circumstances to the earth. In other words, formula [42] shows that the two main tendencies – above cited - that one can single out in the universe can be, in a certain sense, “unified” into a one universal process: here chemical evolution and biological evolution (characterized by a decrease of entropy) are a direct continuation of the “physical” evolution, i.e. of the processes of formation of nuclei, atoms, stars and planets (characterized by an increase of entropy).

It is also important to underline the role of the parameter A , and thus the importance of the maximum value that entropy can reach in the region of ATPS into examination during the evolution. Grandpierre has showed recently that in the universe the entropy increase generates further possibilities that are favourable for biological organization, that it can enhance biological organization (Grandpierre, 2005). This implies that the entropy increase, and the consequent maximum value that entropy can reach in a certain region, play an important role in order to have a significant biological evolution in that region. One can therefore suggest that a significant biological evolution can happen (and can be characterized by all the phases until the development of life and of human being) only if entropy can reach a certain threshold value, and this will be just the maximum value that the entropy (of matter) can reach in the regions of the universe which have similar physical circumstances to the Earth. It is therefore legitimate to think that when the stream of material changes happening in a given region of ATPS can reach the value represented by the parameter A , in that region biological evolution and development of life can happen.

Grandpierre has pointed out that entropy is intimately connected with a reality much more comprehensive than the realm of material processes: namely, with the reality of the individual possibilities (Grandpierre, 2005). But – we suggest – the possibilities which can occur in a certain region of universal space depend on the material changes happening in that region. In fact, according to our view, the biological evolution can take place in a given region of ATPS only if the material changes in that region reach the value A . In this way, it seems legitimate and formally elegant to express the entropy of a given region of ATPS in terms of the stream of material changes happening in that region.

Moreover, in the a-temporal view universe is composed by QS having the size of Planck length and endowed with different frequencies of vibrations. Therefore, one can say that an appropriate value of the frequency of vibration V of the generic quantum of space corresponds to each value of μ_4 (i.e. of the numerical order of material changes happening in ATPS). In this regard, as the change in the entropy of a given region is strictly related to the change in the frequency of the QS composing it, one can assume that the relationship between the frequency of the generic quantum of space and the stream of changes happening in ATPS have a similar behaviour to that of the entropy [42], i.e. that the term $\mu_4 \exp\left(-\frac{\mu_4}{A}\right)$ must be present also in the expression of the frequency of the generic quantum of

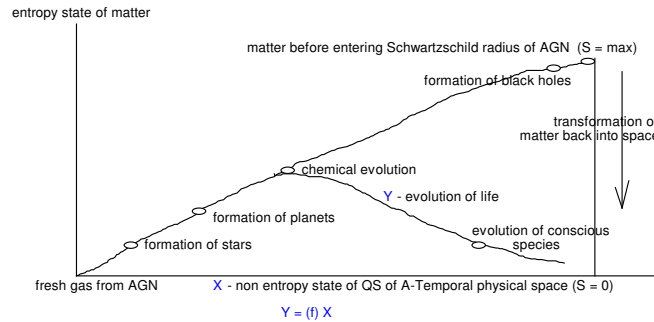
space. In particular, taking into account that for $\mu_4=0$ (situation in which it begins the transformation, in AGN-s, of ATPS into matter) the QS vibrate at the “basic frequency”, that successively it happens the cyclic transformation “space-matter-space-matter...” in AGN-s, and that therefore the universe is a self-renewing system with a total entropy that tends to zero, one can suggest the following relationship between the stream of material changes μ_4 happening in ATPS and the frequency of vibration V of the generic quantum of space:

$$v = v_p - \mu_4 B^2 \exp\left(-\frac{\mu_4}{A}\right) \quad [43]$$

where B is a particular frequency linked to the maximum value A that entropy can reach during the evolution. As regards the relation between A and B further research will give you more information.

On the ground of equations [42] and [43], one can now draw the following important results as regards the evolution.

In the centre of AGN-s, when density of quanta of ATPS in the area inside the Schwarzschild radius is at its maximum, energy of physical space begins to transform into energy of material particles ($\mu_4 = 0$). In this initial situation, the entropy of the generic region of the universe is equal to zero (which is its minimum value) while the frequency of QS is equal to the basic frequency v_p . It must be underlined that the frequency of vibration of the QS constituting ATPS (i.e. the “basic frequency” v_p) is the maximum frequency existing in nature, and that “basic frequency” means zero entropy. Then, for $\mu_4 > 0$ QS begin to change their state from non entropic to entropic (and therefore the frequencies of vibration from the value of the “basic frequency” become equal to appropriate values characteristic of subatomic particles). The first particles to form in ATPS are quarks and leptons (i.e. particles composed by one quantum of space). Therefore, in this first phase of evolution strong interaction among quarks is the prevalent ambient situation: as a consequence, we have certain appropriate frequencies of vibration of QS (characteristic of quarks) that give origin to the formation of nuclei. With the formation of nuclei, as in ATPS there are nuclei and electrons, ATPS assumes the special state represented by the electromagnetic field (in particular, the coulombian potential) acting between nuclei and electrons and this peculiar interaction gives origin to atoms. With the formation of many atoms, ATPS tends to assume the special state represented by the Van Der Waals interactions acting between atoms and this leads to the formation of molecules. In other words, with the presence of many atoms, a-temporal physical universe enters the phase of chemical evolution which leads to the formation of more and more complex chemical aggregates.



As underlined before, chemical evolution is the beginning of the negentropic process of biological evolution: with the process of chemical evolution we have also the formation, in the whole observable space, of the basic organic molecules necessary for the development of life.

According to the model proposed here, one can say that organic molecules that are needed for the development of life are permanently generated in the whole observable space because of the “basic frequency” of QS that build up ATPS. “Basic frequency” of QS of ATPS is a physical environment for chemical evolution (it “generates” formation of organic molecules) that on the earth and the planets similar to the earth develops into life. Evolution of life is a continuous negentropic process and it can be described as a “function” $Y=f(X)$ determined by the “basic frequency” of QS.

During the processes of formation of subatomic particles, nuclei, atoms, molecules, stars and planets (i.e. until the beginning of chemical evolution), on the ground of equation [42] the entropy of

the generic region of the universe increases and reaches its maximum $S_{\max} = (K \ln P) \frac{AV_p}{e}$ for $\mu_4 = A$, which is just the numerical order of changes corresponding to the beginning of chemical evolution (situation in which the amount of matter is at its maximum, in other words is in equilibrium with the density of physical space existing inside AGN-s). At the same time, in virtue of equation [43] the frequency of vibration V of QS composing the generic region of the universe tends to decrease and reaches its minimum value $v_{\min} = v_p - \frac{AB^2}{e}$ for $\mu_4 = A$ itself. Then, for $\mu_4 > A$ with the process of chemical evolution we have at the same time the formation of organic molecules: therefore in the universe it begins also the biological evolution and there form cellules, pluricellular beings and living organisms (in the regions which have similar physical circumstances to the planet earth). Equation [42] implies that for $\mu_4 > A$ (and thus during the biological evolution) entropy starts to decrease. Equation [43] implies that for $\mu_4 > A$ the frequency of vibration of the generic quantum of space tends to increase: living organisms have a tendency to develop into systems composed of QS with higher frequency. One can predict that at the limit of bigger and bigger numerical order of changes, i.e. with the evolution of human being and his consciousness, entropy tends to become smaller and smaller while the frequency of QS tends to become bigger and bigger. In particular, one can say that in the phase of conscious experience of man (i.e. $\mu_4 \rightarrow +\infty$), entropy will tend to zero and the corresponding frequency of QS will approach the “basic frequency”.

On the ground of the model here proposed, QS vibrating at the “basic frequency” can be therefore considered the “elementary driving forces” of the evolution. One can say that the basic frequency of QS is a “physical environment” in which matter has a continuous tendency to develop towards conscious species. Physical evolution, chemical evolution, biological evolution and conscious evolution of man can be considered as processes generated by the basic frequency of QS. In fact, during the first phases of evolution of the universe corresponding to the transformation of energy of the physical space in energy of the matter (i.e. until the beginning of chemical evolution), the entropy of the universe tends to increase and the frequency of QS tends to transform from the value given by the “basic frequency” to other appropriate values (lower than the basic one) characteristic of material particles. Then, with the beginning of the chemical evolution, which leads to the formation of organic molecules and therefore determines also the biological evolution of the universe (in the regions which have similar physical circumstances to the Earth), entropy tends to decrease and the corresponding frequency of vibration of QS tends to become bigger and bigger and, at the limit, will approach to the “basic frequency” with the evolution of the human being and his development beyond the mind (Fiscaletti and Sorli, 2007b).

Universe is physically homogeneous. ATPS has the same physical properties in the whole universe. By considering “basic frequency” of ATPS as its driving force, evolution can be understood as an universal process, as an integral part of cosmic dynamics (Sorli A. and Sorli I, 2004b; Sorli A. and Sorli I., 2005c).

7. CONCLUSIONS

The extended thermodynamic conception consisting in connecting the classical laws of thermodynamics with the Einstein mass-energy relation allows us to explain in a satisfactory way both the evolution of inert matter (which goes in the direction of a decrease in mass and an increase of entropy) and the evolution of living organisms (which goes towards an increase of mass and a decrease in entropy, in their growing phase). In particular, as regards living organisms, some supplementary conditions must be added in order to reproduce the fact that their evolution goes in the direction of a decrease of entropy. Therefore, one can say that the extended thermodynamic conception introduces relevant unitary perspectives in the interpretation of evolution. Moreover, in the self-renewing universe (in which the AGN-s have the role to keep the universe young), it opens the possibility that evolution of life can be seen as a continuation of the evolution of the universe.

According to this view, life on the earth occurs in the whole universe. This new “cosmic approach” goes beyond the “geocentric” approach. It sees evolution as an universal negentropic process that develops towards the “basic frequency” of ATPS. All the processes of physical, chemical, biological evolution and conscious evolution of man can be considered as parts of a one universal process. Evolution of life is determined by the “basic frequency” of ATPS and develops towards the “basic frequency” of ATPS which is the non-entropy state of energy. By introducing a term depending on the material changes in Boltzmann formula, one obtains a new general formula for the entropy which can explain and reproduce both the increase of entropy during the evolution of matter and the decrease of entropy concerning the evolution of life. Analogously a formula expressing the link between the frequency of vibration of the generic quantum of space and the stream of the material changes can be introduced. These two new formulas concerning entropy and frequency can be considered a starting point for a mathematical treatment of the evolution of life as a consistent part of cosmic dynamics.

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