Supernovæ 1a and Decelerating Expansion

In 1998, two groups of astronomers set out to determine the deceleration of the universe by measuring the recession speeds of type la supernovæ (SN1a), came to an unexpected conclusion: its expansion rate has been speeding up. To justify this acceleration, they suggested that the universe does have a mysterious dark energy and they have proposed a positive cosmological constant consistent with the image of an inflationary universe. To explain the observed dimming of high-redshift SN1a they have bet on their distance revised upwards. We consider that an accelerated expansion leads right to a «dark energy catastrophe» and we suppose rather that the universe knows a slowdown expansion under the positive pressure of a dark energy, otherwise called a variable cosmological constant. The dark luminosity of the latter would be that of a «tired light» which has lost energy with distance. As for the low brilliance of SN1a, it is explained by two physical processes: The first relates to their intrinsic brightness – supposedly do not vary over time – which would depend on the chemical conditions which change with the temporal evolution; The second would concern their apparent luminosity. Besides the serious arguments already known, we strongly propose that their luminosity continually fades by interactions with cosmic magnetic fields, like the earthly PVLAS experiment which loses much more laser photons than expected by crossing a magnetic field. It goes in the sense of a «tired light» which has lost energy with distance and, therefore, a decelerated expansion of the universe.

The aim of this paper is to propose the earthly experience *Polarizzazione del Vuoto con LASer* (PVLAS) amalgamated to the radiation of the SN1a, and show that it corroborates the interpretation of the theory of the Relation according to which the observation of the distant SN1a leads to a deceleration of the expansion and a variable cosmological constant.

We consider that the light of the SN1a loses its brightness through the intergalactic magnetic fields, in the same way that the laser of the earthly PVLAS experiment loses photons by going through a magnetic field. This experiment tends to demonstrate that the weakening of the apparent luminosity of the SN1a is due to a physical process rather than a distance to revise upward as required by the theory of inflation. This physical process is added to some of the main propositions already known in opposition to the acceleration of the expansion. It leans toward a very low density of matter and a flat universe, in accordance with the results of the weighing of clusters of galaxies and those from the cosmic microwave background (CMB). It implies a deceleration of the expansion and appeals to a «variable» cosmological constant which derives from the theory of the Relation of which we present some aspects. The basic assumption of this new theory excludes the original phase of exponential growth of the cosmic inflation and uses rather a relativistic big bang [1], stemming from a previous universe, with a primeval dark energy with a density of at least 10^{60} times greater than the current vacuum energy, whose high temperature "substance" would quickly have begun to disintegrate into ordinary matter and dark matter, decay that would have continued during the history of the universe, especially with each broken symmetry, whenever the forces of interaction between particles change their nature. The «full» initial quantum becomes the quantum vacuum of space through a variable cosmological constant, which is nothing else than the dark energy which is transformed into common and dark matter. In this way, the «dark energy catastrophe» is under control and a reconciliation between particle physicists and cosmologists is effected.

INFLATIONARY SCENARIO

Before discussing the theory of inflation currently prevailing, let us mention that the cosmology, which exists hardly since the XXth century, grounded on the laws of physics as we know them, and on the observations done from the smallest to the largest scales, has made up the standard model. This one is an archeology of the universe by the thought which goes back up to the big bang, and which appears as an apotheosis of physics. However in the late 70, some pieces fit together very poorly in the puzzle of the standard big bang theory. For example, observations show that on a large scale the matter is widely distributed in a rather homogeneous way. How then to understand the formation of large structures (clusters of galaxies, superclusters), which show an extreme heterogeneity of the universe today? The physical process at the origin of the small density fluctuations was missing. There was also the riddles of a very flat universe, broken symmetries, magnetic monopoles [2].

In 1980, a new hypothesis, issuing from particle theory, claimed its ability to solve these conundrums, while preserving the success of the standard theory. The universe would have known very early in the cosmic chronology a dazzling phase of expansion, the inflation. One can imagine, there are several tens of billions of years, a universe whose energy was carried by a field, which was perched away from its minimum energy state. Because of its negative pressure, the field drove an enormous burst of inflationary expansion. The space, driven by something akin to the current dark energy, would have dilated with a gigantic factor, say 10^{100} [3]. Then, some 10^{-35} sec later, as the field slid down its potential energy bowl, the burst of expansion drew to a close and the field released its pent-up energy to the production of ordinary matter and radiation. For many billions of years, these familiar constituents of the universe exerted an ordinary attractive gravitational pull that slowed the spatial expansion. But as the universe grew and thinned out, the gravitational pull diminished. About 7 billion years ago, ordinary gravitational attraction became weak enough for the gravitational repulsion of the universe's cosmological constant to become dominant, and since then the rate of spatial expansion has been continually increasing [3, 4].

After twenty years of works, the inflationary universe scenario was able to make macroscopic random fluctuations of energy, inevitable at the quantum scale. With this theory, the most infinitesimal initial irregularities in the distribution of energy can be grown enormously and create future centers of condensation of matter. These will in turn become the seeds from which the matter will gradually be structured on scales larger and larger.

Despite this sketch of cosmic evolution, at the end of the XXth century, views on inflation had failed in forming a definitive scenario. Some astrophysicists were ready to raise arms and declare false the theory of inflation (and even the big bang). Most of the astronomers who had measured the mass of distant clusters of galaxies were convinced that matter represented only 20-40 % of the critical density of the universe, and that the latter should be close to the critical density that makes it flat, but could not find the remaining 80 to 60 % [5].

SUPERNOVÆ

In 1998, a revolution took place in the world of the cosmology. The astronomers of the Supernova Cosmology Project and of the High-z Supernova Search Team announced that the rate of the cosmic expansion accelerates instead of slowing down [4]. The astronomers used old stars thermonuclear explosions – SN1a – to measure the rate of expansion of the universe. They expected to measure a deceleration of the expansion, slowed by the gravitational force attraction of the matter content of the universe. They were stunned to notice that the recession of galaxies, instead of slowing down as the universe grows older, seems to accelerate.

This announcement was consistent with measurements from previous studies, which evaluated the density of matter at 27 %, with the largest part (~22 %) comes from the dark matter, still unknown but which exerts a gravitational influence on observable galaxies [6]. Once this value was determined, researchers had only to take into account the contributions of Cobe satellite and Boomerang balloon, and of course the theoretical framework of the big bang's models. Those stipulate that the sum of three cosmological parameters (matter density, denoted Ω, density curve, denoted Ω_K and cosmological constant, denoted by Λ) must be equal to unity. However, the results of Boomerang have fixed the density curve. Its value is null.

The meticulous analysis of the data led the astronomers to argue so: the recession velocity of a supernova depends on the difference between the gravitational attraction of ordinary matter and the gravitational pull of the dark energy from the cosmological constant; taking the density of matter, whether visible or invisible, equals to about 27 % of the critical density, they concluded that the accelerated expansion they had demonstrated could be explained by a push towards outside due to a cosmological constant which dark energy contribute about 73 % of the critical density.

These two combined values bring the total density of mass/energy of the universe to exactly the 100 % value predicted by the inflationary cosmology! [7]. Measurements of SN1a and the theory of inflation were complementary and confirmed themselves mutually, independently.

THE «DARK ENERGY CATASTROPHE»

However, the concordance of all the experiments which conducts to a space almost flat, ever expanding, startled more than a cosmologist. At the dawn of the XXIth century, astrophysicists discover that all their theories are based only on observation of visible 5 % of the total energy and 95 % of the universe is completely foreign to them. This does not prevent them from continuing to build their theoretical edifice. If the experimental indications of a non-zero value for the cosmological constant comes not only from the SN1a, but also of independent measures on the fluctuations of cosmic background radiation, what is its value?

The acceleration is very slow, which tells us that the value of the vacuum energy, though nonzero, is extremely tiny. The theoretical problem with the observed vacuum energy is that it is far smaller than anyone would estimate. According to particle theorists estimates, energy should be much bigger. But if it was, it would justly not be able to lead to this acceleration of SN1a so difficult to measure. With a huge energy, the universe would have collapsed long ago (if negative) or quickly expanded into the great void (if positive). That is what we call the «dark energy catastrophe.»

Thus, these fascinating measures also present a significant enigma. At this is added the challenge of revealing the nature of dark energy, characterized by the cosmological constant. The vacuum energy is precisely the favorite candidate but effectively, if so, the quantum physicists would prefer to see it multiplied by at least 10^{60} so that this vision of the cosmos suits to the standard model of the physics of particles [8]. Several models are possible, but the predicted value in most cases is 10^{122} times above the limits prescribed by astronomical observation. The cosmological constant is comparable to the inverse square of a length. For the physicists of the infinitesimal, this length is interpreted as the distance scale at which the gravitational effects due to the vacuum energy become manifest on the geometry of space-time. They consider that this scale is the Planck length, or 10^{-33} cm. For the astronomers, the cosmological constant is a force of cosmic repulsion which affects the rate of expansion on the scale of the radius of the observable universe, that is 10^{28} cm. The ratio of both lengths is 10^{61}, which is the square root of 10^{122}.

The vacuum of the physicists is full of energy. Its energy fluctuations give birth to pairs of particles. During the history of the universe, whenever the interaction forces between particles change their nature, thus in every symmetry breaking, the vacuum cashed energy. Today, the vacuum energy, which constitutes the essence of the cosmological constant, should be much larger than the value predicted by the cosmologists.

The observed SN1a seem to say that these remaining two thirds of the critical density seem to exist exist in the form of a mysterious «dark energy» and to bolster up the inflationnaire cosmology. But their rate of acceleration may mean that the contribution of dark energy to the critical density is about 73 %, two-thirds which miss so that the universe is flat, as predicted by the inflation theory, nevertheless this last one, as well as the model of particles or strings, have to explain why the universe's vacuum energy is as small as we know it must be. Their best models of unification, expected to make correct predictions in the field of elementary particles, lead to some absurd cosmological consequences, and they have no answer to this problem. Thus, for theoretical physicists, the hope of reconciling their models and those of their colleagues cosmologists flew away. Some physicists believe that there is no true explanation.

The so-called theories of quintessence were born to dissipate this conception: the cosmological constant is replaced by a variable field during the time, very high in the phases of the early universe, in agreement with the calculations of physicists, but falls very low during the cosmic evolution, according to the value measured by astronomers today. The quintessence field would evolve naturally towards an «attractor» conferring it a low value, regardless of its original value. Physicists consider that a large number of different initial conditions would lead to a similar universe − the one which is precisely observed! But these theories require extra dimensions [3, 9].

Even if astronomers and cosmologists are probably right about the low predicted value of vacuum energy, and that it belongs especially to particle physicists of better understan the theories of unification and the true nature of the vacuum energy, we estimate that both groups are conceptually wrong. Physicists are deluded into believing that, if there was great energy at the beginning, there should be still a great energy today. On the other hand, cosmologists are mistaken in believing that the vacuum energy was always the same, that is to say almost zero. For them, there is no real empty vacuum in nature: constantly, particles are created and annilihated more or less virtually, what explains the presence of energy. To be connected to this low density of the vacuum energy which has never changed, they need a constant energy density that models the presence of a permanent cosmological constant.

A VARIABLE COSMOLOGICAL CONSTANT WITHIN THE FRAMEWORK OF THE THEORY OF THE RELATION

A) SCENARIO OF THE THEORY OF THE RELATION

The question to know why the density of energy is so tiny finds answer within the framework of the theory of the Relation [10]. This new theory uses a «cosmological inconstant», or a variable cosmological constant, which means a variable density energy during the cosmological time. It does not require the presence of extra dimensions: the universe has two complementary and interpenetrated structures structures and four dimensions (one of time and three of space). The structure of the condensation has the aspect of the Einstein's gravific space-time and electromagnetic (EM) matter, whereas the structure of the expansion has some aspects of the Lorentz-Maxwell's flat EM spacetime and ordinary matter.

Since the big bang, the EM structure of the expansion − with the variable cosmological constant − is in decline, having abandoned his energy for the benefit of the increasing structure of the condensation, positive and gravitational. Throughout cosmological time, a perpetual annihilation of the negative energy-mass is transformed into a continual creation of positive energy-mass. The first structure of condensation represents the positive solution of Dirac's equation of energy, while the second structure of expansion express its negative energy solution which was eliminated by a mathematical trick [8].

The negative energy-mass is assimilated to the cosmological constant or the dark energy. The variable density of dark energy takes the form of a variable cosmological constant directly related to the full energy that will become the minimal energy of vacuum. We can say that it starts with the energy of particle physicists, with 10^{120}, and leads to the almost zero energy of the astronomers, that is ~ 10^{0}.

Through the «principle of compensation», the lost negative energy is transformed into positive energy. Permanently, real positive particles (not virtual) are created and all do not disappear (in particular those corresponding to positive energy), hence the presence of a growing positive matter and a weakening vacuum energy. The principle of compensation says that the decreasing of the negative EM energy-mass during the expansion induces a proportional and opposite increasing positive gravitational energy-mass. The EM wave of spacetime is supported by an inhomogeneous vacuum filled of «minimal» negative energy perpetually in interaction with positive matter.

B) GENERAL CHARACTERISTICS OF THE THEORY OF THE RELATION

I) With the theory of the Relation, it is not the dark matter which dominated from the beginning but an expansive dark energy. (96) How does this anti-gravity manifest in the theory of the Relation? It is as early as the big bang related to the density of the «full quantum» which existed in the earliest moments of the universe. This dark energy varies over time, hence the term «variable cosmological constant». The repulsive action of the full energy launches the universe starts in its infancy, between 10^{-35} and 10^{-32} sec, in a crazy phase of annihilation of dark energy and creation of ordinary and dark matter. Its huge negative dark energy is so transformed into positive energy/mass. It is at the same time energy, negative cosmological constant and arrow of time, because it creates space-time and matter. It is associated with the topological defects of the space bound to the various broken symmetries that the universe has experimented in the past. Dark energy empties its energy to reach the today's «quantum vacuum» or the cosmological «vacuum energy», which reconciles the particle physicist and the cosmologist.

II) The structure of expansion goes with dark energy. Globally, into the theory of Relation, our complex universe is dual: positive and negative. The negative part, which is a universe by itself, disintegrates, and «creates» our actual positive universe. The compensation principle asserts that the permanent loss of negative energy of the expanding EM wavelength of spacetime induces the positive gravific spacetime matter. Flat EM spacetime can yield induced gravity to ordinary matter. Gravific spacetime matter produced by the expansion can flatten the EM spacetime. The deep meaning of the compensation principle is that when there is less EM mass/charge repulsive force in the structure of expansion − going forward with the arrow of cosmological time − there is more mass/matter attractive force in the other structure [10].

This said, according to general relativity, even in the absence of particles, the universe can carry energy known as vacuum energy, this energy has a physical consequence: it stretches or shrinks space. The positive vacuum energy accelerates the expansion of the universe, while the negative energy makes it collapse [11]. We do not contest this classification, but in the theory of Relation the positive vacuum energy and the negative vacuum energy have another meaning. The first structure of condensation represents the positive solution of Dirac's equation of energy, while the second structure of expansion express its negative energy solution which was eliminated by a mathematical trick [8]. (Let us say that in the expression $E = \pm mc^2$, $E = + mc^2$ represents the positive energy, while $E = - mc^2$ represents the negative energy. $E = - mc^2$ is considered just as a virtual energy, which is wrong, in our view.)

So, in our theory, the negative vacuum energy means dark energy also known as cosmological constant, while the positive vacuum energy means the structure of condensation, with the positive matter which augments and the space which shrinks. It is the inverse of Einstein's classification.

III) The cosmological constant provokes the expansion of space and at the same time its positive pressure exerted inwards slows down its expansion. This is not the positive pressure that induced deceleration but the transformation of the negative energy of dark matter into positive energy that produces an «attractive» force of gravity. The repulsive force of gravity of the primeval universe is a colossal negative energy which would result from the presumable big crunch of a pre-universe. From 10^{-35} sec, we can say that full dark energy had brutally begun its transformation into «white» energy of the primordial vacuum.

The total energy of matter increases as the universe expands. Similarly the total energy of the graviton increases with decelerated expansion of the universe because it takes energy to the cosmological constant. With the expansion of the universe, the loss of energy of photons becomes directly observable, because their wavelength lengthens – they undergo a redshift – and the more the wavelength of the photon lengthens, the less it has some energy. Microwave photons of cosmic background radiation are thus redshifted during nearly fourteen billion years, which explains their long wavelength (in the field of the microwaves) and low temperature. In this sense, we have a «tired» dark energy, and the gravitons would have extract some energy from the disintegrated dark energy. In short, as the expansion of the universe decelerates, dark energy's negative cosmological constant gives energy to the gravitation of the positive matter, while the graviton takes energy to matter and radiation [4].

IV) There is a transformation of the negative energy (the EM spacetime wave, or dark energy, namely the cosmological constant) into positive energy (ordinary matter + dark matter), and we have a gravitation (energy/mass) which increases with the cosmological time of expansion. The matter increases, so the total energy related to mass of the particle varies. There is creation of particles and therefore of energy/mass. (This does not violate the principle of equivalence: the «proper energy» of the particles is equal to their rest mass). What does not remain constant is the global mass which grows with the expansion. So, if R_U, t_o and M° are the radius, the time and the mass of our universe:

$$t_o c = GM° / c^2, \qquad (1)$$

R_U and M° increase with time.The global mass continues to enlarge because the disintegration of the pre-universe after the big bang is not yet finished.

V) What is the contribution of dark energy to the critical density in the theoretical framework of the theory of Relation? The full dark energy transformed into white vacuum energy, born in about 10^{-32} sec after the big bang has left imprints on the CMB in the form of tiny density fluctuations resulting from small variations in temperature (the order of 0.001 %) of this radiation. By scrutinizing these tiny fluctuations in temperature with telescopes perched on balloons or satellites (in particular, the WMAP satellite launched by NASA in 2001), astronomers have inferred that the amount of dark energy that was responsible for more than two thirds of the critical density. In addition to this evaluation of the density of energy, independently, physicists have determined the density of matter (visible and dark) of the universe. The apparent size of heterogeneities of the cosmic background on the bottom of the sky is partially determined by the overall geometry of the slice of space which separates us from it. This apparent size provides an indirect measure of the total density of the universe and it appears that the quantities of dark and ordinary matter account for less than a third of the found value [4, 5].

Conscientious French researchers declared that to explain that the universe is Euclidian, such as was predicted by the WMAP satellite, we do not need the hypothesis of dark energy and that the density of matter, alone, is sufficient. It is however necessary to put the hand on this missing matter. This claim does not correspond to the theory of inflation. In its framework, the concordance of the experiments is consistent with a very low density matter and the apparent abnormal recession of SN1a led to a positive cosmological constant, sign of an accelerated expansion. Its theoretical framework is consistent with the results of weighing of clusters, deriving from the study of the cosmic microwave background: an energy density of 73 % and a matter density of 27 %. This gives

$$73\ \% + 27\ \% = 100\ \% \qquad (2)$$

and involves a constant density of dark energy, that is to say a positive cosmological constant, during time, since at least 6 billion years.

Nevertheless, it seems to us that the inflation does not correspond to the theory of the Relation, no more than a universe dominated by matter that would sound the death knell of dark energy. In the relationary cosmology, there is a negative «variable» cosmological «constant», in which dark energy density is reduced in favor of the density of matter consistent with the results of weighing galaxy clusters. We obtain

(73 % - 20 %) + (27 % + 20 %) = 100 %.
Dark energy Ordinary and dark matter (3)

This expression means that the energy without mass (without positive mass) of the cosmological constant that contributes about 73 % of the critical density would decrease over time towards 50 %. What is lost of the immaterial dark energy becomes mass, joins the 30 % coming from ordinary and dark matter, and keep the positive matter growing bigger. This compensatory balance maintains constantly the total mass/energy of the universe at the full 100 %. Such a process implies a continuous creation of matter throughout the cosmological time, translates a slowing down expansion and explains a variable cosmological constant (~ 73 % → ~ 50 %) which continues to fill the missing mass (~ 27 % → ~ 50 %).

Dark energy in the framework of the theory of the Relation – with a variable cosmological constant with a maximum of dark energy at the beginning and a minimum of matter/mass – can not only reconcile the model of physicists but also resolves the same endemic difficulties that claims to solve the positive cosmological constant.

For example, the presence of a negative cosmological constant equal to about 73 % of the critical mass allows, as well than a positive constant, to settle an annoying paradox: the present universe is very heterogeneous if one judges by the distribution of matter, nevertheless the expansion seems perfectly uniform in all directions. By using both constants, the contradiction disappears with an energy distributed in a homogeneous way and which would govern the expansion... Except that, in parallel, the dark energy of the positive constant carries back into the past the beginning of the cosmic expansion. If its value was large enough it could even repel it to infinity (big bang eliminated). Whereas dark energy of the variable negative constant can back up until Planck's time and space time and space, starting from the vacuum energy of the cosmologists to the full energy of the physicists. The compensation principle reveals a hidden, evolutionary, variable symmetry which explains the above value but close to the zero of the current cosmological constant.

DISTANCE ON THE RISE OR PHYSICAL PROCESS TO EXPLAIN THE LOW LUMINOSITY OF THE SN 1a?

To explain the low brightness of distant SN1a, scientists had two choices: either a physical process weakened their radiation, or their distance should be revised upwards.

In 1998, the results of the weighing of galaxy clusters, those from the study of cosmic microwave background and the latter resulting from the observation of distant SN1a, formed parts of a cosmic puzzle which matched to present the image of a nearly flat universe with a matter, whether dark or ordinary, which represented only ~ 27 % of the critical density of the universe. Two international teams clamored that the luminosity of distant SN1a were 25 % weaker than their close colleagues. When we observe such a supernova in another galaxy, it is enough to compare its visible magnitude with its intrinsic magnitude (brightness if is was next to us) to know its distance. By decomposing through a spectrograph the light of those stars taken by the expansion of the universe, astronomers determine the redshift, and consequently their receding velocity. These two values, bound by the expansion which depends itself on the contents of the universe, showed a redshift higher upper to the predictions. Astronomers were quick to conclude that they are more distant than previously expected: it was a matter of distance. [12, 13]

The results on supernovæ jibes with the inflationary cosmology. Everything was held so that the expansion accelerates through a positive cosmological constant. Although the case appears heard for most astronomers, it seems problematic if not erroneous. The astronomers had considered *a priori* that the luminosity of SN1a is almost always the same: 5 billion times the Sun. Only there is this: is the intrinsic magnitude of SN1a really constant?

This one is indeed known only due to the explosion models developed by astrophysicists. However, some mechanisms ruling the explosion are still misunderstood and some features of these models are still unprecise, what could modify the fragile value of the intrinsic magnitude that they predict. It is unclear, for example, if the explosion is due to a deflagration propagating slower than sound or to a supersonic boom. Such an uncertainty incites certain cosmological theories to postulate a variation of the constants of the nature, of which the constant of gravitation, although no observation or experiment showed some variation of *G*. A variable cosmological constant would be, however, more likely to change the value of the energy (and hence of the intrinsic magnitude) released by a supernova. Indeed, this energy depends among others on the reaction speed of some elements synthesized during the explosion such the nickel. If the cosmological constant, or dark energy density, has not the same value at the moment of the supernova as today (contrary to what is usually assumed), the reaction rate and the chemical composition involving the nickel would not be the ones envisaged by astrophysicists. There would be an evolution of the system overtime and the measures of luminosity of supernovæ would then be corrected.

On the other hand, the result of the observations of the satellite XMM-Newton of Agency's European Space X-ray observatory (ESA) around 2003-2004 implies a decelerating expansion and excludes a distance in the increase to explain the excessive paleness of distant supernovæ 1a [14, 15]. This is consistent with the theory of the relation.

Within the framework of the theory of the inflation, the concordance of the experiments goes in the direction of a very low matter density and the apparent abnormal recession of SN1a led to a positive cosmological constant. The choice of a physical process that weakens the radiation of supernovæ was quickly dismissed and astronomers opted for the scenario of an accelerated dark energy which would have taken the upper hand during the second half of the history of the universe. This scenario is difficult to check, unless we observe clusters of galaxies today and in the past when the universe was only half its current age. Indeed, in a world dominated by this strange energy that accelerates the expansion, the clusters would be very difficult to form. Galaxies are too distant from each other and would fail to assemble. In the history of such a universe, since very early no more clusters of galaxies would be constitute. Those we see today were formed in the distant past. The question to be answered to determine the existence of dark energy was simple: yes or no, were clusters of galaxies formed in the second half of the life in the universe? It turns out that the XMM-Newton has returned data about the nature of the universe indicating that the universe must be a high-density environment, in clear contradiction to the «concordance model» relying on the theory of inflation. In a survey of distant clusters of galaxies, the results of the satellite revealed that today's clusters of galaxies are superior to those present in the universe around seven thousand million years ago. Such a measure logically inclines toward a decelerated expansion.

For his part, the American astrophysicist Bradley Schaefer obtained a result of the relation distance/luminosity which determines an inconstancy of the density of dark energy [16]. His idea consists to use some gamma ray bursts (GRBs) as distance indicators which would mark out the distant universe. Hundreds of times brighter than supernovæ, GRBs can indeed be detected at distances much greater than these. So they would probe the dynamics of the expansion in an age of the universe very old and still poorly known. In this purpose, he began to analyze gamma-ray bursts detected by satellites Swift and Hete 2. Schaefer said he established the distance of 52 GRBs to about 12.8 billion light years. He compared the intrinsic intensity of the 52 gamma flashes with the intensity seen from Earth, determined their distance and established a relationship between this one and their luminosity. He found that the bursts to the same distances as the distant supernovæ are fainter and therefore further that if the current expansion of the universe was decelerating, thus confirming the acceleration recorded using SN1a. In contrast, the most distant bursts at distances much greater than those where SN1a can be observed with present techniques, seem rather more brilliant and therefore closer than expected if the acceleration was due to a cosmological constant. Since the brightness of 52 GRBs measured until the borders of the universe is too intense for the accelerating expansion is due to the cosmological constant, Schaefer concluded that the density of dark energy, instead of being constant, had to vary [16].

This finding does not seem to stand out from the current framework of accelerated expansion and from increase of distance to explain the low luminosity of the distant SN1a [17]. The fact remains that astronomers know − while acknowledging not knowing enough about the secrets of exploding supernovæ to be sure of their luminosity − that the synthesis of heavy elements in stars was different in the past from what it is today. It is therefore likely that the bursts due to the older stars have had at their disposal a larger reservoir of energy at that time. Ultimately, if the most distant bursts are the brightest, this is due rather to the evolution of objects that are at the origin than to the expansion..

Let us underline that Jayant V. Narlikar showed at the beginning of the years two thousand that the observed SNIa explosions, that were looking fainter than their luminosity in the Einstein-deSitter model, could be explained by the presence in galaxies of a certain type of dusts, forming needles. The absorption of light by the inter-galactic metallic dust would extinguishe radiation travelling over long distances. The galactic dusts would be produced by condensation of iron rejected by previous generations of supernovæ. Explanation which has the merit to lean on facts, since laboratory experiments show that indeed this type of condensation product of dust-like needles [18, 19].

If the issue of absorption of light by metallic dust ejected by the supernovæ explosions is generally ignored in the standard approach, that of a process of «tired light» which would weaken the light is completely excluded. The tired light is a theory proposed by Albert Einstein to reconcile its hypothesis of static universe with the observation of the expansion of the universe. Einstein had emitted the hypothesis that light could, for an unspecified reason, lose energy in proportion to the distance traveled, hence the name of «tired light». The term was coined by Richard Tolman – as an interpretation of Georges Lemaître and Edwin Hubble who believed that the cosmic redshift was caused by the stretching of light waves as they travel in the expanding space. Fritz Zwicky in 1929 suggested, as an alternative explanation to an expansion which derived from the observation of a redshift proportional to the distance of the galaxies, that the shift was caused by photons which gradually lose energy with the distance, probably because of the resistance to the gravitational field between the source and the detector. Obviously, the ideas of Einstein and Zwicky, in a supposed static universe, were quickly ruled out.

With the the theory of the Relation, a form of «tired light» is indistinguishable from the assumption of a decelerated expansion of the universe with a variable cosmological constant. We are talking about the presently undetectable radiation of dark energy. Note that the tired light of this theory has nothing to do with the traditional model of light tired of the static universe in irreconcilable contradiction with the expanding universe. In the case of primeval photons, the tired light is also connected to the expansion of the universe. The distribution of these photons presents today a blackbody spectrum from the hot and dense phase experienced by the early universe. Due to the expansion, of a thermal imbalance with a temperature that decreases with cosmic time, the blackbody spectrum of CMB observed by the COBE satellite in early 1990 is similar but not identical to that of the recombination, approximately 380 000 years after the big bang. The photons during the expansion would have lost energy (collected elsewhere), changed frequency without being deformed, as evolve the cells of a living body between the early youth and the advanced age.

SUPERNOVÆ AND PVLAS EXPERIMENT

That said, we present a novel argument, though slightly approached [20], also supported by an earthly experience, which could explain the weakening of the visible luminosity of SN1a by a physical process. The general idea is that their light loses of its brightness by interactions with cosmic magnetic fields, quite as the laser of the PVLAS experiment loses photons by crossing through a magnetic field [21-22].

On one hand, we have the Italian physicists of the experience «PVLAS» who studied in 2000, in a laser device, the way a magnetic field affects the propagation of a beam of «polarized light». The waves of this type of light oscillate on the same plane, characterized by an angle. Theoretical models predict a slight modification of this angle, because a small number of photons are deflected by the magnetic field and disappear from the beam. Except that the variation observed by Italian physicists was ten thousand times larger than expected. They spent the next five years to verify this result, so much the stakes were potentially important. They acquired in 2006 the certainty that the strange phenomenon they had observed at the beginning of the millennium is not the result of a bias.

On the other hand, we can briefly say that supernova has roughly the volume of the Earth, the mass of the Sun and luminosity five billion times that of this last one. And therefore, one can easily conceive that the light emitted by a SN1a can be as brilliant and coherent than the laser, if not more.

Laser light has special and exceptional qualities which rank it in a separate category. At first, this light is extremely intense: much more than the Sun. It is monochromatic and pure, that is to say of a single color and the same energy for all the photons of the beam. It is temporally and spatially «coherent» because the time interval between the passage of a crest of a wave and that of the next is always the same. Finally, it is directive: the laser beam is very narrow and spreads very little. The SN1a constitute, despite differences, the candidate who can best resemble the laser light [23].

In 1916, Einstein remarked that an electron located in a low energy level can absorb a quantized energy $h\nu$ and jump into an upper level; if the same energy $h\nu$ is then received by the atom, it cannot be any more absorbed because the electron is already in the high energy level; Einstein then anticipated that the atom will behave as if it still wanted to absorb this energy: as it could not do, the excited electron will return to the fundamental state by emitting the energy $h\nu$: we say that this energy is stimulated − the total energy emitted by the atom is thus $h\nu$ not captured + $h\nu$ stimulated = 2 $h\nu$ [24, 25, 26]. We can compare a SN1a, which corresponds to the explosion of a white dwarf star after the accretion of matter and wave carrying the energy $nh\nu$ extracted from a close giant star, to an atomic system with «scales» of energy.

The SN1a form a relatively homogeneous class of objects, both in their mechanisms of explosion and in their spectroscopic and photometric observed characteristics. Their standardisable character authorizes to use them to build a diagram of Hubble permitting the determination of the cosmological parameters [27]. Due to the low dispersion of their maximum of luminosity in the spectral band B and their important luminosity which allows to observe them at very high-redshifts, they have become the «standard candles» to measure great distances and constrain the cosmological parameters. Their maximum luminosity presents a 40 % dispersal, which is still largely homogeneous. Like laser, which is a macroscopic quantum object, a SN1a emits photons which have almost all the same wavelength, are almost all in phase, move all according to parallel paths. Their luminous waves are waves where the radiation emitted by atoms are synchronized between them [28].

The light from supernovæ, assimilated to a laser beam, suggests a supernova-amplifier of EM waves based on stimulated emission, which would cross through cosmic magnetic fields by losing some energy-luminosity, like the PLVAS lasers. The radiation of the supernovæ which inevitably passes through the magnetic fields of galaxy clusters, stars, and interstellar space, gives up photons, which would be transformed into dark matter. The brightness of an EM energy that loses photons and frequency in the long run, without its speed of light being affected, can only wane.

We would so obtain, corroborated by the PVLAS experiment, a kind of tired light that weakens the brightness of supernovæ. If the most distant supernovæ are fainter than expected, this would come from the fact that, at such distances, losses of luminosity by «tired energy» were able to finally be detected. And this observational bias could constitute a method to establish a distance-luminosity relation in the distant universe, predict a change in the density of dark energy and play a crucial role in the determination of the constancy or not of the density of dark energy.

Since the confirmation of the experience PVLAS, physicists have been particularly obsessed with the creation of axions in order to demonstrate the existence of dark matter. Is it the fear of a bad incidence on their conclusions that prevented the astronomers from imagining that a similar physical process can weaken the luminosity of the «cosmic probes»?

DISCUSSION AND CONCLUSION

Since its discovery during the late 90's, the dimming of distant SNIa apparent luminosity has been mostly ascribed to the influence of a mysterious dark energy component. The discovery was able to confirm the ideas of inflation and the acceleration of the expansion. Cosmology has achieved its inflationary version of a standard model, called the «cosmic concordance», within the strongly tested framework of the hot big bang model. However, in this paper we argue that the official declaration of the astronomers in 1998, to the effect that the expansion of the universe accelerates, was precipitated and erroneous. Furthermore, a drawback to their conclusion: The dark energy component or a positive cosmological constant represents, in the current «concordance» model, about 70 % of the energy density of the universe. Nevertheless, a cosmological constant is usually interpreted as the vacuum energy and current particle physics cannot explain such an amplitude approaching zero. No theoretical model, not even the most modern, such as supersymmetry or string theory, is able to explain the presence of this mysterious dark energy in the amount that our observations require. On the other hand, if dark energy were the size that theories predict, the universe would have expanded with such a fantastic velocity that it would have prevented the existence of everything we know in our cosmos. This negative pressure fluid remains a serious weakness known as the cosmological constant problem. We dubbed it the «dark energy catastrophe» [29, 30].

We propose the theory of the Relation with a variable cosmological constant, which explains the early universe as well as the state of the current universe, and which leads to a deceleration of the expansion, what has the merit to resolve the paradox of the cosmological constant. The expansion of the universe is so likened to a positive pressure and to a negative cosmological constant. It has decelerated steadily throughout cosmological time due to the presence of dark energy that varies down in favor of a matter/mass which does not stop growing since the beginning.

The accelerated cosmic expansion of the universe is mostly based on the apparent faintness of the distant SN1a. Two means were available to explain the wanness: revise the distance on the rise, which means an acceleration, and the physical process which means a deceleration. The astronomers hurried to accredit the distance on the rise which was consistent with the theory of inflation. They have disregarded arguments brought by several physicists-theorists and experimentalists (XXM-Newton) that foster physical processes.

We subject an argument susceptible to explain by a physical process the decline of the visible luminosity of SN1a. It is about the PVLAS experiment which revealed a loss of intensity of the luminosity of laser radiation in a magnetic field. Further to this experiment, physicists have struggled to discover the mysterious particle of the dark matter which would explain the loss of photons. They seemed to be obsessed by this single issue, without even considering that light from distant quasars and supernovæ could also lose brightness when it passes through the inevitable cosmic magnetic fields. If the loss of photons experience PVLAS was ten thousand times greater than expected, and if it is appropriated to compare this laser experience with the radiation of SN1a, we can therefore hardly doubt that this is a physical process of «tired light» which increases the redshift, weakens the apparent brightness of SN1a, what indicates a deceleration of the expansion which excludes the increase in distance. Not to take into account of this strong possibility from now on would hold as much from the stupidity as from intellectual dishonesty.

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