GRAVITATIONAL BUCKLING THEORY: EXPLORING NEGATIVE DIMENSIONS AND THE PRE-BIG BANG UNIVERSE

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ABSTRACT

This paper explores the Gravitational Buckling Theory to explain the cyclical nature of the expansion and contraction of the universe, suggesting the existence of negative dimensions beyond the Big Bang. Currently, our universe resides in positive space and is expanding continuously. Introducing the concept of negative dimensions, we propose a radical theory where the universe not only expands in positive space but also contracts under the influence of gravitational forces. As expansion slows, gravity initiates accelerated contraction, ultimately reducing the universe to a tiny Big Bang sphere. Beyond the centre of this sphere lies negative space, which remains beyond the reach of current physical instruments and human comprehension. Upon reaching the Big Bang sphere's size, the universe transitions abruptly into negative space, where a new cycle begins with a violent explosion, giving birth to a new universe. The gravitational binding energy, bulk resistance energy and the kinetic energy of cosmic matter govern this cyclical process of alternating expansion and contraction between positive and negative spaces. The Gravitational Buckling Theory aims to address longstanding cosmological questions regarding the origin and cyclic nature of the universe.

KEYWORDS

Theoretical cosmology, Cyclic universe models, Negative Dimensions, Gravitational Buckling Theory, Pre-Big Bang, Big Bang Origin.

1. INTRODUCTION

The universe has been a source of fascination for scientists and philosophers for generations. It has been a mystery how the universe began and how it will end. In modern astronomy and cosmology, queries regarding the formation of the Big Bang mass, its origins, and the state of the universe before the Big Bang remain unresolved and hotly debated among most Big Bang theorists. While the traditional Big Bang theory explains how the universe evolved after the Big Bang, it doesn't address fundamental questions about what happened before. The theory assumes there was a pre-existing singularity with infinite density, temperature, and energy but offers no insight into the nature of this singularity or what preceded it [1, 2].

Modern cosmological observations prove that the universe continuously expands in all directions [3, 4]. If we trace this expansion backward, we reach a singularity where the universe must have started, but this point creates theoretical challenges. At this singularity point, the laws of physics break down, and mass behaviour becomes unpredictable[5, 6].At the singularity, the universe's zero volume and infinite mass density would exert an infinite gravitational pull on itself, eliminating the possibility of an expanding universe as observed today[7, 8].

If the Big Bang theory is correct, the universe should not be as smooth and uniform as it appears in observations. The Cosmic Inflation Theory, developed to explain the uniformity of the universe, posits that a rapid expansion occurred immediately following the Big Bang, smoothing out any irregularities[9, 10]. This theory is supported by observations of the cosmic microwave background (CMB), the afterglow of the Big Bang [11]. However, it does not address the pre-Big Bang state of the universe.

Another model of the universe, the cyclic universe model, was proposed by Richard Tolman. It suggests that the universe expands and contracts back to a tiny size, after which it will bounce back into an expanding phase in a cyclic fashion [12]. Richard Tolman's cyclic universe model posits that the universe goes through endless cycles of expansion and contraction [13]. While this model is innovative, it has been largely abandoned by cosmologists due to its inability to explain how the universe could transition from a densely compact state back to an expanding phase. An argument addressing this criticism was that negative energy could counteract supergravity, allowing the universe to expand. However, this raised further questions about the origin of such negative energy at that particular stage [14, 15].

Another theory presented as an alternative to the Big Bang theory, the Steady State Universe theory, proposed that the universe is eternal and continuously creates matter as it expands[16, 17]. However, this theory was eventually dismissed due to contradictory observational evidence [18, 19].

Of all the theories about the creation and evolution of the universe, the Big Bang theory is the most widely accepted and supported by observational evidence. Despite this, the Big Bang theory fails to explain the pre-Big Bang era and the origins of the Big Bang mass [20]. To address these gaps, we propose the Gravitational Buckling Theory, which introduces the concept of negative dimensions beyond the Big Bang. Our theory suggests that the universe undergoes cyclical phases of expansion and contraction influenced by gravitational, and bulk resistance forces, extending into negative space. This theory aims to provide a comprehensive explanation for the cyclical nature of the universe's evolution, addressing longstanding cosmological questions about its origin and the nature of space-time.

2. RELATED WORK

The universe was static in Einstein’s view, with no expansion or contraction until 1931, when he corrected his opinion based on observational evidence presented by astronomers. The evidence strongly points toward an expanding universe [21].The concept of an expanding universe was first supported by observational evidence in the early 20th century, revolutionizing our understanding of the cosmos. Edwin Hubble's observations of the redshift in distant galaxies provided the first empirical evidence of the universe’s expansion, leading to the abandonment of Einstein's initial static universe model [22].

In 1931, Georges Lemaître further developed this idea, proposing that the universe began from a "primeval atom" or singularity, later known as the Big Bang theory[23]. George Lemaître presented the idea of the Big Bang with the reasoning - if the universe is expanding, somewhere it must have started its expansion, and that must be the origin of the universe. This implies the universe must have started due to the severe explosion of an infinitely hot and dense singularity object wherein all energy of the universe is packed in a unique quantum [24].

While widely accepted, the traditional Big Bang theory has limitations, particularly in explaining the universe's state prior to the Big Bang. This has led to the exploration of alternative models. One such model is the Ekpyrotic Universe, which suggests that the Big Bang resulted from a collision between two branes in a higher-dimensional space, with the preBig Bang universe undergoing a slow contraction during an ekpyrotic phase [25, 26].

The Cyclic Universe Model, initially proposed by Alexander Friedmann in 1922 and later expanded upon by Richard Tolman, suggests that the universe undergoes infinite cycles of expansion and contraction. Each cycle begins with an expansion called Big Bang and ends with a contraction called Big Crunch. The theory was introduced to avoid the singularity problem[27, 28]. However, the second law of thermodynamics implies that each cycle must be larger and longer than the previous one with more entropy. This implies that the universe must have started at a singularity point, defeating its purpose [29, 30].

In 1948, Bondi et al. introduced the steady-state model of the universe, according to which the universe has no beginning and no end and keeps expanding with the continuous creation of mass. This model, however, was largely repudiated by most cosmologists due to contradictory evidence, such as the discovery of cosmic microwave background radiation [31].

In 2010, Roger Penrose introduced a new cosmological model, Conformal Cyclic Cosmology, which suggests the universe is just one of an infinite series of cosmic epochs, each arising from the remnants of its predecessor. It is a cyclic model of the universe, where each cycle is connected to the next, eliminating the need for an initial singularity. Though the universe’s expansion should be decelerated by gravitational attraction, observational data suggests that the universe is undergoing accelerated expansion. According to the conformal cyclic theory, the accelerated expansion is due to conformal invariance, a property of space-time that allows translational scaling but prevents rotational distortion. The theory suggests that accelerated expansion of the universe is an illusion caused by conformal invariance [32,33].

Gravitational waves have also provided new insights into cosmology. The detection of these waves, predicted by Einstein's theory of general relativity, has confirmed the dynamic nature of spacetime and provided a new tool for probing the early universe [34, 35, 36].

The concept of negative dimensions, as proposed in the Gravitational Buckling Theory, is a novel addition to these discussions. This theory suggests that the universe alternates between phases of expansion and contraction influenced by gravitational, and bulk resistance forces, extending into negative space beyond the Big Bang. This concept of negative dimensions is a radical departure from traditional cosmological models, offering a new perspective on the cyclical nature of the universe [37].

Recent advancements in string theory and higher-dimensional models also offer potential explanations for the pre-Big Bang universe. The concept of brane cosmology, where our universe is a 3-dimensional brane embedded in a higher-dimensional space, provides a framework for understanding phenomena that the standard Big Bang model cannot explain [38, 39].

The Multiverse Theory, which suggests that our universe is just one of many universes that exist within a larger multiverse, also provides a context for exploring pre-Big Bang conditions. This theory implies that different universes could have different physical laws and constants, which may help explain the conditions that led to our universe's Big Bang [40, 41].

Quantum cosmology, which applies the principles of quantum mechanics to the universe as a whole, offers another approach to understanding the pre-Big Bang state. Theories such as loop quantum gravity suggest that the Big Bang was a transition from a previously contracting universe, providing a possible mechanism for the cyclical nature of the universe[42, 43].

In recent years, additional cosmological models and theories have emerged. For instance, the quantum bounce model posits that a previous contracting universe transitioned into our expanding universe through a "bounce" rather than a singularity, supported by loop quantum gravity [44]. This model addresses the singularity problem and suggests a cyclical universe similar to the Gravitational Buckling Theory.

A study in 2021 presented a revised version of the cyclic universe model, incorporating quantum corrections to general relativity to avoid singularities and provide a smoother transition between cycles [45]. This model aligns with the concept of gravitational buckling, where quantum effects play a critical role in the universe's evolution.

In 2021, research on the holographic principle provided insights into the nature of space-time, suggesting that the universe could be described by lower-dimensional information, which might support the existence of negative dimensions as proposed in the Gravitational Buckling Theory [46].

Further, a 2021 study explored the role of dark energy in cyclic models, proposing that varying dark energy could drive the cycles of expansion and contraction, potentially linking to the gravitational forces described in the Gravitational Buckling Theory [47].

Another study discussed the implications of higher-dimensional theories for cosmology, indicating that our understanding of the universe's evolution could be significantly altered by considering extra dimensions and their effects on cosmic dynamics [48].

These diverse theories and models highlight the complexity of cosmological research and the ongoing efforts to understand the origins and evolution of the universe. The Gravitational Buckling Theory, with its introduction of negative dimensions and a cyclical universe model, adds a new dimension to these discussions, challenging existing paradigms and offering fresh insights into the nature of the cosmos.

3. Expansion and Contraction of the Universe in Positive Space

As found in most cosmological studies, the universe is expanding, starting from the Big Bang sphere, as shown in Fig. 1.1. Gravity acts like a retracting force, decelerating the expansion and eventually bringing it to an end. Following this, the universe will start accelerating contraction until it reaches the same size as the Big Bang sphere, as shown in Fig.1.2.

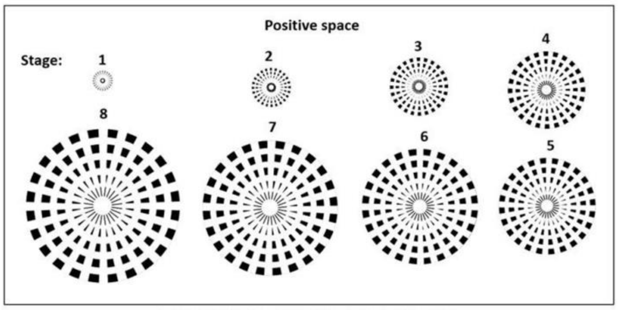

Figure 1.1 Universe expanding in Positive space

The eight radial block spheres in Fig. 1.1 represent various sizes of the universe during its expansion, ranging from its smallest size at the Big Bang incident to its biggest size at the end of the expansion. However, the geometric center of the universe always remains roughly stationary at the center of the Big Bang sphere. The universe keeps expanding and contracting concerning this stationery point.

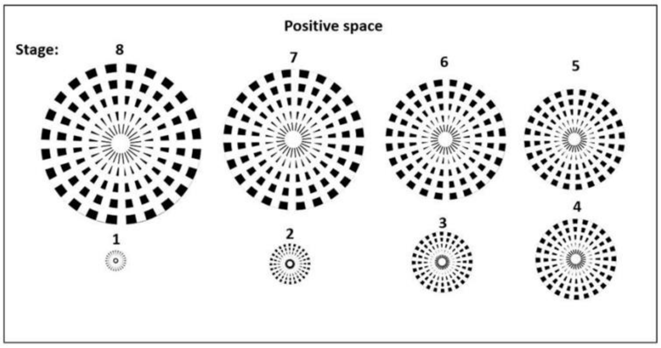

Figure 1.2 Universe contracting in Positive space

Fig. 1.2 above shows the contraction of the universe from its largest to the smallest size, as predicted during the Big Bang.

4. SLIPPING OF THE UNIVERSE FROM POSITIVE TO NEGATIVE DIMENSION

As the universe contracts due to its gravitational pull toward its center of gravity, it eventually reduces to the size of the Big Bang sphere from which it initially exploded. The Big Bang sphere is the critical size of the universe, beyond which its mass cannot be further compressed and contracted. Any little compression and contraction of matter at this stage will suddenly push it into negative space, as shown in Fig. 1.3. Positive and negative spaces are not physically and visually separated, as shown in Fig.1.3. Negative space lies within the positive space beyond the center of the Big Bang sphere. It runs radially inward from the center of the Big Bang sphere, whereas the positive space runs radially outward from the same point.

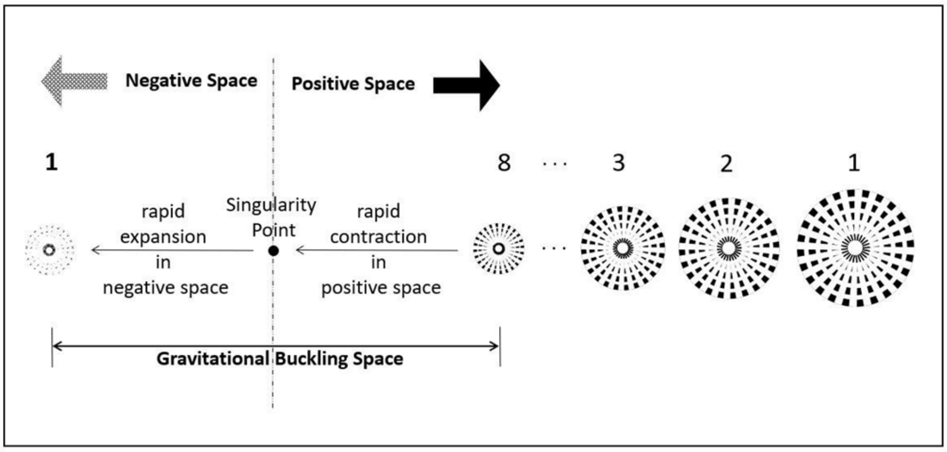

Figure 1.3 Universe contracting in Positive space and suddenly entering negative space

Fig. 1.3 shows only an imaginary view of the universe entering negative space past the singularity point. The universal mass in positive space contracts gradually up to its Big Bang radius, and further pressure would result in its sudden collapse into negative space with super rapid contraction due to gravitational instability, blast opening a new universe that will start expanding, releasing out the internally stored enormous bulk resistance energy, or in other words, the volumetric strain energy.

5. Expansion and Contraction of the Universe in Negative Space

Once the Big Bang sphere of the universe in the positive space collapses suddenly into the negative space, it starts expanding therein, releasing out the enormous internally stored bulk resistance energy developed due to extreme compression by dynamic thrust. Fig.1.4 shows the size of the universe increasing at various stages 1 – 8 as it expands in the negative space.

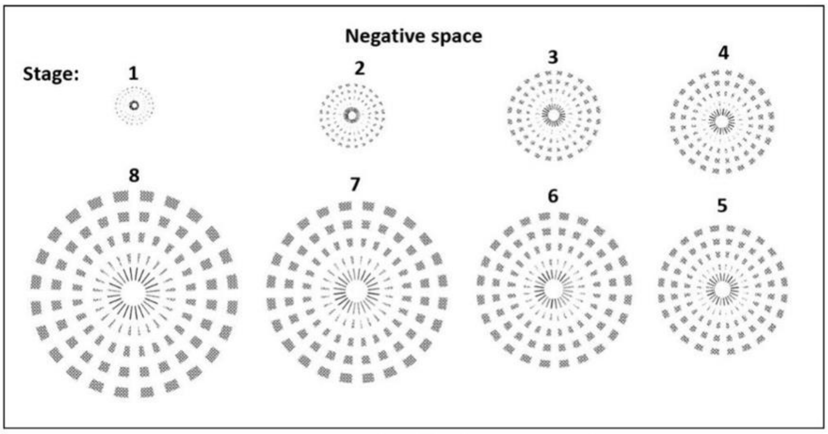

Figure 1.4 Universe expanding negative space

Gravity applies the same retractive force countering expansion even in negative space, as a result of which the expansion decelerates and eventually comes to an end, following which it shall undergo accelerated contraction toward the singularity point. Fig.1.5 shows the contracted size of the universe in negative space at different stages. Once contraction in negative space reaches the size of a Big Bang sphere, it will suddenly collapse, making an entry into the positive space, following which another Big Bang explosion will take place.

The process of expansion due to the Big Bang explosion, contracting back to the Big Bang sphere in one space and then suddenly collapsing into the other space, takes place repeatedly in an endless cyclic manner.

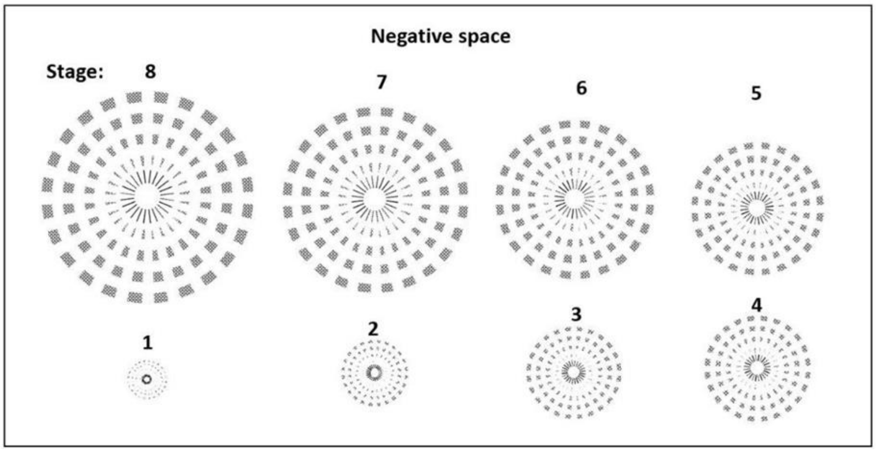

Figure 1.5 Universe contracting in negative space

6. Collapse of the Universe from Negative to Positive Space

The universe contracts in negative space in a similar manner to its contraction in positive space. When it contracts down to the size of the Big Bang sphere, it will have enormous strain energy stored in it due to extreme compression applied by dynamic thrust acting radially inward toward its center of gravity. At this stage, the universe will suddenly collapse into positive space, as shown in Fig.1.6, opening up a new universe that will expand, releasing all the internally stored strain energy.

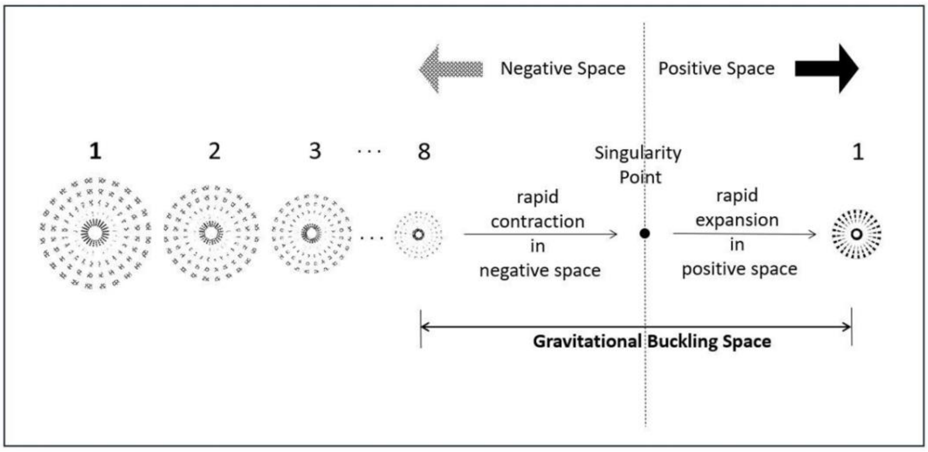

Figure 1.6 Universe contracting in negative space and suddenly entering positive space

7. GRAVITATIONAL BUCKLING THEORY

Gravitational buckling is a phenomenon akin to structural bucking that structural engineers deal with in their design of real-life structures. Structural buckling is a sudden phenomenon that takes place when the compressive force on a structural element such as a column or plate reaches a certain value called buckling, or critical load.

Fig.1.7 shows a straight structural column fixed at the bottom and has a free end at the top. The column remains straight when a little compressive force is applied along its axis. The column remains straight even as the compressive force increases until it reaches a certain value called the critical load. Once the critical load is reached, the column suddenly buckles into a lateral dimension. The value of critical load depends on Young's modulus of the column material, the moment of inertia of the column cross-section, and its height.

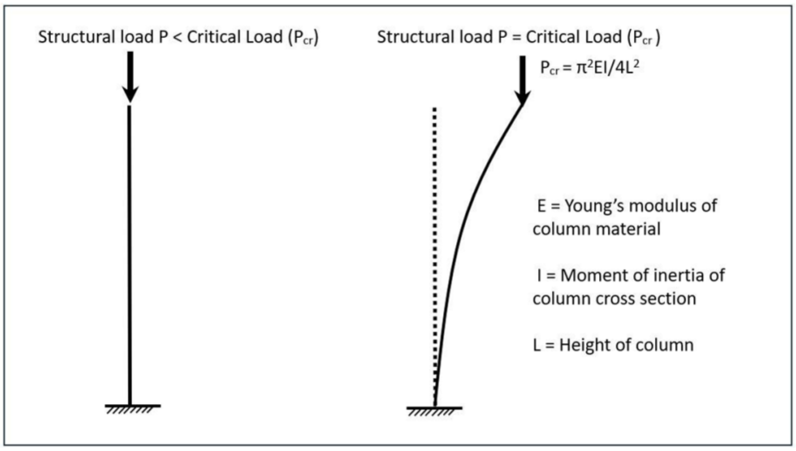

Figure 1.7 A structural column buckling suddenly at its critical load

The reason behind sudden buckling at critical load is the instability of the column caused by equality between internally stored elastic strain energy and external work done by the load. For any load below the critical load, the restoring elastic strain energy internally developed in the column material is higher than the work done by the external bending moment acting on the column, thus holding the column straight. At critical load, the two values become equal, and any infinitesimal increase in load causes the column to deform suddenly, occupying an extra dimension in the lateral direction.

Another such phenomenon can also be observed in mechanical engineering with machinery rotors. When a machinery rotor mounted on a shaft rotates under certain speed, it remains straight, allowing a smooth function of the machine. Once the rotor speed reaches its critical speed, it will deflect suddenly in lateral dimension, occupying the other two dimensions of space. The mechanical phenomenon is called whirling.

Fig. 1.8 shows a machinery rotor spinning straight at sub-critical speeds and suddenly whirling at critical speed. Any little deflection imparted to the shaft will cause eccentricity of the rotor mass from the shaft axis, which will exert centrifugal force on the shaft. At subcritical speeds, the elastic strain energy created in the deflected shaft surpasses the work done by the centrifugal force, hence keeping the shaft straight. At critical speed, both these values become equal, consequently causing the shaft to whirl out. The shaft that remains in a single dimension until the critical speed is reached suddenly occupies the other two dimensions lateral to its axis.

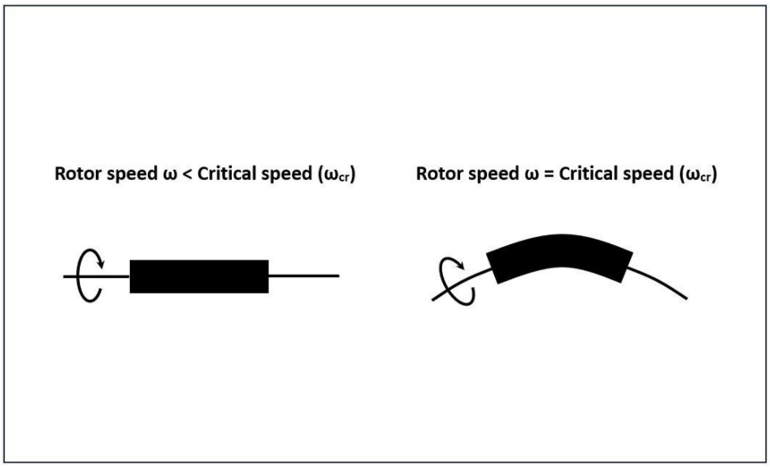

Figure 1.8 A machinery rotor suddenly crippling at its critical rotational speed

Fig. 1.9 shows a protein molecule formed of a long chain of amino acids. Proteins are one of the building blocks of living cells and perform myriad biological functions that depend on their structure. Amino acids are connected in sequence through a strong peptide bond between the nitrogen atom on the amino end of one amino acid and the carbon atom on the carboxyl end of its successive amino acid. The middle atom of an amino acid is an alpha carbon connected to a hydrogen atom and a side chain which varies amino acid to amino acid [49, 50, 51].

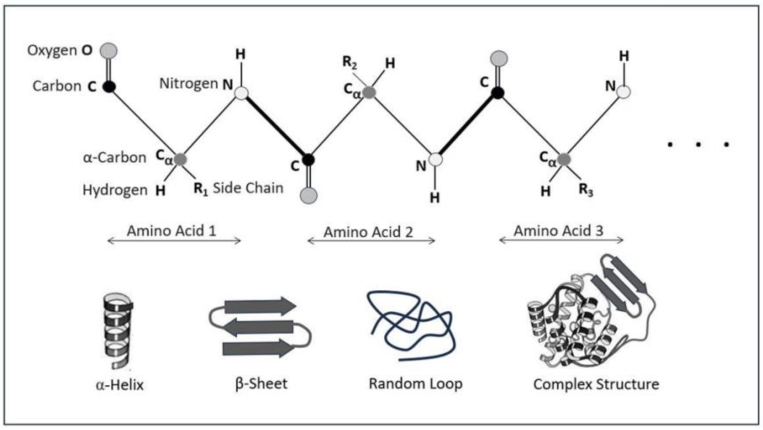

Figure 1.9 A straight protein chain folding various forms in a living cell due to structural instability

A protein is a large molecule formed by joining several amino acids in sequence through a peptide bond. When a protein is manufactured in the ribosome of a living cell, its backbone, defined by C-Cα-N atoms, lies straight as a planar structure. However, as soon as the protein molecule falls into the cell cytoplasm, it starts folding into a unique shape, which looks like a helix, sheet, random loop, or a complex shape as a combination thereof, as shown in Fig. 1.9, depending on its amino acid sequence.

A straight protein molecule folds up due to its instability at the weak C-C_α and C_α-N bonds, allowing the molecule to twist along these bonds due to attraction forces among relative electric charges on the atoms. Thus, protein folding is another example of a two-dimensional object occupying an additional third dimension due to instability.

Gravitational buckling is a phenomenon akin to the previously discussed phenomena, such as structural buckling, machinery whirling, and protein folding. When a spherical mass is compressed and left free, it will reattain its original volume, which is called the bulk resistance property. When a mass is compressed to a lower volume, it creates and stores bulk resistance energy, which restores the original size and shape. At the same time, the gravitational binding energy of the spherical mass also increases as the volume is reduced. While the bulk resistance energy tries to restore the original volume, gravitational binding energy tries to reduce the volume. However, the gain in gravitational binding energy is almost negligible compared to the bulk resistance energy at the initial stage.

Fig. 1.10 shows two masses - mass of the whole universe at its consolidated radius and the same mass super-compressed to its critical radius. Critical radius is the radius where gravitational binding energy of the universal sphere after enormous compression of its matter equals the bulk resistance energy, which is the condition of gravitational instability, and hence theradius where big bang explosion takes place.

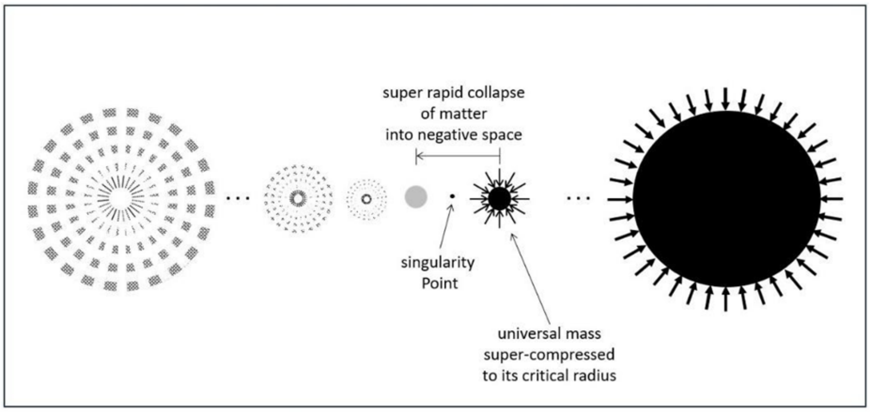

Figure 1.10 Universal mass super-compressed to its critical radius suddenly collapsing into negative space

The right half of Fig. 1.10 shows the void-free sphere of the universe formed when all its matter is collected as a sphere by gravitational attraction during its contraction phase. At this stage, all voids are eliminated in the mass of the universe. However, no compression is applied to the matter by the inward-acting forces due to kinetic energy. Once voids are eliminated, the kinetic energy starts compressing the matter radially inward in all directions, and consequently, bulk resistance energy is developed and stored inside the mass. The energy will decompress the mass to its original volume if compression is relieved. The more a mass is compressed, the more bulk resistance energy it creates and stores in the mass.

The small black sphere in the figure represents the Big Bang sphere that the void-free sphere of the universe is compressed to, where instability of universal mass occurs. At this stage, gravitational binding energy plus kinetic energy of the universal sphere equals bulk resistance energy, which is the condition of instability. With any little further compression of the sphere by kinetic force at this stage, the universal mass will be rapidly pulled radially inward in all directions toward the centre, leading to gravitational collapse. As the sum of the two compressive energies, gravitational binding energy and kinetic energy surpasses the decompressive bulk resistance energy, the universal mass will super quickly collapse into the negative space, past the singularity point.

The left half of Fig. 1.10 shows the increasing size of the expanding universe at different stages in negative space. The different spheres shown in figure 1.10 represent only different sizes of the universe at different points in time. In fact, the spheres are not spatially separated by a distance. All these spheres are concentric with respect to the singularity point at the centre of the void-free, big black sphere. The collapse would be super rapid compared to a contraction of the universal mass before the critical/big bag radius is reached.

As soon as the universal sphere collapses into negative space from positive space, all the compressive forces working on it will disappear as their effect resulted in pushing the universe into negative space. When the universe enters the negative space, it carries along with it the highest kinetic energy it has attained by the time it reaches the singularity point. The kinetic energy keeps decreasing as the universe expands in the negative space because the kinetic energy is expended in expanding the universe against gravitational attraction. Gravitational binding energy tries to compress the universe toward the singularity point the same way it does in positive space. On the other hand, bulk resistance energy tries to expand the universe due to its decompressive effect. Therefore, while gravity tries to contract the universe, kinetic and bulk resistance energies try to expand the universe. The two expanding energies will blast open a new universe with a violent Big Bang explosion. Gravity will decelerate the expansion of the universe, eventually bringing it to an end, following which it will undergo accelerated contraction up to the Big Bang size and will collapse back into positive space. This process continues in an endless cyclic manner.

8. GRAVITATIONAL BINDING ENERGY OF THE UNIVERSAL SPHERE

Imagine a spherical universe in its void-free contracted state where the radius is *R*and mass is *M*as shown in Fig. 1.11.

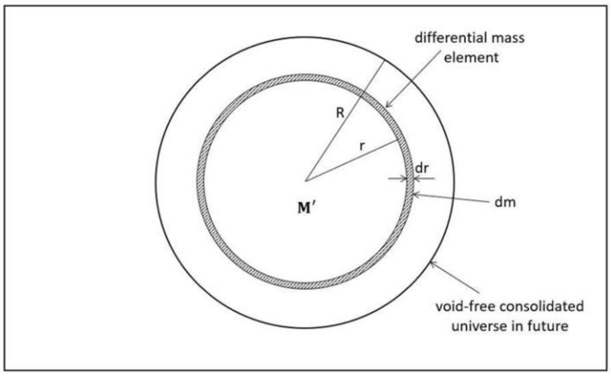

Figure 1.11 Void-free consolidated universe in future during its contraction

Gravitational binding energy of a spherical layer of thickness *dr* at a distance *r*from the centre,

$dE_G = \frac{GM'}{r}dm$,

whereM' is mass of the sphere of radius *r*, and *dm* is mass of the spherical layer of thickness *dr*.

Assuming ρ as density of mass, $M' = \frac{4\pi r^3}{3}\rho$

$$dE_G = \frac{G\rho 4\pi r^3}{3r}dm$$

Substituting dm= $\rho 4\pi r^2 dr$ in the above,

$$dE_G = \frac{G\rho 4\pi r^3}{3r}\rho 4\pi r^2 dr = \frac{16\pi^2 G\rho^2 r^4}{3}dr.$$

$$\text{Integrating both sides,} E_G = \int_0^R \frac{16\pi^2 G\rho^2 r^4}{3}dr = \frac{16\pi^2 G\rho^2 R^5}{15}$$

As $M = \frac{4\pi R^3}{3}\rho$, the above expression can be rewritten as $E_G = \frac{3GM^2}{5R}$

9. BULK RESISTANCE ENERGY OF UNIVERSAL SPHERE

Imagine the universe consolidated as a spherical mass of radius R_0 and mass M compressed to a sphere of radius R_1 as shown in Fig. 1.12.

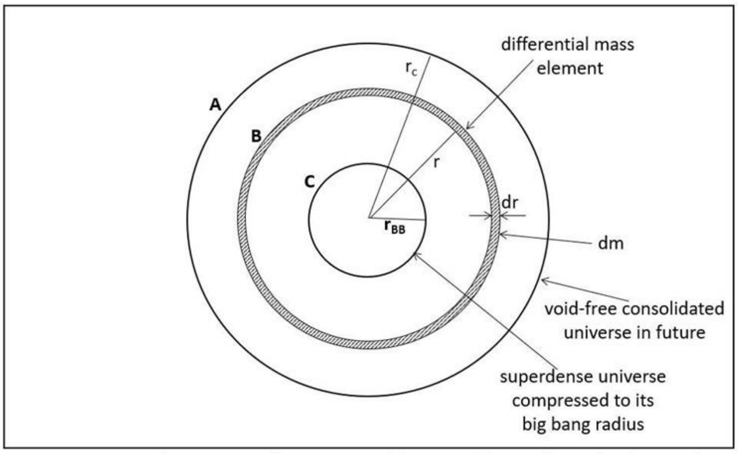

Figure 1.12 Universal mass manually compressed from void - free radius to big bang radius

Let K = Bulk Modulus of the mass M of the universe.

Bulk Modulus is the ratio of the difference in uniform pressure applied over the surface of an object to the difference in per unit volume caused by the pressure.

$$K = -\frac{dP}{dV/V}, \qquad \therefore dP = -K\frac{dV}{V}$$

$$V = \frac{4\pi r^3}{3}, \qquad \therefore dV = 4\pi r^2 dr$$

$$\frac{dV}{V} = \frac{3}{r}dr, \quad \therefore P = -\int_{r_c}^{r} \frac{3K}{r}dr$$

A constant bulk modulus in the above equation holds good if the object is compressed only for a little change in its volume. However, when the object is drastically compressed up to a significant change in its initial volume, a variable bulk modulus that increases as the object gets denser would provide accurate results. By intuition, denser material offers more resistance against compression.

Replacing K with $\frac{r_c^2}{r^2}K$, where K is the initial bulk modulus at void-free radius $r_c$before any compression is applied, in the above equation offers more realistic bulk resistance behaviour, especially in cosmological context. Therefore, substituting the new expression of K in the above equation,

$$P = -\int_{r_c}^{r} \frac{3r_c^2}{r^3} K\, dr = \frac{3Kr_c^2}{2r^2}\Bigg|_{r_c}^{r} = \frac{3Kr_c^2}{2r^2} - \frac{3K}{2} = \frac{3K}{2}\left(\frac{r_c^2}{r^2} - 1\right)$$

Work done by the pressure P in compressing the matter M from radius $r_c$to r,

$$dW = P\ A\ dr = \frac{3K}{2}\left(\frac{r_c^2}{r^2} - 1\right) A\ dr = \frac{3K}{2}\left(\frac{r_c^2}{r^2} - 1\right) 4\pi r^2 dr dW = 6\pi K\left(\frac{r_c^2}{r^2} - 1\right)r^2 dr$$

$$W = 6\pi K \int_{R_0}^{r} \left(\frac{r_c^2}{r^2} - 1\right)r^2\ dr = 6\pi K \int_{R_0}^{r} (r_c^2 - r^2)\ dr$$

$$W = 6\pi K\left(r_c^2 r - \frac{r^3}{3}\right)\Bigg|_{r}^{r_c} = 6\pi K\left(r_c^3 - \frac{r_c^3}{3} - r_c^2 r + \frac{r^3}{3}\right.$$

$$W = 6\pi K\left(\frac{2r_c^3}{3} - r_c^2 r + \frac{r^3}{3}\right)$$

$$W = 2\pi K(2r_c^3 - 3r_c r^2 + r^3)$$

Equating the above to gravitational binding energy of mass M,

$$2\pi K\ (2r_c^3 - 3r_c r^2 + r^3) = \frac{3GM^2}{5r}$$

Light year to meters conversion factor $\alpha = 3x10^8 x\ 365\ x\ 24\ x\ 3600 = 9.46x10^{15}$ Assuming:

$r_c = 1.543x10^5$ light years = $1.543x10^5 x\ 9.46x10^{15} = 1.46x10^{21}mr$ = R = $1.543x10^4$ light years = $1.543x10^4 x\ 9.46x10^{15} = 1.46x10^{20}$m
K = 16 x 10^{10}Pascals (equal to bulk modulus of steel)
G = $6.67x10^{-11}$ $N.m^2/kg^2$M = $1.5x10^{53}$ kg

External work done by compressing the universal mass from radius R_0 to r,

$$W = 2\pi K\ (2r_c^3 - 3r_c r^2 + r^3)$$
$$W = 2\pi\ x\ 16\ x\ 10^{10}\ [2(1.46x10^{21})^3 - 3x1.46x10^{21}x(1.46x10^{20})^2 + (1.46x10^{20})^3]$$

$W = 2\pi\ x\ 16\ x\ 10^{10}\ [6.22x10^{63} - 9.34x10^{61} + 3.11x10^{60}] = 6.16x10^{75}$ Joules

Gravitational binding energy of the universal mass,

$$E_G = \frac{3GM^2}{5R} = \frac{3x6.67x10^{-11}x\ 1.5^2x10^{106}}{5x1.46x10^{20}}$$
$$E_G = \frac{3GM^2}{5R} = \frac{4.50x10^{96}}{7.3x10^{20}} = 6.16x10^{75}\ \text{Joules}$$

Since $E_G = W$at r = $1.543x10^4$ light years, Big Bang radius $r_{BB} = 1.543x10^4$ light years

Table 1.1Void-free Consolidated Radius of Universe for entering Negative Space with manual compression (Light years)

Bulk Modulus of consolidated sphere of Universe	**Assumed Consolidated Radius of the Universe (light years)**	**Big Bang Radius (light years**
1xKsteel	1.543E+5	1.543E+4
1x106xKsteel	4.883E+3	4.883E+2

Values in the first row of the Table 1.1 indicate that if the entire mass of the universe gathered into a void-free matter forms a sphere of radius 1.543E+5 light years and it is manually compressed up to the radius of 1.543E+4 meters, the universe will collapse suddenly in the positive space and enters negative space. When the universal mass is compressed up to this radius, bulk resistance energy stored in it equals its gravitational binding energy, which is the condition of instability. Therefore, the phenomenon of gravitational buckling takes place. With any infinitesimal compression applied to the universal mass at this stage, the gravitational binding energy of the universal mass surpasses its bulk resistance energy. While the bulk resistance energy tries to decompress the universal mass to its original void-free consolidated volume, the gravitational binding energy tries to pull the mass inward toward its centre of gravity, causing it to collapse suddenly and enter negative space.

At the big bang radius, the gravitational pull of the universal mass dominates its bulk resistance, as a result of which the mass is pulled more and more inward toward its centre of gravity. The difference between the above-mentioned two forces accelerates the universal mass toward its centre of gravity. When the universal mass continues its accelerated contraction up to its center of gravity, it will have attained enormous speed of contraction which allows it to contract further beyond that point. This implies that there should also lie some space beyond the center of gravity of the universal mass to allow its further contraction. Hence, the universal mass contracts beyond its centre of gravity, leaving the positive space and entering the negative space. The universal mass does not bounce back in positive space at the singularity point, as the net force acting here is a gravitational binding force pulling the mass inward. From a positive space perspective, it is a contraction of mass beyond the center of gravity. However, from the negative space perspective, it is expansion because the compressive forces reverse their direction and turn into tensile forces.

As soon as the universal mass enters the negative space, the continued contraction at the center of gravity of the mass in positive space will turn out into expansion in the negative space. With the enormous expansion energy of the universal mass, a new universe will blast open in the negative space with a violent big bang explosion.

The inertia of contraction at the centre of gravity of the universal mass in the origin space continues beyond it in the destination space, reflecting as expansion due to the change of space. All the transference of mass from one space to the other at Big Bang incidence takes place within an incredibly shorter period of time. This is because as the universal mass contracts toward its centre of gravity, its gravitational binding energy builds up at an extremely rapid pace, thereby causing an extremely rapid contraction of the mass.

Values in the two rows of Table 1.1 are calculated based on two different values of bulk modulus assumed for the universal mass at its void-free consolidated radius. In the first case, the universal matter is assumed to be as strong as steel in bulk resistance, whereas in the other, the universal mass is considered a million times stronger than steel.

The above-tabulated values were discovered by computations using a Java software program. These values illustrate how the universe will collapse in its present space and enter negative space if compressed manually up to its Big Bang radius. However, in reality, compressive forces are applied to the universal mass by its own kinetic energy during its contraction once its present expansion comes to an end due to gravitational pull.

There are a lot of arguments supported by redshift observations of distant galaxies that the universe will never come back to a contracting phase as its expansion is accelerating. This could only be an illusion caused by ignoring the effect of gravitational redshift and considering that the entire redshift is caused by velocity only [52].

10. KINETIC ENERGY OF THE UNIVERSE

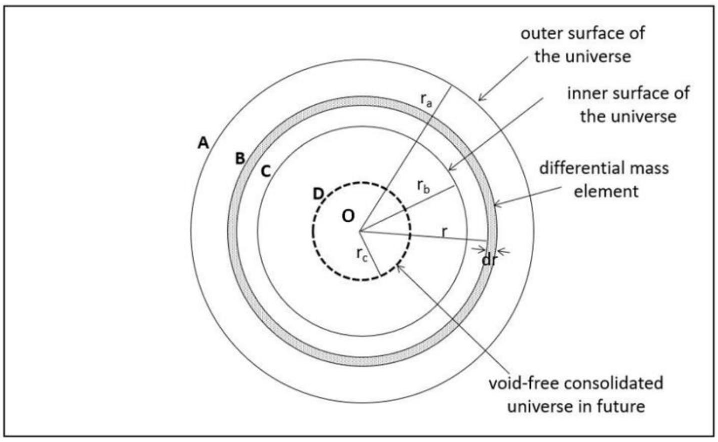

Figure 1.13 Universe at dynamically neutral stage between expansion and contraction

Fig 1.13 below shows the universe at a dynamically neutral stage when its expansion comes to an end. At this point, the universe has no outward or inward motion, and its kinetic energy is zero. This would only be a temporal state, following which the universe will contract due to gravitational pull.

Spheres A and C in Fig.1.13 represent the outer and inner surfaces of the universe between which the entire mass of the universe is loosely distributed. Sphere B represents a differential spherical mass element of thickness **dr** at a distance of **r** from centre of the universe. Sphere D represents the void-free consolidated mass of the universe in the future. As the universe contracts, until this moment, no bulk resistance is developed in the universal mass. Here on, the kinetic energy attained by the universal mass starts exerting a compressive force on itself radially inward, trying to push the universe toward the singularity point at the center.

The differential mass element attains more and more kinetic energy during its contraction. The mass element is accelerated toward the centre of the universe due to gravitational pull, and when it fits in the void-less consolidated sphere at the centre, it will have attained enormous kinetic energy.

The mass of the universe acts like it is concentrated at the center and attracts the differential mass element. Assuming the total mass of the universe as **M**, the gravitational potential energy of the differential mass element dm,

$dE_{G1} = \frac{GM}{r} dm$

$dm = 4\pi\rho r^2 dr$

Mass attracting the differential mass represented by B = M = $\frac{4}{3}\pi\rho\,(r^3 - r_b^3)$

$\therefore dE_{G1} = G\,\frac{4}{3}\pi\rho\,(r^3 - r_b^3)\,4\pi\rho r^2 \frac{1}{r} dr$

$\therefore dE_{G1} = G\,\frac{16}{3}\pi^2\rho^2\,(r^3 - r_b^3)\,r dr$

$\therefore dE_{G1} = \frac{16}{3}\pi^2\rho^2\,G\,(r^4 - r_b^3\,r)\,dr$

$$\therefore E_{G1} = \frac{16}{3}\pi^2\rho^2 G \int_{r_b}^{r_a} (r^4 - r_b^3\,r)\,dr$$
$$\therefore E_{G1} = \frac{16}{3}\pi^2\rho^2 G \left(\frac{r^5}{5} - \frac{r_b^3 r^2}{2}\right)\Big|_{r_b}^{r_a}$$
$$\therefore E_{G1} = \frac{16}{3}\pi^2\rho^2 G \left(\frac{r_a{}^5}{5} - \frac{r_a{}^2 r_b^3}{2} - \frac{r_b{}^5}{5} + \frac{r_b^5}{2}\right)$$
$$\therefore E_{G1} = \frac{16}{30}\pi^2\rho^2 G\left(2r_a{}^5 - 5r_a{}^2 r_b^3 - 2r_b{}^5 + 5r_b^5\right) = \frac{8}{15}\pi^2\rho^2 G\left(2r_a{}^5 - 5r_a{}^2 r_b^3 + 3r_b{}^5\right)$$

$M = \frac{4}{3}\pi\rho\,(r_a{}^3 - r_b{}^3)$ $\qquad \therefore \rho = \frac{3M}{4\pi(r_a 3 - r_b 3)}$

Substituting ρ in the above equation,

$$\therefore E_{G1} = \frac{8\pi^2}{15}\,\frac{9M^2 G\left(2r_a{}^5 - 5r_a{}^2 r_b^3 + 3r_b{}^5\right)}{16\pi^2 (r_a 3 - r_b 3)^2} = \frac{3\left(2r_a{}^5 - 5r_a{}^2 r_b^3 + 3r_b{}^5\right) G M^2}{10\,(r_a 3 - r_b 3)^2}$$

Gravitational binding energy of the universal sphere D at a radius **r** below the void-free, consolidated radius of r_c, $E_{G2} = \frac{3GM^2}{5r}$,

The difference energy, $E_{G2} - E_{G1}$,becomes the kinetic energy compressing the spherical mass D toward the singularity point O.

$$E_K = E_{G2} - E_{G1} = \frac{3GM^2}{5r} - \frac{3\left(2r_a{}^5 - 5r_a{}^2 r_b^3 + 3r_b{}^5\right)GM^2}{10\,(r_a 3 - r_b 3)^2}$$
$$E_K = \frac{3}{5}\left[\frac{1}{r} - \frac{\left(2r_a{}^5 - 5r_a{}^2 r_b^3 + 3r_b{}^5\right)}{2(r_a 3 - r_b 3)^2}\right] GM^2$$

11. ALL THREE ENERGIESAT A RADIUS BELOW CONSOLIDATED RADIUS

Light year to meters conversion factor, α = 3x10^8^x365x24x3600 = 9.46x10^15^ Assuming:

r_a = 45.15 billion light years = $45.15\times10^9 \times 9.46\times10^{15} = 4.27\times10^{26}$ meters
r_b = 40 billion light years = $40.0\times10^9 \times 9.46\times10^{15} = 3.78\times10^{26}$ meters
r_c = 1.835×10^5 light years = $1.835\times10^5 \times 9.46\times10^{15} = 1.736\times10^{21}$ meters
r = 1.835×10^4 light years = $1.835\times10^4 \times 9.46\times10^{15} = 1.736\times10^{20}$ meters
G = 6.67×10^{-11} N.m^2/kg^2 M = 1.5×10^{53} kg

Kinetic Energy, $\mathbf{E}_K = \frac{3}{5}\left[\frac{1}{r} - \frac{(2r_a{}^5 - 5r_a{}^2 r_b^3 + 3r_b{}^5)}{2(r_a 3 - r_b 3)^2}\right] G\mathbf{M}^2$

$$E_K = \frac{3}{5}\left[\frac{1}{1.736x10^{20}} - \frac{2(4.27x10^{26})^5 - 5(4.27x10^{26})^2(3.78x10^{26})^3 + 3(3.78x10^{26})^5}{2[(4.27x10^{26})^3 - (3.78x10^{26})^3]^2}\right] 6.67x10^{-11} x(1.5x10^{53})^2$$

$$E_K = \frac{3}{5}\left[\frac{1}{1.736x10^{20}} - \frac{2.84x10^{133} - 5x1.82x10^{53} x\, 5.40x10^{79} + 2.32x10^{133}}{2[7.79x10^{79} - 5.40x10^{79}]^2}\right] 6.67x10^{-11} x(1.5x10^{53})^2$$

$$E_K = \frac{3}{5}\left[\frac{1}{1.736x10^{20}} - \frac{2.84x10^{133} - 4.91x10^{133} + 2.32x10^{133}}{2[7.79x10^{79} - 5.40x10^{79}]^2}\right] 6.67x10^{-11} x(1.5x10^{53})^2$$

$$E_K = \frac{3}{5}\left[\frac{1}{1.736x10^{20}} - \frac{2.5x10^{132}}{2[7.79x10^{79} - 5.40x10^{79}]^2}\right] 6.67x10^{-11} x(1.5x10^{53})^2$$

$$E_K = \frac{3}{5}\left[\frac{1}{1.736x10^{20}} - \frac{2.5x10^{132}}{1.14x10^{159}}\right] 6.67x10^{-11} x(1.5x10^{53})^2$$

$$E_K = \frac{3}{5}[5.76x10^{-21} - 2.19x10^{-27}] 6.67x10^{-11} x(1.5x10^{53})^2$$

$$E_K = \frac{3}{5} x5.76x10^{-21} x6.67x10^{-11} x\, 2.25x10^{106}$$

$E_K = 5.18x10^{75}$Joules

Gravitational Binding Energy $\mathbf{E}_G = \frac{3G\mathbf{M}^2}{5r}$

$$E_G = \frac{3\ x\ 6.67x10^{-11} x(1.5x10^{53})^2}{5\ x\ 1.736x10^{20}}$$

$$E_G = \frac{4.5x10^{96}}{8.68x10^{20}} = 5.18x10^{75}\text{Joules}$$

Bulk Resistance Energy, $\mathbf{W = 2\pi K\ (2r_c{}^3 - 3r_c r^2 + r^3)}$

$W = 2\pi\ x\ 16\ x\ 10^{10}[\ 2(1.736x10^{21})^3 - 3x1.736x10^{21}x(1.736x10^{20})^2 + (1.736x10^{20})^3]$
$W = 2\pi\ x\ 16\ x\ 10^{10}[\ 1.046x10^{64} - 1.570x10^{62} + 5.232x10^{60}]$
$W = 2\pi\ x\ 16\ x\ 10^{10} x\ 1.031x10^{64} = 1.036x10^{76}$Joules

From the above three energy values it becomes clear that the sum of compressive energies, E_G and E, equals the decompressive energy W, which is a condition of instability. Here on, the compressive energies dominate the restoring bulk resistance energy, thereby rapidly pushing the universal mass radially inward toward its centre of gravity in all directions, and further into negative space.

$$\tau = \frac{E_G + E_K}{W} = \frac{\frac{3}{10}\left[\frac{2}{r} - \frac{\left(2r_a^5 - 5r_a^2 r_b^3 + 3r_b^5\right)}{2(r_a^3 - r_b^3)^2}\right] GM^2}{\pi K\,(2r_c^3 - 3r_c r^2 + r^3)}$$

Big Bang Thrust Factor

Big Bang Thrust Factor τ is the ratio of the compressive energies to the decompressive bulk resistance energy. When this value becomes unity, the big bang condition of instability occurs, which will collapse the universal mass up to its centre of gravity and further pushes it into the negative space. The centre of gravity of the universal mass marks the lower limit of its positive space. The universal mass enters the negative space piercing this limit when Big Bang Thrust Factor τ becomes just greater than unity.

When kinetic energy and gravitational binding energy compress the universal mass up to its big bang radius, gravitational buckling takes place causing extremely rapid collapse of the universal mass with tremendously accelerated motion toward its center of gravity, due to which the mass will make its way into the negative space.

In Table 1.2 below, void-free consolidated radius of the universe with bulk resistance as strong as steel is tabulated for big bang thrust factor starting from 0.8. The radius is computed using a Java program.

Table 1.2 Void-free Consolidated Radius of Universe (with Bulk Modulus = K_{steel}) for entering Negative Space

Void-free Consolidated Radius (Light Years)	**Big Bang Thrust Factor** (τ)
1.940×10^5	0.8
1.884×10^5	0.9
$\mathbf{1.835 \times 10^5}$	**1.0**
$\mathbf{1.792 \times 10^5}$	**1.1**
…	**…**
1.763	$\mathbf{1.174 \times 10^{20}}$

In Table 1.3 below, void-free consolidated radius of the universe with bulk resistance million times stronger than steel is tabulated for big bang thrust factor starting from 0.8. The radius computed using a Java program.

Table 1.3 Void-free Consolidated Radius of Universe (with Bulk Modulus equal to $1 \times 10^6 K_{steel}$) for entering Negative Space

Void-free Consolidated Radius (Light Years)	**Big Bang Thrust Factor** (τ)
6.136×10^3	0.8
5.957×10^3	0.9
$\mathbf{5.803 \times 10^3}$	**1.0**
$\mathbf{5.666 \times 10^3}$	**1.1**
…	**…**
1.763	$\mathbf{1.174 \times 10^{14}}$

The above two tables correspond to two different values of bulk modulus assumed for the universal mass when it reaches a void-free consolidated state with zero compression. Values in each row represent the consolidated radius of the universal mass for different Big Bang thrust factors. A compression step factor of 10 is considered, meaning the universal mass is compressed by one-tenth of its present radius at each computation step to compare the compressive and decompressive forces and check whether gravitational instability occurs. If the Big Bang thrust factor exceeds 1.0, the sum of kinetic energy and gravitational binding energy surpasses the bulk resistance energy. Therefore, the universe will go through a super rapid Big Bang collapse into negative space during its contraction as soon as it contracts to one-tenth the void-free radius. On the other hand, if the Big Bang thrust factor is less than 1.0, the universal mass remains stable in positive space as its bulk resistance energy surpasses the sum of the compressive energies, kinetic energy, and gravitational binding energy. Also, it has been observed from computations that the outer and inner radius of the universe have no significant effect on the thrust factor as these values are pretty high, and the gravitational potential of the universe at this position is negligible compared to the same energy at the consolidated radius. The most influential variables for the Big Bang thrust factor are total mass M, consolidated radius r sub c, and bulk modulus K of the universal mass.

The universal mass with bulk modulus as strong as steel seems unstable at least at a radius of 1.835×10^5light years, attaining a thrust factor of 1.0, which is the necessary condition for big bang collapse into the negative space. In fact, it becomes unstable and gets ready for a big bang collapse even at a higher radius because, at this radius, the universal mass would be loosely spread with a lot of gaps in between, and therefore, bulk resistance would not be at work to resist compression.

If the universal mass is assumed to be as dense as steel when it contracts to a void-free sphere, its radius would be 1.763 light years. At this radius, the universal mass has a big bang thrust factor as high as 1.174×10^{20}, indicating an extremely higher instability leading to a super quick big bang collapse into the negative space. Table 1.4 below shows density of universal mass at different consolidated radiuses and its density ratio with steel.

Table 1.4 Density of Consolidated Universal Sphere for Entering Negative Space

Bulk Modulus of Consolidated Sphere of Universe	**Radius of consolidated universe (Light Years)**	**Big Bang Thrust Factor** (τ)	**Critical Density** (kg/m^3)	**Density Ratio with Steel**
$1 \times K_{steel}$	1.835×10^5	1.0	6.84E-12	8.89E-16
	1.792×10^5	1.1	7.35E-12	9.54E-16
	1.763	1.174×10^{20}	7.72E3	1.0
$1 \times 10^6 \times K_{steel}$	5.803×10^3	1.0	2.16E-7	2.81E-11
	5.666×10^3	1.1	2.32E-7	3.02E-11
	1.763	1.174×10^{14}	7.72E3	1.0

Table 1.5 below shows how the universe contracts in positive space, expands in negative space, and again contracts back toward its centre of gravity in negative space.

Table 1.5 Contraction and Expansion of Universe in Positive and Negative Spaces

Contraction and Expansion of the Universe

(with Bulk Modulus as strong as steel)

Radius of Universe	Tau (Thrust Factor)	Radius of Universe	Tau (Thrust Factor)	Radius of Universe	Tau (Thrust Factor)	Radius of Universe	Tau (Thrust Factor)	Radius of Universe	Tau (Thrust Factor)
Contraction in Positive Space									
1.835E4	1.000	1.835E3	9.862E0	1.835E2	9.861E1	1.835E3	9.861E2	1.835E0	9.861E3
1.835E-1	9.861E4	1.835E-2	9.861E5	1.835E-3	9.861E6	1.835E-4	9.861E7	1.835E-5	9.861E8
1.835E-6	9.861E9	1.835E-7	9.861E10	1.835E-8	9.861E11	1.835E-9	9.861E12	1.835E-10	9.861E13
1.835E-11	9.861E14	1.835E-12	9.861E15	1.835E-13	9.861E16	1.835E-14	9.861E17	1.835E-15	9.861E18
1.835E-16	9.861E19	1.835E-17	9.861E20	1.835E-18	9.861E21	1.835E-19	9.861E22	1.835E-20	9.861E23
…..	…..	…..	…..	…..	…..	…..	…..	…..	…..
1.835E-91	9.861E94	1.835E-92	9.861E95	1.835E-93	9.861E96	1.835E-94	9.861E97	1.835E-95	9.861E98
Expansion in Negative Space									
-1.835E-95	1.00E0	-1.835E-94	1.00E0	-1.835E-93	1.00E0	-1.835E-92	1.00E0	-1.835E-91	1.00E0
-1.835E-90	1.00E0	-1.835E-89	1.00E0	-1.835E-88	1.00E0	-1.835E-87	1.00E0	-1.835E-86	1.00E0
-1.835E-85	1.00E0	-1.835E-84	1.00E0	-1.835E-83	1.00E0	-1.835E-82	1.00E0	-1.835E-81	1.00E0
-1.835E-80	1.00E0	-1.835E-79	1.00E0	-1.835E-78	1.00E0	-1.835E-77	1.00E0	-1.835E-76	1.00E0
…..	…..	…..	…..	…..	…..	…..	…..	…..	…..
-1.835E-4	1.00E0	-1.835E-3	1.00E0	-1.835E-2	1.00E0	-1.835E-1	1.00E0	-1.835E0	1.00E0
-1.835E1	1.002E0	-1.835E2	1.02E0	-1.835E3	1.203E0	-1.835E4	2.999E0	-1.835E5	1.00E0
-1.835E6	1.00E0	-1.835E7	9.996E-1	-1.835E8	9.965E-1	-1.835E9	9.648E-1	-1.835E10	6.485E-1
-4.515E10	2.612E-22 (≈0)								
	Expansion will stop here and the universe will start contracting under gravitational pull.								

From astronomical observations, it is known that the universe has currently spread up to a radius of 45.15 billion light years. For computing figures of the table 1.5, it is assumed that the inner radius of the universe is 40.0 billion light years. If the expansion of the universe ends up at this stage and starts contracting under the gravitational pull, the above table shows how the Big Bang thrust factor of the universe varies at various radiuses during its contraction in positive space and expansion in negative space. It is observed that the thrust factor keeps increasing and reaches a gigantic value in positive space as it gets close to the singularity point at the centre of gravity of the universe.

Once the universe collapses and enters negative space, the thrust factor remains close to unity because, while kinetic energy tries to expand the universe, gravitational pull tries to contract it, and both values are approximately equal. Bulk resistance tries to expand the universe; however, its effect is negligible. The thrust factor starts increasing when the universe expands closely up to the consolidated radius, where bulk resistance becomes significant. The thrust factor falls down to unity again at the consolidated radius and, thereafter, keeps decreasing up to zero when the universe expands up to the same radius it was at before contraction in positive space.

12. WHY THE UNIVERSE ENTERS NEGATIVE SPACE AT THE NEXT BIG BANG

As already discussed in section 7, a structural column buckles into an additional dimension laterally when the load applied to it reaches its critical load. Similarly, when a machinery rotor speed reaches its critical speed, it suddenly starts whirling, occupying two additional dimensions normal to its axis. Similarly, when a straight protein molecule is created in ribosomes and dropped into cell plasma, it folds into various shapes depending on its amino acid sequence. All these phenomena are triggered when a condition of instability is satisfied. It can be inferred from these three phenomena that when instability occurs, the associated object attains one or more extra dimensions.

When the universal mass meets the condition of instability where the compressive energies become equal to the decompressive energies, it will also try to attain one or more additional dimensions. However, a solid sphere is a three-dimensional object occupying all the three dimensions of space. Therefore, left with no more dimensions to occupy, the unstable universal mass will kick off the positive space, entering the negative space and occupies the three new spatial dimensions therein.

Another reason why there has to exist negative space for the universal mass to enter is the direction of compressive forces when the condition of instability occurs. All the compressive forces are pointed toward the center of gravity of the universal mass, causing accelerated motion of the mass toward this center point. When all the mass reaches the center of gravity, it possesses super velocity and acceleration, ruling out any chance for bounce back, as there is no repulsive bulk resistance force, which was already dominated by the compressive forces. Hence, the enormous acceleration of the universe allows it to pass through its own centre of gravity into negative space.

13. CONCLUSIONS

This research challenges the longstanding scientific dogma that space always exists in positive dimensions and that mass always occupies positive volume. By introducing the concept of negative space, we propose that space can also have negative dimensions. This radical notion mirrors the existence of negative charges and south poles in electricity and magnetism, respectively, suggesting a cosmological counterpart in the form of negative space.

The Gravitational Buckling Theory offers a novel explanation for the cyclical nature of the universe's expansion and contraction, proposing that the universe transitions between positive and negative spaces. This theory provides insights into longstanding cosmological questions, such as the origin of the Big Bang mass and the state of the universe before the Big Bang. According to our findings, the universe undergoes continuous cycles: from existing in negative space, expanding due to a Big Bang explosion, decelerating, and contracting under gravitational forces to eventually collapsing and transitioning back into positive space.

Our current universe is in a phase of decelerated expansion, which will ultimately reverse into contraction. As it contracts and reaches its Big Bang radius, it will collapse rapidly and transition into negative space. This cyclic process is proposed to be eternal, providing a comprehensive model of the universe's evolution.

To enhance the credibility of these findings, further empirical evidence and theoretical support are essential. Future research should focus on identifying observational phenomena that could validate the existence of negative space and the cyclical transitions proposed by the Gravitational Buckling Theory. Specific areas for investigation include the empirical detection of transitions between positive and negative spaces and the mathematical modelling of gravitational dynamics across these dimensions. Moreover, it is crucial to address potential limitations and areas requiring further validation. This includes ensuring that all claims made are supported by robust evidence and critically examining the theoretical assumptions underlying the proposed model. By doing so, the scientific community can better assess the validity of the Gravitational Buckling Theory and its implications for cosmology.

Hence, abandoning the notion that space must always be positive and accepting the concept of negative space will open new avenues for discovery and potentially resolve many mysteries of the universe. Future studies should aim to explore these new dimensions and validate the theoretical framework proposed, thereby advancing our understanding of the universe's origin and cyclical nature.

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