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ARCADE 2 Spatial Roar, What Theory of Relation Reveals

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Abstract

The theory of Relation provides an explanation for the Arcade 2 excess. It assumes that the isotropic radio emission measured by the Arcade 2 Collaboration, which is 5 - 6 times brighter than the expected contributions from known extra-galactic sources, is the residue of an immense primitive energy of ordinary matter released by a relativistic *bang* almost 100 million years after the big bang, which gave the mass-energy the missing gravity to activate contraction. This relativistic bang, via a Lorentz energy transformation, would have released enormous energy held to be the source of the powerful radio noise detected by the NASA researchers. This transformation would have simultaneously triggered the formation of the first stars from dense gas and the reionization of less dense neutral gas. This departs from the idea that continuous reionization began after the formation of the first stars. We emphasize the importance of primordial magnetic fields, which would have generated significant density fluctuations during recombination and acted as a direct seed for cosmic structures. The first stars and galaxies were bathed in strong magnetic fields that gave rise to the radio microwave din (*boom*) discovered by Arcade 2. These intense magnetic fields alter the trajectory of charged particles zooming near the speed of light, triggering the space roar and emitting radiation that forms a synchrotron radio background. The theory of Relation offers an alternative to the Lambda-CDM cosmological model, which has become the standard model of the big bang, which leads straight to the vacuum catastrophe.

Keywords

Arcade 2 Excess, Relativistic *Bang*, Theory of Relation, Lorentz Energy Transformation, Cosmic Statics, Cosmic *Boom*, Synchrotron Radio Background, Primordial Magnetic Fields

1. Introduction

In 2006, Alan Kogut and his colleagues of NASA's Goddard Space Flight Center, searching the sky for heat from population 111 stars formed about 13 billion years ago, discovered a mysterious cosmic radio noise that booms six times louder than expected [1]. The researchers based their findings on 2.5 hours of data gathered during the flight of a stratospheric balloon with seven radio receivers called ARCADE 2 (Absolute Radiometer for Cosmology, Astrophysics, and Diffuse Emission) [2] [3]. This instrument is designed to measure the temperature of the cosmic microwave background at centimetre wavelengths and to search for deviations from a blackbody spectrum resulting from energy releases in the early universe. It covered about 7 percent of the night sky.

Arcade's radio receivers for the balloon flight were the first detectors capable of identifying the mysterious radio-noise signals. They were cooled to a temperature just 2.7 degrees above absolute zero, the same temperature as the cosmic microwave background (CMB) radiation, in order to not contaminate the cosmic signal by the instrument's heat. No physical model had predicted the existence of a so intense background hiss of radio noise, and it results from no known radio sources in the universe.

On its July 2006 flight, the large helium-filled balloon launched from NASA's Columbia Scientific Balloon Facility in Palestine, Texas, flew to the edge of the Earth's atmosphere to an altitude of 36 km. The aim was to measure the spectrum of the CMB at centimetre wavelengths by hoping to detect the signature of star formation or the decay of the hypothetical dark matter particles that make up 25 percent of nature and that form the scaffolding for galaxies [4] [5] [6]. When the researchers get back the instrument and analyse the results, instead of the expected faint signal, it was a real uproar which recorded the detector. The researchers thought at first of a problem of grading of devices and verified their data during almost one year. The noisy signal is always imperative. They compared the data collected by Arcade with the recordings brought back by the other missions and found the signs of their radiation. It was hidden because the devices of the other astrophysicists had not the adequate calibration. It was thus by a real stroke of luck that the unexplained residual signal appeared significantly in the range of frequencies studied by Arcade 2.

According to the article by Fixsen, *et al.* [7], the Arcade 2 instrument has measured the absolute temperature of the sky at frequencies 3, 8, 10, 30, and 90 GHz, using an open-aperture cryogenic instrument observing at balloon altitudes. Data show an excess radio rise of 54 ± 6 mK at 3.3 GHz in addition to a CMB temperature of 2.731 ± 0.004 K. Combining the Arcade 2 data with data from the literature shows an excess power-law spectrum of $T = 24.1 \pm 2.1(\mathrm{K})\nu/\nu_o{}^{-2.599 \pm 0.036}$ from 22 MHz to 10 GHz ($\nu_o = 310\,\mathrm{MHz}$) in addition to a CMB temperature of 2.725 ± 0.001 K. Although the data at 10, 30, and 90 GHz are consistent with the CMB temperature 2.725 ± 0.001 K measured by the *COBE*/FIRAS instrument at frequencies above 60 GHz [8], the data at 8 and 3 GHz show a clear excess radio spectrum. The excess is statistically significant, with 3 GHz channels lying more than five standard deviations above the FIRAS value. The radio background from Arcade 2 and radio surveys is a factor of ~5 brighter than the estimated contribution of radio point sources.

The detected extragalactic radio background is brighter than expected. American researchers formulated during long months, unsuccessfully, hypotheses on known radio sources in the universe [9]. The first one implied the solar magnetopause, the border of the region dominated by the magnetic field of our star, which sends us any sorts of radiations. Because the magnetopause is not symmetric, the emission should have been very different according to the angle under which we look at it, what is not the case. The second implied the radio galaxies. By accelerating electrons by their magnetic fields, these galaxies emit radio radiation in great quantities. The most powerful were listed, and even by taking into account the sum of other, more discreet and more numerous, their accumulated brightness is six times less intense than the signal of the radiation collected by Arcade. The last candidate is the most intense of the radio sources: our own galaxy. Dusts, atoms and particles of the intragalactic environment, slowed down by gases or accelerated by magnetic fields, bombard us with radio radiations. The galactic emissions are influenced by the electric and magnetic fields which cover the Milky Way, and even if this influence were the same everywhere, the observed radiation would be yet too intense to originate from our galaxy. Still the researchers of the Nasa have no idea where this cosmic static is coming from, wait that their data are examined closely and dash on new tracks. To date, there is no plausible explanation for the unclassifiable observed radio source but it is clear that it is too intense to come from our galaxy: it would be extragalactic.

In this paper, we suggest that the unexpected radiation detected by Arcade 2 is a secondary cosmological background emanating from a relativistic bang just under 100 million years (Myr) after the big bang, whose energy would have led to the birth of primordial stars and the reionization of neutral gas. After recombination, primordial magnetic fields would have produced the density fluctuations. The paper is organized as follows:

Section 2 shows that, with computer simulation, astronomers believe they can determine the age of the first stars between 30 and 100 Myr after the big bang. They postulated the existence of cold, exotic gravitational dark matter because there was too little time at the start of the expansion to allow for condensation of matter. The theory of Relation assumes instead that the radio radiation signal detected by Arcade 2 is the residue of an immense primitive energy of ordinary matter released by a relativistic bang, which gave the mass-energy the missing gravity to activate contraction. Section 3 points out that the neutral gases in the intergalactic medium were reionized at the same time as the first stars were formed, thanks to the energy brought about by the relativistic bang. This diverges from the view that the history of continuous reionization began after the formation of the first stars. Section 4 examines, through the theory of Relation, the relativistic bang which, via a Lorentz energy transformation, released enormous energy held to be the source of the powerful radio noise discovered by NASA researchers. This Lorentz energy transformation would have simultaneously triggered the formation of the first stars from dense gases and the reionization of less dense neutral gases. Section 5 examines the importance of primordial magnetic fields. Primordial magnetic field could have generated sizeable density fluctuations (overdensities) at recombination and could have acted as a direct seed for cosmic structures. In addition, they are thought to trigger the space roar by altering the trajectory of charged particles zooming close to the speed of light. They emit radiation that forms a synchrotron radio background. We reproduce "*the estimate of the effect that a primitive magnetic field would have on the large-scale mass distribution*" presented by P.J.E. Pebbles. The latter uses baryonic dark matter. Instead, we conjecture a surplus of ordinary baryonic mass from a relativistic bang within the framework of theory of Relation. Section 6 offers an alternative to the Lambda-CDM cosmological model that has become the standard big bang model. This model requires the presence of primitive dark matter and repulsive dark energy to accelerate the expansion of the universe. It leads to the catastrophe of the vacuum. The alternative is the Relation theory model which, in addition to resolving the problem of the cosmological constant, unites gravitation and quantum theory. It also resolves the iron paradox. Iron is found in all ancient stars, whereas it should be scarce in population stars 11 and concentrated in population stars 1.It is assumed that massive stars of population 111 would have supplied this iron before disappearing. A gravitational collapse of the star due to dark matter would have led straight to the black hole and "trapped" the iron. On the other hand, gravitational collapse due to additional ordinary matter would have generated nuclear reactions, triggered an energetic explosion (hypernova) and scattered the iron into space. Section 7 proposes a possible history of the birth of a primordial galaxy according to the Relation theory. In the 1950s, Hoyle linked the formation of planets to the formation of the Sun itself from a rotating cloud of gas containing a magnetic field. Similar little-known mechanisms are thought to be at work in the formation of large structures. It has been suggested that stars could not form in the absence of a magnetic field in the interstellar gas. By crossing thermal, magnetic and rotational barriers, a nebulous cloud is transformed into a galaxy. Conclusion: primordial magnetic fields (rather than dark matter) after recombination would have formed the lumps (overdensity); a huge release of energy (instead of dark matter) from a relativistic bang nearly a hundred Myr after the big bang would have shaped the first stars and structures. The radio-microwave din discovered by Arcade 2 corresponds to the first stars and galaxies bathed in a powerful magnetic field.

2. First Stars

One of the great problems concerning the formation of the first stars is that there was not enough time to condensate during the early expansion. Once this first phase of passing from a pure homogeneity to small regions of overdensity is done, the second phase is easy: overdense regions attract towards them the surrounding matter by their field of gravity, the primeval inhomogeneities get closer increasing their high density and the attractive power produces a snowball effect. The contraction could start after the recombination (380000 yrs.; 3000 K), with a gravity able of fighting the general movement of the expansion and the thermal pressure, but unable to double the local density in a sufficient time that would allow to realize the current large-scale structure in the universe.

To solve this problem of too little time, astronomers postulated the existence of a primordial, exotic, gravitational dark matter, not neutralized by photons like ordinary matter, which would have the effect of condensing the exotic pockets of overdensity without disturbing the isothermal process. Ordinary matter was thus attracted, accelerating the germination of stars and galaxies [10] [11]. The accepted hypothesis is that cold dark matter began to accumulate first; cold because it is a heavy, slow, unknown particle; dark because it cannot be observed by electromagnetic radiation.

We assume, on the contrary, that dark matter was in small quantities at the start of the expansion, accumulated over time and became the kind we observe today [12] [13]. Ordinary matter was in the majority, with hot dark matter, such as the neutrino, initially unable to play the role attributed to cold dark matter [14]. Cold and exotic dark matter waiting since the big bang to be recovered to form the first stars is immediately excluded. We surmise that primordial magnetic fields would have played this role instead. According to the theory of Relation [15] [16], the big bang was relativistic, and it was a relativistic bang nearly a hundred Myr after recombination that helped release the gigantic energy of ordinary matter that cooled the expansion and provided the gravitational field with the mass needed to trigger the contraction. The expansion shortly after the big bang was at the speed of light and decreased very slowly at first. The term "bang" means an emanation of kinetic energy due to a sudden deceleration below c, obeying the Lorentz transformation. This bang would have jointly enabled the condensation of dense primordial gases forming the first stars, the beginning of the reionization of less dense neutral gases, and the roar of Arcade 2 space coming from the strong magnetic fields required to slow down the rotation of gases that had been accelerated by contraction. The release of energy from the relativistic bang becomes the plausible candidate for the radio source of the strange noise.

For the present-day universe, however, the theory of Relation uses the CCDM (Compensation Cold Dark Matter) model, in which the total density is equal to the density of ordinary matter plus that of dark matter, but below the critical density. The difference between the total density and that of ordinary matter plus dark matter is bridged over cosmological time by an expansionary space-time wave that transforms its negative energy into positive energy. This decelerating expansionary space-time wave constitutes dark energy. Until the critical density is reached, this process could be likened to a continuous creation of positive matter, immediately condensed to become ordinary matter or dark matter.

Researchers' Computer Models

Astronomers utilize numerical cosmology simulating the formation of galaxies and clusters of galaxies, and they operate the same numerical and physical approaches to study the first structures forged after the big bang. The dominant position is that in a flat Cold Dark Matter model with $\Omega \approx 0.3$ that agrees with present large-scale structure observations, the oldest stars in the Milky Way should have formed in the first halos where gas was able to cool with the high peaks of the density field collapsing on scales of $\sim 10^7 M_\odot$. It has been generally accepted that population 111 of stars was formed at $z \sim 20$ (about 200 million years after the big bang) [17] [18]. Devoid of heavy elements, they were formed from the hydrogen and helium of the universe's origins. Their maximum mass is estimated at 10^{33} kg.

The "Jeans mass", minimum mass that a quantity of gas must have to collapse under its gravity, is proportional to the square of the gas temperature and inversely proportional to the square root of its pressure [19]. Because the temperatures of the first collapsing gas clumps were almost 30 times higher than present-day molecular clouds, the "Jeans mass" of the first star-forming systems would have been almost 1000 times larger [20] [21].

The first star-forming clumps were much warmer than the molecular gas clouds in which most stars currently form. Dust grains and molecules containing heavy elements cool the present day clouds much more efficiently to temperatures of only about 10 K. By rapid fragmentation without heavy elements and strong magnetic fields maybe low-mass stars were fabricated at the same time as the first massive stars [22]. These first stars were probably not sufficient of themselves to reionize the universe, but they could locally ionize the medium, and ongoing supernova served the important role of polluting it fairly extensively with heavy elements, which allowed the next generation stars to form more easily [23].

That being said on predominant position, the simulations, sometimes contradictory, tend to put off in the time the formation of first stars. On one hand, experts from the US Department of Energy's (DOE) SLAC National Accelerator Laboratory, the Michigan State University, and the Stanford University have at the beginning of the century managed to use computer models to simulate the way in which the first *twin* stars in the very early universe were shaped. Stretching as far back as 200 Myr after the big bang, the model reveals the population III stars were not nearly as massive as first suggested, and that they have been hardly originally formed by themselves in star systems [24]. The initial conversion of gas into stars was highly inefficient and produced a very small number of stars. Probably less than 1% of the gas in these primordial clouds actually cooled and collapsed to sufficiently high densities to form stars. On the other hand, researchers use more and more cold dark matter to compensate for the shortage of ordinary matter. Although there are many unknown parameters, such as the quantity and type of dark matter forming the bulk of the mass of the universe, they consider that the differentiation of matter into galaxies and stars could have begun when "Jeans mass" was obtained as little as ~30 Myr after the big bang corresponding to $z \sim 65$ [19]. The cosmic temperature was low enough for electrons to be captured into atoms and for gravitation to overcome the enormous pressure of matter and the associated radiation [25]. At this time the overdense regions contained about $10^5 M_\odot$ and population 111 massive stars may have been formed. Consequently, there are presently a number of contenders for a theory to explain the origin of galaxies and large-scale structure in the universe, but no single model can fit all the observational data with the theoretical calculations of the distribution of matter produced by the action of gravity on small initial density fluctuations in the expanding universe.

Nasa considers that the spectrum of radio noise power, at a level estimated at six times higher than the combined radio emission from all known radio sources in the universe, is consistent with the one produced by radio galaxies via charged particles spiraling in a magnetic field, which thereby emit radio noise through synchrotron emission. The researchers are convinced the loud microwave radio noise source does not match any known pattern from sources in the Milky Way and is not from distant galaxies or from decaying particles of exotic dark matter.

The Relation theory approach [15] [16] is that the elements and characteristics set out above are also compatible with primordial post-recombination magnetic fields producing lumps and a surplus of energy from an energetic transformation of Lorentz belonging to the relativistic big bang. A hundred Myr after recombination, a relativistic *bang* would have injected colossal energy exceeding the already existing positive energy. This is electromagnetic radiation containing electrically charged particles. Gravity tightened the magnetic field lines as it joined the existing gases. These new ionized particles, moving with relativistic velocities across these lines, are both slowed by collision with the original particles and accelerated by the magnetic lines, producing the inordinate synchrotron emission.

3. Reionization

The first major phase transition of gas in the universe was recombination. It occurred at a redshift $z \sim 1089$ (379,000 years after the big bang), due to the cooling of the universe. The rate of recombination of electrons and protons to form neutral hydrogen was higher than the reionization rate. The Dark Ages start when the universe became transparent as more electrons and protons combined to form neutral hydrogen atoms. The Dark Ages start when the universe became transparent as more electrons and protons combined to form neutral hydrogen atoms. The second phase change occurred once gas clouds started to condense in the early universe that were energetic enough to re-ionize neutral hydrogen. As these objects formed and radiated energy, the universe reverted from being composed of neutral atoms, to once again being an ionized plasma. This occurred between 150 million and one billion years after the big bang (at a redshift $20 > z > 6$) [26].

Astronomers hope to figure out where neutral hydrogen has accumulated over time and when it reverted to its ionized form [27] [28] [29]. They thought previously that neutral gas in the intergalactic medium had been reionized when it was heated by radiation from early stars, galaxies and quasars, about 1 billion years after the big bang ($z \sim 5$). But in 2001, a group of astronomers led by Robert H. Becker of the University of California, detected possible signs of the final stages of cosmic reionization at $z \sim 6$ [30]. In the spectrum of one of the most distant quasars known, dating to about 800 Myr after the big bang ($z \sim 6.28$), they found a telltale signature of neutral gas: all of the ultraviolet light had been absorbed by hydrogen atoms in the ionizing background along the line of sight to this high-redshift quasar. Slightly closer quasars ($z \sim 5$) do not show such complete absorption. These findings suggest the last patches of neutral hydrogen gas were ionized around that time.

A new turning point in 2003. Investigators on the Wilkinson Microwave Anisotropy Probe (WMAP) announced that reionization of the universe's intergalactic gases had probably occurred very early, at a redshift from $30 > z > 11$ [31]. They suggested less than 200,000 years after the big bang, in clear disagreement with the redshift range of the quasar spectra study [32]. However, in 2006, WMAP data returned a different result, with reionization starting at $z \sim 11$ (~370 Myr after the big bang) and the ionized universe at $z \sim 7$ (~750 Myr).

This is in much better agreement with quasar data [33]. In 2018, the study of the stellar population of a galaxy observed through the galaxy cluster MACS J1149.5 + 2223 estimates that the redshift had the value $z = 15$ at the time of reionization.

Studying the results of Planck 2015 indicates that the average redshift at which reionization occurs is between $z = 7.8$ and 8.8, depending on the reionization model adopted. This suggests that an early onset of reionization is strongly disfavoured by the Planck data [34].

Overall, the 2018 results from the Planck mission leave an idea of reionization that occurred late and fast with a redshift of $z = 7.68 \pm 0.79$ [35].

Relativistic Bang and Cosmic Boom

In cosmology, this never-ending story of reionization would have begun just after the Dark Ages, when a large number of atoms existing in the universe were ionized by the intense radiation of population III stars, the probable very first generation of stars to have illuminated the universe. Their high mass enabled them to radiate at a temperature high enough to ionize the surrounding interstellar medium. These stars, unobserved today, would have been created during the cosmic dawn, thanks to the indispensable contribution of dark matter.

Our hypothesis of a relativistic bang during the formation of the first galaxies seems more appropriate than the postulate of dark matter from the very first instants of the universe. The hypothesis of the Relation theory is that the cosmic radiation detected by Arcade 2 is a remnant of an enormous release of primitive energy caused by a relativistic bang around 100 Myr after recombination. The seemingly endless story of reionization would have started with this tremendous emission of ultraviolet light. This influx gave matter the extra energy it needed to jointly initiate the condensation of dense gases and the reionization of the weakest primordial gases. It is not unreasonable to believe that more moderate releases of energy followed, via the Lorentz transformation in the equation of Relation theory.

The theory of Relation imposes an electromagnetic space (tc_{EM}) as an initial condition and implies a turbulent image of the primitive universe. After recombination, when the baryonic matter of the universe was mainly in the form of a vast gas of neutral hydrogen, the light source kept emitting radiation. When the light rays struck the hydrogen atoms, they separated the electrons from the protons and ionized the clouds. When two charged particles are separated from each other, an electric field appears. And when an electric field appears in an inhomogeneous medium, a magnetic field also appears [36]. This very intense magnetic field produces intense fluctuations in matter density. The gas actually became very inhomogeneous, *i.e.* it contained numerous "clouds", some of them like plasmas, and it is around them that the conditions can be fulfilled for a magnetic field to appear. It is clear to us that towards the end of the Dark Ages, shortly before the formation of galaxies and stars, reionization had already begun [37] [38].

4. Theory of Relation and Relativistic Expansion

We estimate that at this time the proton had a speed ~298,100,000 m/s and energy ~10^{10} eV, which is about 10 times the proton rest mass (This evaluation is greater than the current assessment. Theory of Relation appraises that until about 5 years after the big bang, the speed of the expansion was very near *c* and a hypothetical proton at Planck time would contain more kinetic energy than the estimated ~10^{25} eV based on the Planck mass).

4.1. At Least Four CBR

There could be at least four cosmic background radiation (CBR), or cosmic static, which is energy left over from the primordial universe [39] [40]. The first takes its source in the events connected with the matter and the antimatter, which took place from the very first microseconds after big bang. At Planck time, there was a spontaneous symmetry breaking producing graviton flow or gravitational waves. The theory of the standard big bang foresees a second: the existence of a fossil radiation of cosmic neutrinos at about 10^{-4} sec [41]. The third CBR, known as CMB, is the electromagnetic microwave background discovered by Penzias and Wilson in 1964. The microwaves came from a time when the universe was hot, dense plasma—a roiling mix of subatomic particles and light. As the universe expanded and cooled down, matter and radiation decoupled, about 380,000 years after the big bang. At that instant, the photons were free to travel unimpeded through space for the rest of cosmic history. Spanning every sector of the sky, in every direction, the CMB is a direct link to the big bang.

Even if this discovery launched the age of modern cosmology, the study of the early universe is hampered by a lack of direct observations. Astronomers have no observations of the era between quasar astronomy at $z \sim 6$—a billion years after the big bang and CMB astronomy at $z \sim 1000$—a few hundred thousand years after the big bang. We presume that Arcade 2 cosmic radio noise is a relic of this distant past referred to by cosmologists as the Dark Age [42] [43]. Before examining the effect of this event on primordial star formation and reionization, let us first look at our conception of the big bang through the framework of the Relation theory.

4.2. Big Bang as Seen by the Theory of Relation

Big bang theory became the standard model for the history of the universe, and it rests on the observation that the universe is expanding. In its early cosmic epoch, it was a super-small-compressed-hot soup with thermodynamics symmetry, no entropy, everything was energy, movement at the velocity of light. The energy resulting from the *big crunch* of a pre-big bang was negative with regard to the positive energy of our big bang. This means that the negative matter-energy of the pre-universe is transformed into positive matter-energy of our universe. This transformation was made very quickly, almost instantly, during the early universe. With the cooling and the decreasing of the rate of expansion, the transformation of the negative energy-matter into positive ordinary matter became slower and weaker. And it still continues today.

At Planck time there was a broken symmetry, a *thermodynamic imbalance*, a beginning of entropy, a passage of the speed of some particles under the speed of light, and the creation of *two structures* acting like if there was an *impervious separation* between both. It is also the separation of gravity from a superforce merging the four known forces of nature. It is a quantum gravity separated from the strong-electroweak force. We can say that the "charge" of the quantum gravity begins to decrease at this length of space, contrary to the "charge" of the classic gravitation which begins to increase.

We have seen that our universe is made up of two complementary and interpenetrating structures: condensation and expansion [15] [16]. Since the big bang, the electromagnetic structure of expansion has been decreasing, transferring its energy to the positive and increasing gravitational structure of condensation, thus obeying the principle of Compensation. A continuous annihilation of negative mass-energy is transformed into a continuous creation of positive mass-energy via the Dirac-Higgs mechanism. The first condensation structure represents the positive solution of the Dirac energy equation, while the expansion structure expresses the negative solution.

4.2.1. An Inexhaustible Source of Energy

When Einstein presented his special theory of relativity in 1905 with his equation $E = mc^2$, which demonstrated that mass (m) is a form of energy (E), the concept of mass was transformed. But the interchange of energy and mass in line with Einstein's equation was not conform to the quantum theory developed by Schrödinger, Heisenberg and others in the 1920's. Dirac in 1929 reconciled these two theories by discovering an equation which is the "square root" of the ordinary wave equation:

$$E = \sqrt{m^2c^4 + p^2c^2} \tag{1}$$

But the equation of the ordinary wave equation, which is

$$E^2 = m^2c^4 + p^2c^2 \tag{2}$$

has two square roots of opposite signs. Therefore the equation:

$$E = -\sqrt{m^2c^4 + p^2c^2} \tag{3}$$

where the energy E is negative and compatible with the Equation (2) and appears in the solutions of the Dirac equation. Dirac provided an equation that describes negative energy matter as well as ordinary matter [44] [45].

Dirac remarks that under Pauli's exclusion principle each negative-energy state can only be occupied *zero* or *once*, and he further postulates that, for obvious thermodynamic reasons, all negative-energy states are normally occupied, and therefore unobservable. The calculation shows that if an electron from the "ocean of negative energies" receives enough energy to pass into a state with positive energy, the "vacancy" thus created in the "ocean" will manifest itself as a particle with spin analogous to the ordinary electron, except that the sign of the charge will be positive.

In 1932 Carl Anderson studying cosmic rays found the positron on a in a snapshot taken at his Wilson cloud chamber. The Dirac equation predicted that every sort of particle should have an associated mirror image, or antiparticle. After the Second World War antiprotons and other antimatter particles were discovered in cosmic rays, antineutrons, antineutrinos were found, and now antiparticles of all varieties are routinely made out of energy.

Dirac's idea implies that material particles can be created from an infinite and invisible reservoir, provided that they are accompanied by "mirror" particles, of the same mass but of opposite electric charge (and also of opposite magnetic field and spin) [46] [47].

4.2.2. Principle of Compensation: Electromagnetic Energy That Transforms Its Energy into Matter

The structure of expansion being relativistic, we can say that the big bang is relativistic. The basic idea is that the initial hot, dense, compact universe started to expand with a huge energy-matter with the constancy of the velocity of light ($v = c$)

$$1 - v^2/c^2 = 0 \tag{4}$$

At Planck time the expansion underwent a broken symmetry, the cooling down would have provoked a violent phase of thermodynamics imbalance. The velocity of the negative matter becomes smaller than c

$$1 - v^2/c^2 > 0 \tag{5}$$

what would have provoked a kind of friction, like a satellite entering in the atmosphere, which would have been capable for warming the universe by creating a huge quantity of fermions and bosons. With this thermal imbalance of the nature, it is "energy which is transformed into matter" (we would rather say "negative energy which is transformed into positive matter"), and not the opposite. It is the "Lorentz transformation of energy". History of our universe is essentially a constant conversion of energy into matter.

This negative matter-energy, in the theory of the Relation, is usually called "dark energy". In its *general* sense, it is a negative EM energy containing bosons and fermions which will be converted into positive matter-energy. Negative bosons will lose some energy (not speed) at the rate of the growing space-time. This tired light, in a *restricted* sense, can be assimilated to the energy of expansion, to the cosmological constant, to the electromagnetic negative wave of space-time, or to the dark energy. The photons of negative energy are converted into photons of positive energy, by reason of the principle of Compensation, becoming photons with mass in the gravific space-time of Einstein [48].

Under the Principle of Compensation of the theory of Relation, there is a continuous transformation of so-called "negative" energy into "positive" energy. The process would have started with the big bang (we assume a pre-existing quantum plenum) in the Planck era and would continue again. The principle says that the decrement of negative electromagnetic energy-mass during the expansion induces a proportional and opposite increment of the positive gravitational energy-mass [16]. According to the equation

$$ke^2 = M_{VP}^2 t_o c \tag{6}$$

of the theory of Relation [M_{op} is the proton rest mass which is 938 MeV or 1.00758 amu; $M_{op}\left(1\Big/\left(1 - v^2/c^2\right)^{1/2}\right)$ gives the relativized proton M_{vp}, *i.e.*, the rest mass + the kinetic energy; v = the estimated recessional velocity of the galaxies], or more precisely

$$\pm ke^2 = \pm\left[M_{op}\Big/\left(1 - v^2/c^2\right)^{1/2}\right]^2 t_o c \tag{7}$$

since the particles come in pairs, each with a counterpart antiparticle, the term M_{VP}^2, or $\left[M_{op}\Big/\left(1 - v^2/c^2\right)^{1/2}\right]^2$, is a new fundamental variable in physics. Its value changes throughout the expansion [49]. The important point is that in the equation

$$ke^2 = M_{VP}^2 t_o c = M_{VP}^2 h / m_0 c = M_{VP}^2 GM^0 / c^2 \quad (8)$$

by virtue of the principle of Compensation of the theory, m_0 and M^0 are related. When m_0 decreases (as well as M_{vp}^2 on whom m_0 depends), M^0, which represents the global mass of the universe, increases. M_{vp}^2 and m_0 form the kinetic energy of the universe which decreases, whereas M^0 constitutes the potential energy that grows as heavy weight [15].

4.3. Relativistic Proton

The speed of expansion of the "negative fermions" (v^2 of $M_{vp} / \sqrt{1 - v^2/c^2}$) converges from c toward null speed (*i.e.* $1 - v^2/c^2 = 0$). When they are converted into positive fermions, they acquire inertia, *i.e.* resistance movementor mass. We can say that they are the ordinary matter, mainly of protons, of the present Riemanian-Einsteinian spacetime.

In the universe forming, we imagine some relativistic protons (constituted by quarks) with a mass "content of positive energy" enormously bigger than the current rest mass proton. Before becoming a positive matter, it was a particle full of negative kinetic energy stored in a mass "content of negative energy". Speed and energy are connected [50]. The speed v of the energetic Lorentz transformation implicates both the speed of the matter (galaxies) and the energy of particles which commands the possibility and the nature of the reactions. The growth of space-time and the cooling had the effect of causing them to lose energy, as if their relativistic mass were eroding faster in every small deceleration. The relativistic proton had to lose its surplus of negative energy at the rate of decrease of the expansion velocity of the universe. Thus, the primitive proton, with v close to the speed of light, is a proton of ultra high negative kinetic energy

$$M_{op} / \left(1 - v^2/c^2\right)^{1/2} = M_{vp} = M_{op} + \Delta M_p \quad (9)$$

(M_{op}: *rest mass of the proton*; M_{vp}: *relativistic mass of the proton*; ΔM_p: *kinetic energy of the proton*; v *is the speed of the particle*), whose lost energy ($v < c$) is converted into a proton of ultra-high positive kinetic energy. This last one has a cumulative mass and forms the galaxies. The negative protons (and their antiprotons of negative energy) are a part of the dark energy, or negative energy, intended to be transformed into positive energy, via the Dirac-Higgs mechanism and the mass-energy equivalence. The relativistic big bang does not need the hypothesis of an unknown cold dark matter during the early universe.

Ultra-high-energy relativistic positive protons from the event detected by Arcade 2 are thought to have helped shape galaxies and reionize primordial gas at a very early stage. They also make up today's intergalactic gas and contribute most of the ultra-high-energy cosmic particles that rain down on Earth from all regions of the sky. They are cold ordinary matter, as they are rather heavy, relativistic, and electromagnetic.

4.4. Effects of the Lorentz Transformation of Energy

In the early universe, the variation of the mass-energy, according to small decreases of the high speed, entailed colossal liberation of energy. There was a disproportionate inflationary liberation of negative energy, soon transformed into positive energy, for a tiny slow down of the expansion. After the recombination, because there were no large luminous objects to disturb the primordial soup, the radiation must have remained smooth and featureless for millions of years afterward. As the cosmos expanded, the background radiation redshifted to longer wavelengths and the universe grew increasingly cold and dark [25]. We imagine that the huge energy revealed by Arcade 2 is an energetic Lorentz transformation during the period following the emission of the CMB.

We believe that this Lorentz energy transformation, called a "relativistic bang", took place between $z=30$ (86 Myr after the big bang) and $z=20$ (150 Myr), when the speed of expansion of matter increased from 299,144 km/s (the relativistic mass of the proton was 15 times its rest mass) to 299,000 km/s (the relativistic mass was 4 times its rest mass).

There is then a potentially significant concomitance between the last shedding of a large amount of kinetic energy between two nearby high velocities (very low deceleration from the approximate velocity of *c*) and the last measured redshifts where there is little time between spectral shifts. Moving towards the big bang, the short time between redshifts indicates that seconds contain a high concentration of energy.

Note that from $z=30$ onwards, moving towards the big bang (analogous to the unattainable speed limit *c*), there is less and less time between spectral shifts: $z=1100$ (280,000 years after the big bang); $z=\infty$ at time $t=0$ .From $z=30$, as we move towards our epoch ($z=0$), there is more and more time between spectral shifts. Between $z=30$ and $z=20$, there are 64 Myr; between $z=6$ and $z=5$, there are 190 Myr; between $z=1$ (5 billion years after the big bang) and $z=0$ (15 billion years after the big bang), there are 10 billion years [50] [51] [52].

From ~299,730 km/s to 299,000 km/s, the velocity decreased by 0.24% of *c*, while the mass of the relativistic proton would have lost mass by releasing much of the kinetic energy stored as mass [50]. This release of energy at speeds of less than a few thousand km/s (when the v/c ratio begins to be low compared to 1) decreases the particle's inertia, so the more we decelerate, *the easier we make deceleration*. This gigantic drop in energy would occur during the first 800 Myr after the big bang. Specifically, we place the relativistic bang between 86 Myr after the big bang ($z=30$) and 150 Myr ($z=20$). The energy input of this bang leads to two effects: a first system of star formation from dense gases, and the re-ionization of dilute gases, simultaneously with the contraction of dense gases.

4.5. ARCADE 2 Excess

Radio observations at multiple frequencies have detected a significant isotropic emission component between 22 MHz and 10 GHz, commonly termed the ARCADE 2 Excess. The origin of this radio emission is unknown, as the intensity, spectrum and isotropy of the signal are difficult to model with either traditional astrophysical mechanisms or novel physics such as dark matter annihilation [53] [54]. Theory of Relation [15] [16] proposes a model capable of explaining the key components of excess radio emission. More precisely, the model shows that from a Lorentz energy transformation one hundred Myr after recombination, a relativistic bang would have injected colossal energy exceeding the already existing positive energy. It is electromagnetic radiation containing electrically charged particles. Gravity tightened the magnetic field lines by joining the existing gases. These new ionized particles, moving at relativistic speeds along these lines, are both slowed by collision with the original particles and accelerated by the magnetic lines, thus producing the synchrotron emission. This acceleration of electrons via turbulence in forming galaxies is able to explain the intensity, spectrum, and isotropy of the Arcade 2 data. We conclude that for the radio background to be at the level reported by Arcade 2, it must be largely composed of emissions from primordial galaxies forming at $z \sim 30$ in which the observed radio-to-far-infrared flux ratio increased significantly with redshift.

5. Magnetic Fields

The purpose of NASA's Arcade 2 instrument was to get a closer look at the cosmic microwave background, seek out the heat of primordial stars and remnants of the big bang and catch a glimpse of the first stars and galaxies coming into being. Arcade was looking out for radio waves since light from that far away loses energy and turns into radio waves by the time it gets over here. He picked up a "space roar" that didn't come from a single source because it was so diffuse. It was found to be made of synchrotron radiation, which is unleashed by charged particles zooming near the speed of light when a magnetic field or other force changes their trajectory [55] [56]. The idea that cosmic magnetic fields may have played a role in the formation of galaxies is not new.

5.1. On the Importance of Magnetic Fields

Magnetic fields have been detected within very diverse astronomical objects: planets, stars, galaxies and clusters of galaxies, interstellar and intergalactic gas. The Earth has had a magnetic field for over three billion years. Magnetic fields have been detected on other planets in the solar system, in the Sun itself, in other stars, in the tenuous interstellar gas between the stars of our own and other galaxies, and in the even more tenuous gas in galaxy clusters. Magnetic fields have been identified in "normal" galaxies half the age of the universe, as well as in radio galaxies less than a tenth the age of the universe. Despite all these observations, however, we cannot conclude that a magnetic field is present in the entire universe: there is as yet no definitive proof in this sense [57] [58] [59].

5.2. Primordial Magnetic Fields

What role can magnetic fields play in the formation of structures and the evolution of galaxies? Before the recombination phase, matter was tightly coupled to radiation and unlikely to have been subjected to magnetic forces. The universe then consisted of a non-magnetized plasma in motion.

However, physicists have suggested that the large-scale magnetic fields observed today in galaxies or clusters of galaxies originated at the very beginning of the universe from interactions between photons and electrons before the first atoms had time to form. In the early universe, ordinary matter consisted of hot plasma containing protons, electrons and photons, within which the photon density fluctuated. The result was regions of varying photon density. These photons "pushed" the electrons, but not the heavier protons. This process generated rotating electric currents which, in return, generated "seeds" of magnetic fields [60].

It has long been suspected that galactic spin may be the relict of turbulent motions in the early universe which eventually generated large-scale density inhomogeneities that condensed into galaxies (Gamow 1952; Ozernoy 1969, 1972; Ozernoy and Chemin 1968, 1969; Ozernoy and Chibisov 1971a, b) and that galactic magnetic fields may be the fossil remnants of a large-scale primordial magnetic field (Harrison 1970, 1973a, b; Piddington 1971, 1972; ZePdovich 1965, 1970). E.R. Harrison [61] explained that magnetic fields are generated during the radiation era of the early universe in regions that have rotation. These fields are weak compared with the present intensity of the galactic magnetic field and therefore must be amplified as the Galaxy forms and evolves.

Simulations by researchers suggest that the very large-scale magnetic fields that dominate the universe today developed from their tiny magnetic fields, which arose spontaneously in turbulent plasmas. They simulated turbulences within this plasma to study a phenomenon known as Weibel instability. They explain that asymmetries can appear when more particles move in one direction than in others. These asymmetries in the charged particles lead to the spontaneous appearance of tiny magnetic fields. The models used revealed that the Weibel instability created a tiny initial magnetic field, forcing the charged particles to clump together. Combined with the swirling plasma, this agglutination led to a progressive increase in magnetism. Turbulence takes these magnetic field lines and twists, stretches and bends them, helping to reinforce them. Eventually, tiny magnetic fields may reach the galactic or even intergalactic scales we observe today [62] [63].

5.3. Post-Recombination

Ira Wasserman [64] shows that if we assume the existence of a disordered cosmic magnetic field at recombination, then, provided the field varies on a comoving scale corresponding to a typical galactic mass, we can account for the existence of galaxies, galactic angular momenta, and galactic magnetic fields.

After recombination, the coupling becomes much weaker and magnetic forces were able to influence the growth of density structures, provided the magnetic field was of sufficient strength. We know that random magnetic forces produce fluctuations in the density of matter: these two random distributions are correlated with each other if the magnetic field is intense enough. The Lorentz force drives compressional and rotational perturbations which grow into spinning protogalaxies. The frozen-in primordial magnetic field gives rise to the galactic magnetic fields. Magnetic force measured today after a long period of expansion corresponds to about 0.001 μG (μG, or micro-gauss, is one millionth of a gauss).

In addition to its dynamic aspects, the formation of galaxies must take into account thermodynamics. Indeed, cold gas must condense from a background environment which may be hot. The thermal conductivity of hot gas being very high, cold condensations, in particular small condensations, naturally tend to evaporate. Therefore, the suppression of heat conduction by even a weak magnetic field may be an important ingredient in the formation of protogalactic condensations [49] [65] [66].

5.4. Magnetohydrodynamics

Magnetohydrodynamics (MHD) is a model of electrically conductive fluids that treats all interpenetrating particle species together as a single continuous medium. It applies to astrophysics, including stars, the interplanetary medium and possibly the interstellar medium and jets. The hypotheses that the universe was permeated by a disordered magnetic field at recombination accounts for the existence of galaxies, galactic angular momenta, and galactic magnetic fields. One might well ask if the magnetohydrodynamic theory of galaxy formation presented here really represents an improvement on the conventional gravitational instability theory. Although the MHD theory of galaxy formation appears to be superior, in some respects, to the gravitational instability picture, we cannot consider the theory complete in the absence of a comprehensive theory for the origin of the primordial field [67] [68] [69]. The lack of consensus does not prevent from thinking that magnetic fields were present before galaxies [70] [71].

In his book "Principles of Physical Cosmology" [72], P.J.E. Pebbles refers to Wasserman [64] to present the estimate the effect a primeval magnetic field would have on the large-scale mass distribution:

"If a primeval magnetic field homogeneously expanded to the present epoch has present characteristic value B_o for the component with present characteristic length l_o, the mass density perturbation produced by the field stress at decoupling is

$$\delta_i \sim \frac{B_o^2(1+z)^4}{4\pi} \cdot \frac{l_o^2}{(1+z)^2} \cdot \frac{1}{\rho_o l_o^3} \cdot \frac{4}{9\Omega H_o^2(1+z)^3} \cdot \frac{1+z}{l_o} \cdot \frac{\Omega_B}{\Omega} \tag{10}$$

(current magnetic field: B_o; gravitational constant: G; Hubble constant at present time: H_o; net density: Ω; baryon density: Ω_B; current length: l_o; length in mega parsecs: l_{Mpc}; current density contrast: δ_o; density contrast at decoupling: δ_i)

The first factor is the magnetic force per unit area. The force multiplied by the proper area of the coherence length l_o and divided by the mass is the fluid acceleration. The product with the square of the world time is the characteristic displacement in an expansion time. That divided by the characteristic proper length of the field fluctuation is the density contrast δ_i produced in the baryonic matter at decoupling. The last factor indicates that the net mass contrast is reduced by the ratio Ω_B/Ω of the baryon density to the net density in movable matter."

For the rest of the demonstration, Peebles assumes that dark mass (whether adiabatic or isocurvature) is baryonic, $\Omega = \Omega_B$. In total disagreement, we conjecture that it is morea case of a surplus of ordinary baryonic mass, $\Omega = \Omega_B$. In the framework of Relation theory, this excess of ordinary mass would come from a Lorentz energy transformation during a relativistic bang, as described above in section 4.4. We continue the demonstration not with a dark baryonic mass but with an ordinary baryonic mass:

"*Then the gravitational growth factor of* δ *to the present is about* $(1+z)$ *if the universe is cosmologically flat and* $\Omega \lesssim 0.1$*, and the magnetic field needed to produce the present density contrast* δ_o *on the scale* l_o *measured in mega parsecs work out to*

$$B_o \sim \frac{l_o H_o^2 \Omega \delta_o^{1/2}}{G^{1/2}\left(1+\left(1+z_{dec}\right)^{1/2}\right)} \sim 10^{-9}\,\delta_o^{1/2} l_{Mpc} h^2 \Omega \text{ gauss} \tag{11}$$

Typical magnetic fields in galaxies are $B \sim 10^{-6}$ *gauss at matter densities* ~1 *proton* cm^{-3}*. If this were isotropically expanded by six orders of magnitude, to the background density, it would bring the flux density to*

$$B_o \sim 10^{-10} \text{ gauss}. \tag{12}$$

Here again is a conceivably significant coincidence: that an interesting magnetic flux density, if primeval, would do interesting things to the mass distribution.

The energy density in the cosmic background is equivalent to $B_\gamma \sim 10^{-6}$ *gauss, and the CBR energy density scales with redshift in the same way as a homogeneously expanding primeval magnetic field, so the energy in a primeval magnetic field would be a fixed fractional perturbation to the mass density at high redshift,*

$$\delta\rho/\rho \sim B_0/B_\gamma^2 \sim 10^{-8}, \tag{13}$$

for the present flux density in Equation (12)*. This is an unacceptably large perturbation to the net mass density at very high redshift, where fluctuations in the total density grow as* $\delta\rho/\rho\ \alpha\ t\ \alpha(t)^2$*, because after an expansion factor* ~10^4 *the fluctuation* (13) *on scales larger than the Hubble length would grow to* $\delta\rho/\rho \sim 1$*.*"

Whatever the result of a primitive field's effect on large-scale mass distribution, it's clear to us that at the beginning there was mostly ordinary baryonic matter, very little dark matter and primitive magnetic fields.

6. Alternative to the Massive Confusion Theories of the ΛCDM Model

The Standard Model, dubbed ΛCDM, is the jewel for theorists. Built up over the decades by generations of cosmologists following Einstein, it describes the universe as a fluid composed mainly of cold dark matter (CDM), whose expansion is accelerated by a kind of vacuum energy called cosmological constant (Λ). Its strength is that it describes all the large-scale properties of the universe using just six parameters. And it fits in perfectly with the theory of cosmic inflation which holds that, in its first fraction of a second, the universe swelled immeasurably. Its simplicity is only valid if the universe is flat [73].

Our alternative to this model is the theory of Relation, which has always advocated a spherical universe model with decelerated expansion [74]. The space-time of our theory has a decelerated dynamic, which results in a positive space-time curvature ($K = 1$), or spherical, and a negative cosmological constant. Even if the total amount of energy (all forms of matter and energy combined) contained in the universe were smaller than the critical density, and space were consequently open in the shape of a hyperbola ($k < 0$), it would still be in decelerated expansion because of its negative cosmological constant, not because of its curvature [75].

Theory of Relation doesn't have the "science appeal" of the ΛCDM model: you don't make headlines with a decelerated universe. However, things have been changing since 1998. Based on the latest data from the Planck satellite for observing the cosmic microwave background—the primordial radiation of the universe, emitted 380,000 years after the big bang—three researchers assert that the geometry of the cosmos is not equivalent to that of a plane, but of a sphere. And if space is curved, even by just 4% as Planck's measurements indicate, then the standard model of cosmology collapses [76].

In fact, what these researchers are saying is that Planck's reliably accurate data show that the sum of the angles of a triangle is greater than 180°. The universe is not geometrically flat ($k = 0$) but curved. A spherical geometry. Data from the WMAP satellite launched in 2001 to map the fossil radiation of the universe had a faint indication of positive curvature suggesting that the universe is closed. Data from its successor, the Planck satellite launched in 2009, were more conclusive. They say that there is more than a 99 out of 100 chance that the universe is closed, contrary to the current consensus. With such a high probability, the hypothesis of a universe with spherical geometry can no longer be ignored. And if it doesn't fit with the sacrosanct ΛCDM model, then the big problem is a positive cosmological constant. An "apprehended crisis" [73] [77].

6.1. First Stars

Astronomers now believe that the first stars began to form less than 100 Myr after the big bang. Studies carried out with the James Webb Space Telescope (JWST) in 2023 discovered candidate galaxies in the first 400 Myr of cosmic time [78]. How did the universe, in such a short space of time, go from a gaseous "soup" composed of 76% hydrogen and 24% helium to a world teeming with stars? According to astrophysicists' computer simulations, primordial stars were 100 to 1000 times more massive than the Sun. On the one hand, they were forges where the first heavy atoms were created. Secondly, their UV radiation began to ionize hydrogen. Population 111 corresponds to these massive primitive stars devoid of heavy elements, which would have disappeared by now. Because their composition at the time of their formation consisted exclusively of hydrogen and a little helium, they required an enormous mass of gas clouds to condense sufficiently for gravity to overcome the dilatation of the gas, which heats up as it contracts, and start the thermonuclear reactions that make them glow. The Cosmic Renaissance is the period of transition when the universe became transparent to optical and ultraviolet wavelengths.

The hypothesis of the disappearance of gigantic primordial stars is supported by two concrete facts. Firstly, the presence of large quantities of iron from the very first billion years of the universe. Iron is only dispersed when stars die [79]. It therefore took one or more generations of very short-lived stars, such as a 200-solar-mass star with a life expectancy of less than 5 Myr, to provide such a high concentration of iron. Secondly, if there had been small stars of population 111, they would still exist. Although stars with very low levels of heavy elements have been found, iron-free stars have never been detected in the Milky Way.

Scientists are wondering by what mechanism supermassive stars, which have short lives and synthesize many heavy elements, were able to create iron and disperse it within a billion years of the big bang. According to the models, a lot of dark matter had to be added to form an enormous mass of gas [80], which leads to the fatal collapse. However, most of the elements produced remain trapped in the black hole that forms; the iron is definitively masked when the star dies.

According to the Relation Theory model, the added energy from the relativistic bang could, for stars of 100 solar masses or more, destabilize the core and lead to a tremendous explosion: a *hypernova*.

6.2. Equilibrium of Hyper-Condensed Stars: White Dwarfs and Neutron Stars

"White dwarfs" (electron stars) are very small stars that derive their equilibrium from the same principle that keeps the hydrogen atom stable [81] [82]. The electron of the hydrogen atom is in equilibrium under the action of two counterbalancing forces: the force of electrical attraction (which varies as $1/r^2$) and the repulsive force associated by quantum mechanics with the size of the system (which varies as $1/r$). In a similar way, when a star condenses, atomic electrons move closer together and their mutual distance is associated (again by quantum mechanical formulae) with a kind of agitation velocity creating a repulsive force capable of counterbalancing the attractive forces of gravity. The total energy per atom of the white dwarf is given by the formula

$$\left(h^2 N^{2/3}\right)\Big/ m_e R^2 - \left(GNm_H^2\right)\Big/ R \,. \tag{14}$$

(m_e: electron mass; N:number of atomic nuclei; m_H: proton mass; R: star radius; M: star mass)

The first term gives the average kinetic energy per electron. This energy is opposed by the gravitational energy per nucleus. Equilibrium is achieved when the two terms are equal. From this formula we derive the formula for calculating the size of a white dwarf.

$$R = h^2 \Big/ \left[G m_e m_H^2 \left(M / m_H \right)^{1/3} \right]. \tag{15}$$

Knowing that a white dwarf has about the mass of the Sun (2×10^{30} kg), we find a value for its radius of the order of 6,000 kilometers, *i.e.* the size of the Earth.

The equilibrium of a neutron star formally obeys the same laws, except that the degree of compactness is such that we are dealing only with neutrons of mass m_H. It is enough to replace me (mass of the electron) by m_H, in the formula (15), to obtain the radius of such an object. We find a value a thousand times smaller, of the order of a few kilometres. The mass per unit volume, on the other hand, is a billion times greater, on the order of the density of the proton itself.

6.3. Imbalance Leading to Black Hole, No Iron

The basic idea of relativity is to always consider time and space concomitantly: a mass-energy, assimilable to the temporal component of a vector, is invariably accompanied by a momentum, assimilable to the spatial component of the same vector. The formula (2: $E^2 = m^2c^4 + p^2c^2$) gives the energy of a particle of mass m and momentum p, and shows that a mass at rest, *i.e.* with zero momentum ($p = 0$), has a certain energy ($E = mc^2$). The results lead to black holes. To understand this, it is necessary to evaluate the modifications to be made when the relativistic effects become notable, particularly with the addition of dark matter. The gravitational energy of a star of radius R and mass M is considered by a term (M^2/R). But M only contains the sum of the "rest" masses of all the particles (neutrons). However, since these particles are animated by the velocity of agitation, considering the effect of dark matter, we need to add to this mass a term representing the quantity of motion contained on average in an element of given volume. According to the formulas of quantum mechanics, the total mass of the star is

$$M = Nm_H \tag{16}$$

N is the number of atomic nuclei, protons of mass m_H. Roughly speaking, these N particles are distributed in a volume R^3, if R is the radius of the star. Each is therefore allocated an elementary cube of volume (R^3/N). The distance a between two neighboring particles is of the order of the edge length of this cube, *i.e.*:

$$a = \left(R^3/N\right)^{1/3} = R/N^{1/3} \tag{17}$$

The inter-particle distance $a = \left(R^3/N\right)^{1/3}$ (a is also the average distance between two electrons) corresponds to a momentum:

$$p = h/a = hN^{1/3}/R \tag{18}$$

According to Equation (2), *i.e.* $E = m_H c^2\left[1+\left(p^2/m_H^2c^2\right)\right]^{1/2}$, the non-relativistic formulae must be modified by multiplying the rest mass by the square root of the quantity in square brackets, *i.e.*, considering formula (18), by $\left[1+\left(\hbar/cm_H\right)^2\left(N^{2/3}/R^2\right)\right]^{1/2}$.

Because of the modification relating to M, the gravitational energy, in (M^2/R), will see its term in ($1/R$) replaced by the expression

$$\left(1/R\right)+\left(k/R^3\right) \tag{19}$$

with

$$k = \hbar N^{1/3}/cm_H \ .$$

It is the ($1/R^3$) term in formula (19) that completely changes the behavior of the solutions. Whereas previously the ($1/R^2$) quantum repulsion term could oppose gravitation, now the total energy no longer presents a stable minimum: when the radius decreases, the energy instead passes through a maximum for then decrease without limit. The conclusion is inescapable: if the star crosses the corresponding threshold, nothing can stop its fall in on itself: iron is confined in perpetuity [78].

6.4. Imbalance Leading to Hypernova, with Iron

According to the model of theory of Relation, the added energy input from the relativistic bang, *i.e.*, the injection, from a Lorentz energy transformation one hundred Myr after recombination, of colossal energy exceeding the already existing positive energy (Section 4.5), could, for stars of 100 solar masses or more, bring into play more collisions between pairs of electrons and positrons formed during nuclear reactions. We have seen (16)that the total mass of the star is $M = Nm_H$. If, at the inter-particle distance $a = \left(R^3/N\right)^{1/3}$, a photon of high energy hits any particle, it serves as a stopping point, a fulcrum, the radiation materializes by creating a particle and an antiparticle, which has mass. Very quickly the antiparticle is attracted by a particle and there is dematerialization. These collision-annihilations completely destabilize the star's core, culminating in a powerful explosion: a hypernova [79] [83].

If the star's mass is between 140 and 260 solar masses, the explosion completely shreds it. No neutron star or black hole remains. All the matter of the first-generation star, with its heavy elements, including iron [79] [84], is expelled into space at colossal speeds, seeding the universe with heavy elements and dust for a new stellar generation.

7. Formation of a Primordial Galaxy according to the Theory of Relation

The majority view is that galaxy evolution occurred in accordance with the ΛCDM cosmological model. This model of concordance between dark matter and dark energy associated with a positive cosmological constant has become the standard model of the big bang. If official cosmologists are to be believed, the early universe began with a fluid composed marginally of ordinary matter in the form of radiation (photons and neutrinos), and predominantly of dark matter, whose expansion is accelerated by a kind of dark vacuum energy. Around 10,000 years after the big bang, once matter became the dominant species, large structures began to develop. Since ordinary matter was still just a coupled plasma of photons, nuclei and electrons, dark matter would have been responsible for these structures, shaping small gravity wells in the form of invisible lumps towards which ordinary matter would have rushed when it was liberated from photons around 400,000 years after the big bang. Without this hidden activity of dark matter, ordinary matter alone would not have had time to generate the galactic structuring of the universe in the period since the big bang [85] [86].

We challenge this postulate, which states that dark matter was totally physically present from the very beginnings of the universe. And that it participated from the start significantly in its structuring from invisible lumps while ordinary matter remained frozen in its sea of photons. And we contradict this dark energy that is producing the current acceleration in the expansion of space. The value of this energy calculated by quantum theory is at least 10^{120} times greater than any cosmologically acceptable value, which necessarily leads to the vacuum catastrophe.

Scientists expected the radio emissions picked up by Arcade 2 to form a diffuse radio background coming from all directions, but they didn't expect a "boom", *i.e.* a radio signal six times louder than expected, more intense than all other radio sources in the entire universe. Consequently, there would have to be six times as many galaxies in the distant universe to match the intensity of this widespread roar resonating in the depths of space [56]. In addition, extremely strong magnetic fields would be required for high-energy charged particles spiralling along magnetic field lines to radiate disproportionate power at radio frequencies via the synchrotron process.

Faced with a so-called "precision" cosmology, which decrees that more than 95% of the world's content consists of dark matter and dark energy of an unknown nature, almost undetectable, it's time to rethink the universe by including magnetic fields. Astrophysicists still don't know how stars form. They believe that they are born by the condensation and fragmentation of interstellar clouds but are unable to describe the mechanisms accompanying the various stages. What triggers the cloud to contract? Is a magnetic field necessary? If so, what is its value and distribution? The discipline of MHD is devoted to the study of plasma behavior in the presence of a magnetic field, but it has not yet achieved the level of results required for modeling. The actual variation of stellar plasma as a function of distance from the star's center is not in line with theoretical predictions. No stellar model predicts the existence of chromospheres and corona. Sunspots and prominences are direct manifestations of the Sun's magnetic activity. The jets of matter are caused and channeled by the magnetic field. However, no stellar model can include this magnetic field [87].

Let us clarify that we are not contesting either the existence of dark matter or its participation in the formation of stars and galaxies, but rather its overall existence from the outset and its action to form the first lumps. Magnetic fields would initially have had this task, rather than dark matter. We believe that the latter appeared gradually. Blogs would probably have appeared after the disappearance of population 111 stars. These stars would have existed before the formation of galaxies and, according to models, could only have existed as very massive, metal-free stars with very short lives. No primordial stars have yet been observed. These dark matter blogs mixed with ordinary matter would next have helped give rise to galaxies. According to cosmological models, the first small star-forming systems should have appeared between 100 and 250 Myr after the big bang. These protogalaxies would have been 100,000 to a million times more massive than the Sun, and 30 to 100 light-years across. These properties are similar to those of the molecular gas clouds in which stars are currently forming in the Milky Way [51] [88].

A Possible History of the Birth of a Primordial Galaxy

Here is a model of the birth of a primordial galaxy. Imagine a ragged cloud of gas about twice the size of the galaxy's halo today. Standard theory would assume that its density is too low, around a thousand atoms per cubic metre, to form a galaxy after such a short time, but the density could be six times higher with the bang suggested by the theory of Relation, making formation very possible. Under these conditions, the proto-galactic cloud was probably turbulent, swirling with random currents. The agitated peripheral parts of the cloud are conducive to generating strong magnetic fields.

At first, gravitational energy slowly contracts the cloud, with its central regions collapsing faster than its outer parts. Throughout the cloud, turbulent vortices of varying sizes form, break up and disappear [84]. Gravitational energy is first partially transformed into rotational energy. By contracting, rotation accelerates. Peripheral magnetic fields are linked to the cloudy gas and contract with it. The contraction of the field generates a progressive increase in magnetic pressure, which opposes and slows down the contraction, as if the gas were becoming elastic. Soon, however, the protogalactic cloud spins too fast, becomes too hot and is far too magnetized to condense into stars.

During these sequences, it is estimated that the protogalaxy emitted a *Brems-*

strahlung radio emission noise about six times louder than expected. Bremsstrahlung is the electromagnetic radiation emitted in the form of photons (X-ray) when a charged particle is decelerated upon striking against another charged particle. On the contrary, the synchrotron emission of electrons strongly depends on the magnetic field of the medium. It is caused by the slowing down during collisions of electrically charged relativistic particles that spiral in intense magnetic fields. Simultaneous observations of the two forms of radiation can provide clues about the configuration of the cosmic magnetic field [89].

A mechanism then comes into operation which can extract excess magnetic and rotational energy from the cloud: this is the coupling that the galactic magnetic field ensures between the contracting cloud and the surrounding matter. The cloud's rotation, accelerated by contraction, causes the lines of force to become entangled, taut, and increasingly resistant, like an elastic band being stretched. The twisted lines of force tend to slow down the rotation of the cloud by speeding up that of the disk, thus transferring angular momentum from one to the other. They also tend to push the material of the disc outwards, thus accelerating its expansion [90]. This environmental resistance has the desired double effect: it reduces the rotational energy and drains the rotating mass of its magnetic energy. When the centrifugal force becomes comparable to the gravitational force, the contraction can no longer continue. The cloud then appears as a very flattened, highly magnetized disk. The magnetic field lines, anchored in the inter-proto-galactic medium on the one hand, and driven by the cloud's revolutions on the other, have applied an effective brake at the disk's periphery, where stretching is at its maximum. As the surplus energy is evacuated, the nebula contracts and approaches galactic dimensions [91].

Eventually, the vortices become dense enough to contain enough mass to hold together. These could be hundreds of persecs in size—nascent globular clusters. Not all the gas is consumed in this explosion of globular cluster formation. As the original cloud contracts, it rotates more quickly around its axis of rotation, consistent with the conservation of angular momentum, and slowly falls into a disk. Throughout this process, Arcade 2 could have picked up intense radio microwaves made up of synchrotron radiation: new ionized particles moving at relativistic speeds along the magnetic field lines are both slowed down by collisions with the original particles and accelerated by the magnetic lines. As the disk forms, its density increases, and more stars form. Each globular cluster therefore becomes denser, then subdivides to form individual stars—all born around the same time with the same chemical composition. This happened 15 billion years ago [84].

The globular clusters retained some of the radial motion of the contraction of the original cloud and therefore found themselves in eccentric orbits around the center of the Galaxy. The formation of the halo took place quickly, in less than 2 billion years. Each star-birth explosion leaves behind representative stars at different distances from today's disk. Eventually, the remaining gas and dust settle into the narrow layer we see today. One way or another, density waves appear, leading to the formation of spiral arms. Meanwhile, massive stars were making heavy elements and releasing them back into the cloud. As successive stars were born, each subsequent type contained more heavy elements. This enrichment continues today in the disc of the Galaxy, but much more gradually than in the past.

8. Conclusion

In total contradiction with current cosmological understanding, the theory of Relation postulates the existence of dark energy emanating from a relativistic big bang which, in the guise of an expansive electromagnetic space-time wave, transforms its negative energy into positive matter. The radio wave detected by the Arcade 2 radio antenna would reveal a "cosmic static" resulting from the hot primordial universe. This extragalactic radio background, 5 to 6 times brighter than the estimated contribution of all point radio sources, would result from an enormous release of energy from a relativistic bang around 100 Myr after the big bang, via a Lorentz energy transformation. This excess energy would manifest itself as a cosmic boom, a kind of roar from space that is radio waves that allow us to hear electromagnetic waves from farther away than we can see light. This roar would be caused by synchrotron radiation, a type of emission of charged particles in magnetic fields. The energy of the bang (resulting from the velocity drop from $\sim c$ to v of the expanding matter) would have produced energetic particles and magnetic fields strong enough to generate a regular synchrotron radio background. Reionization would also have begun with this surplus of energetic radiation overcoming and ionizing the neutral hydrogen atoms in the vicinity of the dense gas clouds, carving out a growing bubble of ionized gas around each of them. Without the need for super-massive stars, the currently accepted cause. The reionization of neutral gases by radiation from the first supernovae, black holes and the rapid disappearance of the first massive stars, would have been added later.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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