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Universe: the dynamics of the minimum and maximum expansion states

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Abstract

Two hypotheses stand out in describing the evolution of the Universe. The predominant one predicts that the current expansion began at a certain instant and will not preserve any variation of energy that performs work; apparent flat Universe ($\Omega = 1$) is advocated by relativistic calculations and observational data, with an end or thermal death at its maximum expansion (3D Space). The other hypothesis considers that the Universe is cyclical (always alternating phases of expansion and contraction). This proposal aims to demonstrate that both hypotheses can be correct by not being distinct, but complementary. Supported by the immutability of physical laws, analyses of concepts such as space, mass, energy, gravity, spin, and entropy define an exclusive presence of 1D Space in the minimum and maximum expansion states of the Universe. With our 3D Space Universe created and existing between these extreme states, a complete universal evolution is outlined. More objectively, all the exposed dynamics complements the usual relativity. The concept of complete rest energy (1D Space) was able to be applied, demonstrating that the complete evolution of the Universe is spatially dynamic in a perpetual time dimension, always recreating our Universe.

Keywords: Universe, Energy, Spin, Gravity, Entropy.

Introduction

The state of the Universe depends on energy. If the Universe is in an extremely contracted state, with the scarcity of space inside, no environment that promotes life would exist. In contrast, if the Universe is in a well-expanded state, the energies would not generate agglutinations for planetary formations or existence of life ; therefore, the study of universal evolution [1] is important.

In Cosmology, the evolution of the Universe [2] is studied via astronomical observations, particle collision experiments, computational analysis, and relativistic calculations. However, its complete understanding is hindered by factors, such as the unknown nature of some of its constituents.

The most accepted theory about our Universe evolution posits a certain initial state and an accelerated spatial expansion. However, the structure generating this expansive beginning is still under debate.

The instants of extreme universal contraction are usually related to presence of a great energy concentration.

Moreover, the existence of an expansive universe, the predicted current amount of mass, and entropy (S) are commonly associated with a future thermal death or total dissipation.

Given these current associations, this study highlights concepts such as Universe, energy [3], dimension, and space to present solutions and coherently complete the predominant existing model of evolution.

Development

The Universe can be considered the holder of all space-time, that is, any massive or energy content that generates a variation of space related to the time dimension [4].

The characterization of the true extreme states is necessary to define a complete evolution of the Universe. Already well-established physical concepts can facilitate the achievement of this objective.

Conceptually, the Universe must be in a static state of finite maximum contraction to initiate an expansion. Just as the minimum temperature cannot be lower than Absolute Zero, the most extreme contraction will be limited to the maximum possible absence of space; for this extreme state, the universe is formed with a finite amount of contraction energy available to be converted into an energy that can represent the maximum expansion state.

Thus, the universe is limited with respect to the maximum and minimum space it can occupy, or its complete evolution is limited to a resting state at the extremes, naturally preserving its existence.

Complete evolution limited in extreme states: for the beginning or the end of any relative motion, it is necessary to be at rest.

Before the expansive beginning, the components of the entire universe had to be at rest.

For the maximum expansion, the components of the entire Universe will be at rest.

For the presence of extreme and static states, conserving the dynamic, the presence of maximum potential energy (space vague between the masses) is necessary, i.e., the presence of a maximum distance (occupied or not) or 1D Space.

The possible variation of space is always the same : limited by 1D (extreme states).

The entropy depends on the distribution of components in space or on the degree of freedom present, that is, on the type of Space that exists: 3D, 2D or 1D; the degree of freedom of complete universal evolution is limited in 1D Space.

Maximum contraction: 1D Space has a maximum occupation; relative motion is zero; spin is zero.

Maximum expansion: 1D has a minimum occupation; the space (between the two minimum 1D particles) is vague; spin is zero.

There are studies that propose the exclusive existence of lower dimensions [5, 6].

Relativity (3D + 1D) and quantum mechanics analyze the beginning of the expansion only of our Universe (3D Space); the initial instant of expansion of the complete universal evolution happened earlier, in 1D Space.

Energy (of a complete Universal evolution) is neither created nor lost; energy is exchanged or transformed.

Since our Universe does not conserve its total energy (relativity), it is necessary the existence of component (lower dimension) in complete evolution, making the Universe conserve its energy.

Mass formed by internal spaces (2D) is the existence in which one of the dimensions is minimum or no space for variation.; Mass formed by internal spaces (1D) is the existence in which two of the dimensions are minimum, with no spaces for variation.

In the analysis of extreme static states (relative motion is zero), it is possible to apply the concept of complete rest energy.

When the internal energetic interactions of any amount of rest mass (m_0) are undone, all value of gravitational potential energy (E_g), of energetic interactions: quantum, atomic and electromagnetic (E_q), and of internal kinetic energy (E_k) [7] are equivalent to the total rest energy ($ET = E_0 = m_0 \times c^2$) [8].

The total invariant mass (at the resting instant of the universe: minimum or maximum expansion) is the analog of the resting mass.

Thus, ET (1D Space) is expressed as follows:

$$ET = E_0 = E_g + E_q + E_k = m_0 \times c^2 \quad (1)$$

For Universal resting state (minimum and maximum (1D Space) expansion), the following points are considered:

- $ET_{maxC} = E_{gC} + E_{qC} + E_{kC}$, where ET_{maxC} , E_{gC} , E_{qC} and E_{kC} are the maximum contraction total energy, gravitational potential, E_q , and Kinetic energies, respectively, in this extreme contracted state.

- $E_{TmaxE} = E_{gE} + E_{qE} + E_{kE}$, where E_{TmaxE} , E_{gE} , E_{qE} and E_{kE} are the maximum expansion total energy, gravitational potential, Eq, and Kinetic energies, respectively, in this extreme expansive state.
- $E_{kC} = 0$ (for the state at rest, relative motion is zero): the maximum contraction.
- $E_{kE} = 0$ (for the state at rest, relative motion is zero): the maximum expansion).
- $E_{qC} = 0$ ($E_{kC} = 0$. Only static state (Quantum energy (Q_e) = Planck's constant (h) x Frequency (F) = 0 ($F = 0$; $E_{kC} = 0$). Without atomic presence, and without electromagnetic interactions).
- $E_{qE} = 0$ ($E_{kE} = 0$. Only static state ($Q_e = h \times F = 0$; $F = 0$), without atomic presence, and without electromagnetic interactions).
- $E_{TmaxE} = E_{TmaxC} = E_{gE}$ (maximum value) + E_{qE} (=0) + E_{kE} (=0) = E_{gC} (maximum value) + E_{qC} (=0) + E_{kC} (=0).
- For maximum E_{gE} , the maximum distance (the empty space) between the two minimum massive particles (one- dimensional) must be present.
- For E_{gC} , the maximum value must be present, even with the scarce empty spaces.
- For E_{gC} to have the maximum value, the masses must be distributed in 1D length (maximum distance between the centers of mass).

If for E_{gC} the masses are distributed in 1D length ($d = 2 r$), and for E_{gE} the maximum distance (the empty space) between the two minimum massive particles is 1D, the gravitational field is uniform, and the reference point is the center of mass.

For these extreme states, the use of the integral: $U(x) = \int \mathbf{F}(x) \cdot d\mathbf{x} = E_g = (-G \cdot m \cdot m / r)$ makes the value of potential energy negative; with the value of E_k tending to zero or equal to zero (at minimum and maximum expansion), E_g has a maximum value tending to zero.

For uniform gravitational field (for these extreme states, before the expansive start: maximum E_g , $E_q = 0$ and $E_k = 0$), total energies are positive ($E_g = m \cdot g \cdot h$; g = acceleration of gravity, and $h = d / 2 = r = \text{distance} / 2 = 1D \text{ length} / 2$).

For the minimum and maximum expansion of the Universe, the following points are considered:

- The **variation** of the capacity to perform work is always the same, limited by the perpetual existence of some empty space between masses (energy variation).
- Maximum expansion: two minimum masses (particles) are separated to maximum by 1D empty space, corresponding to $E_0 = E_{TmaxE} = E_{gE}$.
- Maximum contraction: two minimum spaces are present, i.e., the universal structure is composed of three mass parts: one minimum mass (particle) between two maximum mass ($m_0 + m_0$) for the conservation of energy.
- $M_0 - m_0 =$ minimum mass (1D particle; where $M_0 > m_0$, and $M_0 \cong m_0$).
- $M_0 + M_0 + (M_0 - m_0) =$ Universe total mass in the maximum contraction state (if it were possible the non-existence of empty spaces).
- $m_0 + m_0 + (M_0 - m_0) =$ Universe total mass in the maximum contraction state (With the necessary presence of the two minimum empty spaces).
- The energy of the state of maximum contraction is the gravitational potential energy related to the masses ($M_0 + M_0 + (M_0 - m_0)$) subtracted from the absence of $2 (M_0 - m_0)$ or the empty spaces present.

- There is no energy directly associated with the existence of the spaces in the extreme states of the entire universe (static 1D Space). Such existence is related to a limited gravitational potential energy (existence of mass) in a state of maximum, but not complete, contraction or expansion.
- Energy available in the maximum contraction state:

$$(M_0 + M_0) \times c^2 + (M_0 - m_0) \times c^2 - 2 (M_0 - m_0) \times c^2 = m_0 + m_0 + (M_0 - m_0) = (M_0 + m_0) \times c^2$$
; formed by a maximum massive part, a minimum empty space, a minimum particle (mass), another minimum empty space, and another maximum massive part. (With the necessary presence of two internal empty spaces, corresponding to incomplete and maximum contraction for the energy conservation, $E_0 = E_g C \neq 0$).
- The energy of the state of maximum expansion is the gravitational potential energy related to the presence of empty space (1D) , or the absence of masses: $(M_0 + M_0 + (M_0 - m_0))$, subtracted from the presence of two particles $(2 (M_0 - m_0))$ that do not generate empty space or expansion.
- Energy available in the maximum expansion state:

$$((M_0 + M_0) \times c^2 + (M_0 - m_0) \times c^2 - 2 (M_0 - m_0) \times c^2) = ((M_0 + M_0) \times c^2 - (M_0 - m_0) \times c^2) = (M_0 + m_0) \times c^2$$
Two minimum massive particles separated to maximum by an empty space (1D) corresponding to incomplete and maximum expansion, for the energy conservation, $(E_0 = E_g E \neq 0)$.

In this way, the extreme universal states are represented as follows:

$$\text{Energy available: } E_{T\max C} = E_0 = E_g C = (M_0 + m_0) \times c^2 \quad (2)$$

$$\text{Energy available: } E_{T\max E} = E_0 = E_g E = (M_0 + m_0) \times c^2 \quad (3)$$

$$E_{T\max C} = E_{T\max E} \text{ (conservation of the energy available)}$$

$$(M_0 + m_0) \times c^2 = (M_0 + m_0) \times c^2 \quad (\text{Energy available}) \quad (4)$$

$ET_{max}E = (M_0 + m_0) \times c^2$, does not mean that the universe will have a rest mass quantity $(M_0 + m_0)$ in its state of maximum expansion, but that it will have an energy corresponding to the universe at maximum contraction (the state with this rest mass present).

In the linear states of maximum and minimum expansion, the gravitational potential energy is maximum and the same; in a state of maximum contraction, the amount of mass is maximum, but the distance to the center of mass is smaller (compared to the state of maximum expansion); in a state of maximum expansion, the amount of mass is minimum, but the distance from the particles to the center of mass is maximum.

In extreme states (1D Space), not only Time, but also Space is a linear dimension.

The possible variation of Time relativity is always the same: limited by speed ($v=0$ and $v=c$).

The possible variation of Space (relative to complete Universal evolution) is always the same: limited by 1D Space, and by states of rest.

The entropy (S) or the degree of freedom must be associated with the dimension; the degree is the same in possible extreme 1D Space dimension states ($\Delta S = 0$); When the entire universe expands to reach 1D Space, entropy decreases, due to less space (linear dimension) with the existence of the two minimum massive particles (1D); therefore, entropy is minimum (1D Space: minimum and maximum expansion); thus, expansions are followed by contractions of the same intensity.

Figs. 1–3 show that any contraction and expansion, although intense, cannot be total; demonstrating that the entire Universe is dynamic, always transforming with the preservation of some energetic variation.

Figure 1. The entire Universe (complete evolution).

Figure 2. Universe (1D maximum contraction, 2D, 3D, inflation, 2D, 1D maximum expansion)

<p>Maximum Contraction</p> <p>Part A (1D) • Part B (1D)</p> <p>The spaces</p> <p>For maximum contraction: maximum E_g ($E_g C$: maximum mass; maximum distance between centers of mass with occupied space); $E_q C = 0$ and $E_k C = 0$; Spin = 0 (maximum mass distribution along 1D Space). Relative motion = $V = 0$.</p> <p>In maximum contraction:</p> <p>Part A (m_0), Part B (m_0), particle and only two empty spaces (1D) fill the Space (1D) = without spatial curvature. E_g decreases = E_k increase (energy conservation, 2D and 3D Space entropy) = expansive process starts.</p> <p>1D (Space).</p> <p>Part A • Part B</p> <p>The initial expansion is oriented according to the fact that the sign of the complete disappearance of the space curvature reaches the extremities after a certain time. [9].</p> <p>(Spin)</p>	<p>The Space (2D) arises between the masses = E_g decreases, and E_k and spin increase = approximation of the parts (2D Space).</p> <p>Spin 2D (Space)</p> <p>Spin 2D (Occupied by 1D and 2D Internal space components)</p> <p>The interactions (two dimensions) , begin to form particles with the 3D internal space, and thus generating 3D Space.</p> <p>Spin 3D (Space; Our Universe)</p> <p>Inflation:</p> <p>The spin effect flattens our Universe (centrifugation)</p> <p>3D Space (flat Universe)</p>	<p>Space that becomes 3D (our Universe) is occupied by 1D particles, 2D particles and 3D particles.</p> <p>With more intense interaction, the amount of 1D and 2D masses decreases, while those of 3D increase, making the expansion of the universe accelerated with the increase of its spin (by centrifugation). A flat or curved [10] state of our Universe (3D Space) does not predict the cyclic or non-cyclic of the complete Universal evolution; the extreme linear states of the Universe (1D Space) that define the continuity of its evolution.</p> <p>Dark (matter and energy) has the opportunity or the possibility to be represented by 1D or 2D particles interacting to form 3D particles, in our 3D Space.</p>	<p>Universe 2D Space (Expanding Disk) (Spin)</p> <p>After the complete interaction between the particles, there being only 3D masses in 3D space, the expansion starts to decelerate.</p> <p>With the mass 3D tending to dissipate and returning to form 2D masses, 3D Space again becomes 2D Space (Disk), the spin decreases.</p> <p>For the maximum expansion, the smallest quantity of masses 1D possible emerge:</p> <p>$2 (M_0 - m_0)$, separated by the maximum space:</p> <p>$(E_g E = (M_0 + m_0) \times c^2)$</p> <p>Linear Space (1D)</p> <p>$(M_0 - m_0)$ $(M_0 - m_0)$</p> <p>The universe cannot continue to expand (the existence of massive minimum particles preserves the total energy: $E_{TmaxC} = E_{TmaxE}$ $E_k E = 0$; $E_q E = 0$; $E_g E$ (Maximum)).</p>
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Figure 3. Universe (1D maximum expansion, 2D, 3D, 2D, 1D maximum contraction)

<p>Maximum expansion state: (Spin =0), there is the empty space (1D) between the 1D particles (masses) = without spatial curvature, E_g decreases = E_k increase. Work-related: $E_g E = (M_0 + m_0) \times c^2$, or 2D and 3D Space entropy (start of contraction).</p> <p>The initial contraction is oriented according to the fact that the signal from the complete disappearance of the curvature of space does not instantaneously reach the entire universe; E_g does not convert to E_k and E_q instantaneously.</p> <p>Contraction starts:</p> <p>Particle energetic interactions = E_g; E_k and E_q; E_k, and E_q interactions intensify = E_g decreases; E_k increases and E_q increases = massive particles and the spaces (2D) formations. Neutrino experiments (2020) show the possible asymmetry in the formation of matter and antimatter [11]. The formation of antimatter maybe prevails in contraction, (symmetry only in the set contraction + expansion).</p> <p style="text-align: right;">(Spin)</p> <p>The one-dimensional Space decreases: the formation massive structures and space in two-dimensions begins.</p>	<p>The largest energy concentration is represented by the masses at the two extremes of the universe. The mass quantity at the edges increases, forming the second dimension (Space) and, subsequently, the third dimension (in contraction).</p> <p>3D particles formed maximum spin in 3D Space, flat Universe in contraction</p> <p>(3D to 2D and 1D Space)</p> <p>With 3D spatial maximum compacted (The scarce empty internal spaces) = maximum spin (3D Space occupied and in contraction).</p> <p>E_k is not completely converted to E_g (The contraction continue). Via centrifugation and planarization, will exist to a return (maximum) to the second dimension (2D Space). Maximum massive contraction (2D Disk + particles).</p> <p>The maximum contraction in 2D, will consist of a fully compressed disk, between two particles (symmetry), so that there are spaces, for potential energy (maximum mass of disk) and energy conservation.</p> <p style="text-align: right;">(Spin)</p> <p>2D Flat disk</p>	<p>In its maximum 2D contraction state, the disk (with no internal spaces) loses its internal gravitational effect. the contraction continues (spin) to 1D Space (E_k is not completely converted to E_g).</p> <p>When the disk loses particles by spin, the only space that exists for motion is between the edge of the disk and the particles, that is, the surface (between the disk and the particles) is cone shaped. The homogeneous mass distribution of the disk to future parts (A and B) is defined by spin and entropy.</p> <p style="text-align: center;">The spaces</p> <p style="text-align: center;">Part A Part B</p> <p style="text-align: center;">Consecutive new expansion.</p> <p>Via linearization, Universe becomes 1D Space.</p> <p>The universe returns to the maximum contraction state and the parts are separated by a necessary more central spaces and minimum particle (which allows conservation of the total energy).</p> <p>E_k is completely converted to E_g and the contraction ceases. The Parts A, B and the particle completely reach one dimension (Space), the expansion resumes. ΔS (extremes states) = 0.</p>
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Conclusion

It has been demonstrated that there can be maximum contraction to a single spatial dimension (spinning, centrifugation), but not so intense to be complete, tending only to a single point; similarly, maximum expansion can only occur without the existence of complete dissipation for the entire Universe (complete evolution); there is the perpetual existence of some empty space between masses (energy variation and conservation in the complete evolution of the Universe).

For the presentation of this proposal, the efficiency of observational data and calculations that already delineate the evolution of our three spatial dimension Universe (with inflation) was considered; however, the description of a contraction and an expansion extended to the first spatial dimension was necessary to delineate a more complete evolution with 1D spatial Universe that generates the dynamics in truly extreme and static states, where there is no scope for vibrations or oscillations. The presence of 1D and 2D masses interacting and increasing the 3D massive presence was proposed, explaining the current accelerating expansion in 3D space.

The rest energy (E_0) in 1D (Space) was considered, thus ruling out the use of certain relativistic and quantum calculations ($4D = 3D \text{ (Space)} + 1D \text{ (Time)}$) [12, 13].

The Dynamic Universe (eternal energy transformation) has finite energy (contraction and expansion) in continuous cycles. Energy is limited one-dimensionally by the necessary presence of minimum empty spaces at maximum contraction (1D Space) and minimum masses at maximum expansion (1D Space).

For the beginning or end of any motion (expansion), the entire Universe must be at rest. Relative motion is zero only in the states of maximum contraction and expansion.

An equation has been formulated that respects the necessary preservation of total energy in the entire Universe:

$$(M_0 + m_0) \times c^2 = (M_0 + m_0) \times c^2$$

Our Universe (3D Space), studied by relativity and quantum mechanics, does not conserve its energy total.

The current motion of the Universe already represents an energetic and spatial variation.

The model presented can demonstrate why the Universe starts its spin with the beginning of the expansion [9].

The smallest massive particles (formed by internal spaces 1D and 2D) and their associated energies are occupying and propagating in our universe (3D Space). while these particles do not bond to form 3D internal space particles, their presences are perceived by the energetic effect of their existences. When they group together and form 3D particles (of greater 3D mass union), they represent our accelerated expansion, by the faster rotation of our 3D Space Universe (with a greater amount of 3D mass).

Every energy signal is absorbed in the maximum contraction state of each cycle; thus, Olbers' paradox [14] can be disregarded.

This approach respects the Ockham razor perspective and the principle of parsimony. The best explanation should assume the fewest number of premises [15].

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