

UNORTHODOX APPROACH AND UNCONVENTIONAL ALTERNATIVES TO BIG BANG, DARK ENERGY, PHASE CHANGE, FALSE VACUUM, AND COSMIC INFLATION

Jaswant Rai Mahajan
Abstract

A careful analysis focusing on the estimated mass-energy of the universe, the enigmatic expansion of space-time, and its regression into the past reveal that the cosmic expansion & compression cycle is carried out well-inside its theoretical Black Hole. And, the expansion of universe since its very birth, points out that it was never under the full control of its total mass-energy released during its birth. Thus, indicating that it was born as EMR – under the gravity-free conditions – flying ahead of the ensuing g-effects and enlarging the size of the cosmic globe. However, on its partial materialization into the 1^{ary} building blocks of the universe (e, p, e), the local g-forces caught up with matter, agglomerating it into trillions of galaxies, followed by their ongoing development, differentiation, and evolution, carried out in a cascade of nuclear fusion reactions, which produce the Chemical Elements of the Periodic Table. However, it will not expand forever, because the total amount of EMR released during the cosmic birth, apart from being partially tied up as Matter, is also exhausting itself by expanding the cosmic globe against the g-field. On the other hand, during the contraction phase, the presently scattered trillions of galaxies are destined to coalesce to a single compact system, bringing the compressed globe under the g-control of its total mass-energy and enclosing it very much inside its theoretical Black Hole! Thenceforth, the stronger and stronger g-forces contract the globe to higher and higher densities, impeding the propagation of EMR and slowing the pace of space-time – finally bringing it to a halt, which renders the ‘cosmic nucleus’ inert and brings about a drastic phase change. However, in a sharp contrast to the ‘Primeval Atom’ or ‘Singularity’ of the Big Bang, the present proposal stops much before the lawless states, postulating a limit on the g-compression of mass-energy and space-time, as argued and detailed in the pdf of the present investigation.

PRELUDE

“Twinkle, twinkle, little star, How I wonder what you are!
Up above the world so high, Like a diamond in the sky”.
[Jane Taylor, “The Star”, 1806].

“What is this life if, full of care, We have no time to stand and stare”.
[W. H. Davies, “Leisure”, 1916].

INTRODUCTION

Gazing the heavens in awe or admiration is as old as the existence of the human race. While the sun rises, brightens up and warms the day, the star-studded nights, decorated with the waxing and waning moon, provide a fascinating spectacle against the dark background. Thus, staring at the skies to behold the celestial display possibly became one of the first pastimes,

hobbies, and sciences of the Homo sapiens. It molded their ideas, views and conjectures about the splendor of the heavens with its brilliant cast, making them wonder about the nature of the 'Author/ Director' of this marvelous play.

Day and night, easily visible phases of the moon, the periodic sequence of the seasons – summer, autumn, winter, and spring – coupled with the related phenomena: rains, floods or the dry months; blooming of flowers or the shedding of leaves; sowing period and the harvest time, etc., helped them organize their monthly and annual calendars, marking the days for the monthly celebrations and the annual festivals. No wonder then that the primary choice of the ancient civilizations (Chinese, Indian, Babylonian, Hebrew, and Hellenic, etc.) were the **lunar calendars**. However, as the cycles of the moon are not in sync with the solar-based seasons, the lunar calendars need occasional corrections – annually or every few years – to bring them in harmony with the seasons. In fact, this peculiar necessity gave rise to the so called '**lunisolar**' calendars, which still play an important role for determining the dates for the religious ceremonies and festivals of many social groups. Thus, to make a long story short, the easily observable sojourn of the celestial bodies strongly influenced the religious beliefs and the way of life of the early people, slowly seeping into their arts, philosophy and sciences, especially Astronomy and Astrology, which apparently were among their major concerns.

In due course of time, the earth-bound mortals arrived naturally at the earth-bound or **geocentric** schemes for the movements of the heavenly bodies. The geocentric model expounded by Aristotle in the 4th century BC and improved by Ptolemy in the 2nd century AD, reigned supreme well after the publication (1543) of the **heliocentric** system proposed by Copernicus. The heliocentric model received a major support from Galileo's telescopic observations (1610 - 1619) of the heavens and especially the finding of the orbiting moons around Jupiter. And at about the same period, Kepler described the elliptical orbits of the planets around the Sun. And a bit later, in 1687, Sir Isaac Newton provided the necessary universal gravitational force to keep the planets revolving around the sun and the moons around their planets. But in spite of this diverse support, the acceptance of the new model was rather slow and reluctant.

Furthermore, during all these past centuries, our scope of the visible / observable universe, even after the invention of the telescope (1609), was limited to just about the **Milky Way**. Thus, till the early years of the 20th century, astronomers could see only a small portion of the presently observable bigger picture, made possible by the modern powerful telescopes and other sophisticated equipment. Nevertheless, they thought and strongly believed that our

universe had fixed and stable boundaries – the so called **Static Universe**. This conclusion or belief was so firmly established that even the great genius of modern physics and the father of **Relativity**, Albert Einstein, deemed it necessary and appropriate to modify his **General Relativity** equations (1916 – 1917), instead of admitting a dynamic (expanding / contracting) universe [1,2].

But, even though Einstein apparently stabilized or anchored the universe by adding to his equations the well-famous **Cosmological Constant**, other research workers were finding both observational and theoretical evidence which favored an expanding universe:

1. Vesto Slipher (1912 onward) measured the Doppler shifts of several “Spiral Nebulae” (presently identified as Spiral Galaxies) and found that their light was shifted towards red, which was attributed to the moving away of these objects.

2. In 1922, Alexander Friedmann derived for GRT new solutions called Friedmann equations, which also pointed towards an expanding universe.

3. From 1924 onward, Edwin Hubble measured (*estimated*) great distances to the distant spiral galaxies. And in 1929 he tied up these distances to the respective red shifts of these galaxies, formulating the now familiar **Hubble Law**: $V = H D$, where V is the recessional velocity, D the distance of the object from Earth, and H stands for **Hubble Constant**.

4. During this time, Georges Lemaitre independently derived (1927) Friedmann equations and proposed that the observed red shifts of galaxies were due to the expansion of the universe. Furthermore, in 1931, he suggested that the extrapolation of the observed expansion backwards in time leads to a smaller and smaller universe till one reaches a single point, which he called the “**Primeval Atom**”, having infinite values for the mass-energy density, temperature, and gravitational forces, etc. – *a state where the known laws of physics break down and operate no more*. This extreme “end-point” or “primeval atom” was later called a **Singularity** by Roger Penrose and Stephan Hawking – from where the present universe somehow sprang up, despite its “*lawless state*”! *A Cosmic Miracle, Indeed!*

But this “Primeval Atom” or “Singularity” has been (and continues to be) a hard-to-swallow pill. While the protagonists found it a panacea that could cure the “ills” of the observable universe, others accepted it with a pinch of salt, but the dissidents looked askance or shunned it altogether to refrain from the “lawless” domain. The most hard-hit were the adherents of the then prevalent “**Steady State**” model. Thus, one of these enthusiasts, Fred Hoyle, during a BBC broadcast in 1949, coined the very forceful term (epithet) “**BIG BANG**” to cut a sharp contrast with his own favorite cosmos with a “**Steady State**”. The pros and cons contest or debate between these two main rival models and several minor ones continued till 1964,

when Arno Penzias and Robert Wilson, during their surveys of the radio waves coming from the Milky Way galaxy, unexpectedly found an omnipresent signal in the microwave region. This ubiquitous signal is presently called the “**Cosmic Microwave Background Radiation**”, shortened as **CMBR**, **CMB** or just **CBR**. This finding provided the crucial evidence in favor of the Big Bang model, as it had predicted such a radiation before its experimental observation.

In the meantime, during the cold war decades, ex-USSR launched **Sputnik** in 1957, ushering in the **Space Age** and the accompanying **Space Race** between USA and Russia. This new rivalry and race imparted a major impetus to **Space Research** and the related fields, such as, Rocket and Missile Technology, Astrophysics, Astronomy, Cosmology, etc., and launched the **Aerospace Industry**. The spin off from these efforts has filtered into our daily lives and households. As for Cosmology, the big gains have been the development of extremely sophisticated analytic instruments and equipment, very powerful telescopes, and the Research Satellites, such as, the Cosmic Background Explorer (COBE), Wilkinson Microwave Anisotropy Probe (WMAP), and numerous others, which have provided the state of the art picture of the CMB and given additional support to the expanding universe. Furthermore, **Hubble Space Telescope** launched in 1990, has greatly enlarged the horizons of the presently observable universe and provided unprecedentedly spectacular pictures of the distant galaxies, supernovae, and diverse other fascinating celestial objects in the very remote parts of the heavens [3]. More recently, the scrutiny of the red shifts of type **Ia supernovae** suggests that the expansion of the universe has been accelerating since it was about half its present age. This observation has greatly puzzled the cosmologists, obliging them to attribute this acceleration to the presence of the so called **Dark Energy** – a “**Negative gravity**” or a **Repelling Force** in our universe! *In short, there is no doubt about the expansion of the universe, though its causes are still ill-understood and remain obscure [4a, 5].*

Justification of the Proposed Model: As pointed out in the opening section of this study, the very fascinating spectacle of our Universe has captivated the human mind, since antiquity. And coupled with our curiosity and concerns about *matters involving life and death*, it has engaged the contemplative minds to enquire about its (*and our*) origin and end. Consequently, there are a large number of models for the life cycle of our Cosmos, resulting in a vast amount of literature: religious, philosophical, popular, and during the past 100 some years highly professional [6]. Thus, it is neither easy nor prudent to advocate yet another model on this theme. But in spite of these precautions and restrictions, pondered scrutiny of the independent expansion of space-time – presently attributed to the presence of **Dark Energy** causing the centrifugal pull of the **Vacuum Field** - , vis-a-vis the centripetal nature of the **Gravitational Field**, compounded by the hypothetical **Inflation** of the so called

“**Primordial Atom or Singularity**”, provide some compelling reasons to propose an Unorthodox Scheme for the life cycle of our Universe. The conventional as well as some non-conventional supporting arguments leading to the proposed Model are detailed in the following sections.

Preliminary Comments on the Definitions, Assumptions, and Conventions used in this investigation:

1. **The Eternal Void or the Vacuum Field (V_0)** is devoid of any electromagnetic radiation (EMR) and matter. Thus, it is neither perceived by our normal senses nor directly detected by our scientific instruments. Consequently, for all practical purposes it is not evident to us. Nevertheless, its presence may be inferred from the behavior of the Manifest Universe, which is expanding into an apparent emptiness. Hence, “*this transcendent boundless sea of an apparent emptiness*” is the Primary Universal 3D stage in which the phenomenon of the Manifest Universe is played out marvelously by a wide spectrum of **EMR**, dancing as **Energy** waves. And only a very small select cast disguised as **Matter**: Electrons, Protons, and Neutrons.

It has several enigmatic properties some of which are known (G, h, c), while others await discovery. Thus, the observations on the inexplicable independent expansion of space-time, which increases the size of the Universe, indicate that the Vacuum energy (if any), instead of contributing to the Gravitational Field or the centripetal attraction, exercises a pull or a negative pressure on the **Manifest Universe**, *which is constituted by the space-time containing EMR and matter*.

Well that is no surprise, as it is the expected behavior of the vacuum, which by definition has a lower pressure and energy density (ideally, zero) than the system on which it is superimposed. And I would like to draw readers’ attention that we are dealing here with the Eternal Sea of Emptiness, *devoid of any EMR and Matter*, surrounding the Manifest Universe delimited by the total volume of the Space-time containing a diverse spectrum of EMR and all sorts of celestial bodies, plus the gaseous and the dispersed matter.

In comparison, the *Relative Vacuum* created in the lab equipment and that present in the interplanetary, interstellar, and intergalactic spaces reflects the respective local environment, which contains the gaseous plus the particulate matter and is crisscrossed by all sorts of photons, coming from the local as well as the distant celestial sources.

In a sharp contrast, the real surprises are: the mutual gravitational attraction between bodies attributed to the space-time curvature caused by their energy and mass. And especially, the very much stronger electromagnetic (EM) repulsion and attraction between the like and the unlike charges, respectively, whose reason and mechanism have not been explained, but are just taken for granted by merely assigning the plus (+) and minus (-) signs. For instance, it is well-known that the EM interaction is about 10^{40} times stronger than the gravitational attraction, yet no explanation is available for its extraordinary strength nor I am aware of anyone who has calculated the curvature of space-time provoked by an electron, proton and / or by the bigger charges!

2. **Space or Space-time** constitutes the Void V_0 populated by EMR, which may also be occupied by the dispersed particulate matter as well as all sorts of material objects. *The radial progress of the Primary EMR, generated (emanated) at the birth of the Universe before the onset of the g-forces*, defines the dynamic frontiers of space-time, which are expanding uniformly in all directions at the speed of light. The gravitational field (g-field / g-curvature) does not retard its progress, as it is fleeting at the speed of light and is always ahead of any g-effects. *Consequently, the real extent and size of the Space-time are far larger than that determined for the Universe observed by our instruments.* Thus, I would like to point out here, that the observed g-tug near the massive bodies is felt only by the Secondary EMR, emitted during the later processes taking place within the Manifest Universe: recombination, CBR, particle decay, nuclear fusion and fission, etc. In fact, the gravitational effects become significant only for matter and especially the aggregated matter, because due to inertia the material objects cannot travel at the speed of light. Thus, these objects become prey of their mutual g-fields, growing bigger and bigger, unless they can adequately balance their negative potential energy with their kinetic energy in a sustainable orbit, giving rise to the stellar systems, galaxies, and galaxy clusters, etc. These systems and super structures are mainly governed by the local gravitational fields, as discussed in an earlier report [7].

3. **Electromagnetic Radiation (EMR)** or the EM waves represent the energized and polarized state of the V_0 , conducting momentum ($mc = \hbar/r$), angular momentum ($mc \times r = \hbar$), and energy ($E = \hbar c/r = mc^2$), at the speed of light (c). Thus, the top-most possible speed 'c' of EMR and the extremely small values of the Planck constant ($h = 6.63 \times 10^{-34}$ J s) or its reduced form ($\hbar = h/2\pi = 1.055 \times 10^{-34}$ J s), attest to the super-sensitive and super-conducting nature of the of the V_0 , because its undetectable V_0 state becomes highly disturbed and polarized by an extremely small input of energy during a very short fraction of a second: $h = E T$ or $\hbar = E t$. The resulting electromagnetic wave flies away at the top-most speed (c) and can be detected by our instruments or even seen as light of different colors.

Apart from the numerous familiar as well as the specialized uses of light, heat, microwaves, x-rays, and gamma rays, etc., the great importance of EMR and its associated energy lies in its primordial link with the very birth of our Cosmos, as it is strongly believed that the essential building blocks of our Universe: electrons (e), protons (p), and neutrons (n), arose from the Primordial Energy, as may be deduced from Einstein's very famous equation: $E = mc^2$ or $m = E/c^2$.

But in spite of the well-documented link between mass and energy, it should be borne in mind that though the spectrum of EMR is almost infinite, yet its conversion into matter (and especially the stable particles) is very selective and extremely limited. Thus, only gamma-ray photons of appropriate energy ($hf \geq mc^2 \geq e^- + e^+$) have been materialized into $e^- + e^+$ (**Pair Production**), as already examined in a previous report [8].

The other high energy experiments exploit the collision energy of particles ($e^- + e^+$; p, p) or the heavy ions, which have been boosted to very high speeds and very high kinetic energies. Thus, these examples are neither clean nor true photon materializations. Instead, these

experiments produce a plethora of unstable and some stable particles, which have their importance in the Particle Physics, but could be far removed from the scheme proposed here, which does not jump-start from a very hot soup of EMR and particles plasma, nor involves any violent collisions. Instead, according to the new scheme, the events during the birth of our Universe are believed to be fairly orderly, though evolving at the speed of light!

Therefore, I would like to stress again that only a small fraction of the Primary EMR is converted into matter; *the major portion is just fleeting away radially in all directions expanding the extent of Space-time and the overall size of the Universe, which qualifies it as the “Dark Energy” candidate.* Though this escaping radiation cannot be detected directly by our instruments, yet the increasing size of the Universe is evidenced (detected) by the increasing separation between the far away galaxies. I may add here, that a small portion of the 2-ary radiation, especially from the celestial bodies at the outermost frontiers, is also escaping from the material Universe, but may not add to the overall space-time frontiers, being a much later and rather very small contribution.

4. Space-Time Expansion and Contraction – Well, this topic brings us to the crux of the matter under investigation, as the Big Bang and its upgrades or variations are based on the logical reversal of the presently observed expansion of the Cosmos to a smaller and smaller size in the past. Thus, as pointed out in the introduction, Georges Lemaitre arrived at the “**Primeval Atom**”, having infinite values for the mass-energy density, temperature, and gravity, etc. – an unknown state where the known laws of physics break down and operate no more! Presently, this ‘point’ is called a **Singularity**, from where our universe sprang up somehow by speculative means and measures.

In a sharp contrast, **the Present Proposal** postulates a limit on the gravitational compression of the total mass-energy of our Universe to a finite minimum volume, reaching a maximum possible density corresponding to about $1.464 \times 10^{20} \text{ kg/m}^3$ or $1.067 \times 10^{23} \text{ kg/m}^3$ (Entry 9 or 10, Table 2; see later text), which is several orders of magnitude higher than the estimates for the density of **neutron stars** ($3.7 - 5.9 \times 10^{17} \text{ kg/m}^3$). During this **Cataclysmic Isotropic Gravitational Squeeze**, when nothing can escape from its extremely strong g-hold, all the potential and kinetic contents of the compressed mass-energy of the Universe are spent against the reaction to compression and the extreme resistance to EM propagation in the denser and denser medium. **Finally, there occurs the most important phase change event at this stage:** *the EM fluctuations and their propagation, both linear and as standing waves, come to a halt. Hence, mass-energy ($E = mc^2$) along with their related parameters (mc , $mc \times r$, $mc^2 r$, etc.) are reduced to zero losing their essence, meaning and significance. Consequently, in the absence of mass-energy, there is no more gravitational interaction: $G M = \text{zero}$ and $G/c^4 \times \text{energy} = \text{zero}$. Thus, on attaining their peak, both g-compression and the counter EM reaction come to a halt! Apparently, the whole system becomes inert and unresponsive – signifying its “Death & Demise”. **Instead, a small homogeneous and isotropic nucleus suspended in the infinite eternal Void (V_0) attains the maximum values for its anti-gravity potential.** *In other words, during the declining phase, the Manifest Universe pays back to the Vacuum Field the energy invested in its birth, growth, and**

evolution. Thus, born as the EM agitation in the Primordial Void, it finally attains rest and becomes quiescent (latent).

Well, apart from the known difficulty for the passage of EMR in very high density media, the gravitational redshift, blue shift, and **Time Dilation** are presently proven facts. Therefore, it is tempting to recall that according to GRT, time's duration (say, 1 s) varies with the measuring clock's distance (R) from the g-source M [4b]:

$$t_0 = t_f \sqrt{1 - 2G M / R c^2} = t_f \sqrt{1 - R_s / R}$$

Thus, clocks closer to the massive body - with a smaller R and stronger g-field - tick slower (t_0) than those very far away (t_f) in a weaker g-field. Therefore, time runs slower and slower on approaching the g -source. Similarly, as the local space-time is wedged together and the speed of light 'c' is constant, the covered distance also slows down correspondingly. *But the most significant result is reached at $R = 2G M / c^2 = R_s$ (**Schwarzschild radius**), when time should come to a stop ($t_0 = zero$), halting any further contraction and delimiting the size of R_s – the **Event Horizon** of the **Black Hole**.*

And in its support, apart from “**Sagittarius A**” at the center of our own Milky Way galaxy, many Super Massive Black Holes (SMBH) have been observed in several other near as well as far away galaxies. But there are no signs or evidence for any phase-change or the dormancy of g-forces and the latency of mass-energy. Instead, extremely energetic plasma jets are being flung out (squeezed out?) of their polar regions. At present, there is no satisfactory explanation for these jets, though some reports attribute them to the matter falling on / around the Event Horizon of these black holes, where it is converted into plasma jets. But, it may be argued that there should be much more matter falling along the plane of the galactic disks than that in the Polar Regions of the Black Hole!? Well, as this observed phenomenon is not yet settled, let us wait for its clarification.

Nevertheless, as GRT does not postulate any phase change nor the accompanying fatal consequences for the fate of a Black Hole, a note of caution and some explanation is needed to justify the drastic and unprecedented conclusions about the fate of the Manifest Universe, conjectured in an earlier paragraph. Thus, I would like to point out that the galactic discs containing medium size “**Sagittarius A**”, or even those harboring the super massive black holes (SMBH), are not a good analogy for the Manifest Universe, especially during its contraction cycle. Because when during the compression phase it really becomes homogeneous and isotropic, say around $R = 10^{16}$ m or 10^{15} m, it will be many orders of magnitude smaller than its calculated R_s (2.966×10^{27} m; *see following section 5 and Table 2*) and subject to extremely high gravitational potential and g-forces, which are much beyond the GRT formulations for the Black Holes, as will be developed and described in the subsequent sections.

But, to the best of my knowledge, neither the pioneers nor the subsequent advocates of the Big Bang and the related models have applied these considerations to arrive at the “Primordial Atom” or Singularity. Instead, they mentally or mathematically crush the mass-

energy of the Universe to zero dimensions, obtaining infinite values for energy density, temperature, and gravitational field, etc.

In a sharp contrast, according to my understanding and the present proposal, the real victims are our familiar mass-energy, because the EMR fluctuations and their propagation – both linear and as standing waves (particles), which constitute the very essence of mass-energy and a measure for the space-time – are snuffed out of existence, much before attaining the postulated tiny or zero dimensions, spelling out the demise and “RIP” of the Manifest Universe!

Well, how long this situation (or moment) lasts is difficult to answer, because in the absence of EM fluctuations (agitation) and their propagation – *the very measures of mass-energy, space-time, and any existence* – the enquiry loses its meaning and amounts to nonsense, as no means and measures survive this fatal event. But recalling some familiar situations involving the kinetic and potential energy interconversions (K. E. \Leftrightarrow P. E.), such as a pendulum, a projectile or an object thrown up in a g-field, or an oscillating weight hanging from a spring, the moment of inversion has no noticeable delay and appears to be instantaneous. However, these examples or analogies do not transform the objects into something else and much less involve the extremely drastic and unfamiliar phase change: the annihilation of the mass-energy of the Manifest Universe and its conversion into the potential energy of a small ‘inactive cosmic nucleus’, with respect to the anti-gravity nature of the surrounding infinite Vacuum Field. *And let us recall that the Eternal Void or Vacuum (V_0) represents the Nonmanifest Universe (Emptiness) and is the arena for the Manifest Universe, as defined in section 1.*

Thus, we are facing a bewildering situation never confronted before. But, fortunately we have also found a possible solution to the age-old puzzle: “*What and who is the Source of the Mass-Energy of the Manifest Universe?*”? Evidently, the answer just found above is the abnormally high potential energy of the ‘inert cosmic nucleus’ suspended in the anti-gravity field of the infinite Primordial Vacuum, which restarts the P. E. \Leftrightarrow K. E. cycle.

5. GRT and the Manifest Universe – Now let us examine if we can apply the GRT arguments to the estimated mass-energy of the presently **Observable Universe**. But as the limits of our observations depend on the performance limits of our instruments, these estimates are far below the real value, because we can only detect EMR which is directed towards our instruments and has had time to reach us. Thus, though our capacity to observe the universe has undergone thousands to million fold improvement - since the invention of the 1st telescope to the present day marvels of the Observational Cosmology -, yet nobody can claim that we have seen the outermost edge of the universe. Such a claim could be made only by an observer situated far outside, but not by those who are immersed several billion light years (Gly) deep inside the 3D space-time ocean! Therefore, I propose to do this verification and develop the necessary arguments by *assuming a tentative value of 2×10^{54} kg*, which is 13 to 20 times bigger than the current estimates for the mass-energy of the **Observable Universe** (1 to 1.5×10^{53} kg) [4c].

The approximate values of some Universal Constants and the assumed features of the Universe employed in this study: Planck constant, $h = 6.63 \times 10^{-34}$ J s / cycle

Reduced Planck constant, $\hbar = h/2\pi = 1.055 \times 10^{-34}$ J s / radian

Speed of light (EMR) in vacuum, $c = 3 \times 10^8$ m / s

Light year = 365.25 days = 3.15576×10^7 s = 9.46728×10^{15} m

Mass of Sun: 2×10^{30} kg; Mass of Earth: 6×10^{24} kg

Assumed Total Mass-Energy (EMR + Matter) of the Universe = 2×10^{54} kg; (1.8×10^{71} J)

Number of Galaxies in our Universe: 10^{12}

Gravitational constant, $G = 6.6735 \times 10^{-11}$ m³/s² kg

Gravitational constant for Schwarzschild radius (Rs): $2G/c^2 = 1.483 \times 10^{-27}$ m/kg

Gravitational constant for Semi Schwarzschild radius (Rc = Rs/2): $G/c^2 = 7.415 \times 10^{-28}$ m/kg

Gravitational constant for Energy content (Mc²), instead of mass:

$G^\# = G/c^4 = 8.2389 \times 10^{-45}$ s² / kg m (1/Force; 1/N; m/J)

Inverse of $G^\#$, $1/G^\# = c^4 / G = 1.21375 \times 10^{44}$ kg m/s² (Force; N; J/m)

Thus, based on the observations that our *Cosmos appears to be homogeneous and uniform in all directions (isotropic)*, when viewed at the cosmologically large scales, one may derive some important conclusions:

Schwarzschild radius of the Universe: $R_s = 2M G/c^2 = 2.966 \times 10^{27}$ m; 313.29 billion light years (Gly)

#Semi Schwarzschild radius of the Universe: $R_c = M G/c^2 = 1.483 \times 10^{27}$ m (156.645 Gly)

Volume of Schwarzschild sphere: $V_s = 4\pi/3 (R_s)^3 = 1.093 \times 10^{83}$ m³; (1.3662×10^{82} m³)*

Mass density of the Universe at Rs: 1.83×10^{-29} kg/ m³; (1.464×10^{-28} Kg/ m³)*

Gravitational Potential at Rs: 4.5×10^{16} m²/s² or J/ kg; (9×10^{16} m²/s² or J/ kg)*

Acceleration at Rs: $g = c^2/ 2R_s = 1.5172 \times 10^{-11}$ m/s²; (6.0688×10^{-11} m²/s²)*

#*Semi Schwarzschild radius* (Rc = Rs/2), though unknown for black holes, is included here to develop arguments in the text.

*Figures in parenthesis represent values at Rc.

Therefore, comparing the calculated Rs (313.29 Gly) and Rc (156.645 Gly) with the current estimates for the age (13.8 billion years) and the radial expansion of the Observable Universe (46.5 Gly), I wondered if we were living in the Universal Black Hole (UBH)! But on closer scrutiny, these passing doubts were soon dispelled by the following main reasons, as detailed in a previous report [7]:

- a) No body is experiencing any bizarre g-effects of living inside the UBH.
- b) The Universe is expanding instead of collapsing under the g-field of UBH.
- c) The Universe observed at very large scales is only statistically homogeneous and uniform but is not so in reality, as it is composed of several billion galaxies separated by huge voids – disqualifying it as a compact single system. And the galaxies themselves are composed of trillions of stellar and planetary systems. Thus, there is a hierarchy of g-fields within g-fields (local > immediate neighbors > the far away bodies), which govern the local and the distant g-dynamics of the planets and their satellites, the stellar systems, galaxies and the galaxy clusters.

Now, let us focus on some other expected properties of the universe listed above. For instance, its calculated average mass-energy density at Rs ($1.83 \times 10^{-29} \text{ kg/ m}^3$; $1.647 \times 10^{-12} \text{ J/ m}^3$) and at Rc ($1.464 \times 10^{-28} \text{ Kg/ m}^3$; $1.3176 \times 10^{-11} \text{ J/ m}^3$) are extremely low, amounting respectively to about 1 H-atom/ 91 m^3 and 1 H-atom/ 11 m^3 , which again attest for the presence of lot of emptiness (void) and against the expected compactness of a black hole. Moreover, in spite of **the assumed higher mass ($2 \times 10^{54} \text{ kg}$) for the universe**, the calculated densities at Rs and Rc are also smaller than the present estimates for the density (10^{-26} kg/ m^3 ; 6 H-atoms/ m^3) and age (13.8 billion years) of the Observable Universe, indicating that it has not yet expanded to those long distances. Instead, **for the assumed mass**, the estimated density would correspond to a sphere of $2 \times 10^{80} \text{ m}^3$, providing $3.628 \times 10^{26} \text{ m}$ (38.32 Gly) for the radius of the expanding globe!

6. GRT Space-Time Curvature versus the Potential Energy Gradient and the Space-Time Inclination – Next, what about the space-time curvature at the supposed Rs and Rc? Well, as I am not conversant with the GRT math and its various conventions, let us leave it for the experts to provide the necessary figures. *Instead, I adopt the local acceleration, $g = v^2/R$ (the ratio between the local g-potential v^2 and its distance R from the g-source) as a **guide** for the local potential energy gradient and the space-time inclination.*

Thus at Rs: $g = c^2/ 2R_s = 1.5172 \times 10^{-11} \text{ m/ s}^2 = \tan \theta$; $\theta^\circ = 8.7 \times 10^{-10}$; and at Rc: $g = c^2/ R_c = 6.0688 \times 10^{-11} \text{ m/ s}^2 = \tan \theta$; $\theta = 3.48 \times 10^{-9}$ degrees, provide the potential energy (P.E.) gradient at those radial distances. In other words, the value of theta indicates the local space-time inclination. Hence, the above extremely small values of gradient or inclination amount to essentially a planar horizon.

However, let us bear in mind that the energy potential at the **Event Horizon** (Rs) of all black holes has the same value ($c^2/2$), but the length of Rs changes proportionally to the mass of the

black hole. Therefore, the tiny acceleration and space-time inclination calculated for the hypothetical X-large black holes would become progressively large and very significant for the lower mass black holes, as exemplified in **Table 1**. Thus, black holes resulting from our Sun and up to a billion solar masses (items 1 – 4) have very high values of g , providing a gradient of 90 or very close to 90 degrees, which declines progressively for the still larger and low density black holes (items 5-6) - possibly pointing against the formation of extremely large black holes.

Table 1: Mass Density, Surface Gravity and the Potential Energy Gradient at the Event Horizon of some Hypothetical Schwarzschild-Radius (R_s) Black Holes

Example	Mass (kg)	R_s (m)	Density (kg/m^3)	' g ' (m/s^2)	θ°
1. Sun	2×10^{30}	2.966×10^3	1.83×10^{19}	1.5172×10^{13}	90
2. Sun $\times 10^3$	2×10^{33}	2.966×10^6	1.83×10^{13}	1.5172×10^{10}	90
3. Sun $\times 10^6$	2×10^{36}	2.966×10^9	1.83×10^7	1.5172×10^7	89.99
4. Sun $\times 10^9$	2×10^{39}	2.966×10^{12}	18.3	1.5172×10^4	89.99
*Sun $\times 6.5 \times 10^9$	1.3×10^{40}	1.9279×10^{13}	0.4331	2.334×10^3	89.97
5. Sun $\times 10^{12}$	2×10^{42}	2.966×10^{15}	1.83×10^{-5}	15.172	86.23
6. Sun $\times 10^{24}$	2×10^{54}	2.966×10^{27}	1.83×10^{-29}	1.5172×10^{-11}	8.7×10^{-10}

*: A 6.5 billion solar mass Black Holes was recently reported (April 2019) in the center of nearby galaxy M87 [9].

The above argument for the P.E. gradient and space-time inclination is not just limited to Black Holes, but can also serve as a **general guide** for ordinary situations. For instance, compare the mild solar g and the potential energy gradient at Earth's orbit – ($g = 0.006 \text{ m/s}^2$; $\theta = 0.344^\circ$) – with the values of g and θ under our feet: 9.8 m/s^2 ; $\theta = 84.17^\circ$. Thus, though we are firmly earth-bound, yet it is not a black hole situation, because our energy potential is only about $6.3 \times 10^7 \text{ m}^2/\text{s}^2$ (or J/ kg) against the $4.5 \times 10^{16} \text{ m}^2/\text{s}^2$ (or J/ kg) at the Event Horizon (R_s) of a black hole. In other words, the escape velocity from Earth is just about 11 km/ s, versus 'c' from the Event Horizon of a black hole.

Table 2: COSMOS UP AND DOWN THE ROAD TO SINGULARITY

Entry	R (m)	D (kg/ m ³)	P. E. (J/ kg)	'g' (m/s ²)	θ (degrees)#
1.	2.966×10^{27}	1.83×10^{-29}	4.5×10^{16}	1.5172×10^{-11}	8.7×10^{-10}
2.	1.483×10^{27}	1.464×10^{-28}	9×10^{16}	6.0688×10^{-11}	3.477×10^{-9}
3.	1.483×10^{21}	1.464×10^{-10}	9×10^{22}	60.688	89.056
4.	1.483×10^{18}	0.1464	9×10^{25}	6.0688×10^7	~ 90
5.	1.483×10^{17}	1.464×10^2	9×10^{26}	6.0688×10^9	90
6.	1.483×10^{16}	1.464×10^5	9×10^{27}	6.0688×10^{11}	90
7.	1.483×10^{15}	1.464×10^8	9×10^{28}	6.0688×10^{13}	90
8.	1.483×10^{12}	1.464×10^{17}	9×10^{31}	6.0688×10^{19}	90
9.	1.483×10^{11}	1.464×10^{20}	9×10^{32}	6.0688×10^{21}	90
10.	1.6478×10^{10}	1.0672×10^{23}	8.1×10^{33}	4.915×10^{23}	90
11.	2.966×10^3	1.83×10^{43}	4.5×10^{40}	1.5172×10^{37}	90

The GRT space-time curvature for Items 1to 11 provided by an expert will be appreciated.

7. The Expanding Baby Cosmos was outside the Realm of GRT – However, it turns out that we cannot apply the same arguments to our expanding Universe, because at the present dimensions, it does not behave as a compact single system controlled by the g-hold of its total mass-energy. Instead, its g-centers are widely scattered as trillions of galaxies, containing a

similar number of sub-systems, forming an intricate hierarchy of g-fields: planets, stars, galaxies, and galaxy clusters, as already discussed earlier. In fact, based on the ongoing expansion of the Universe, one can safely conclude that since its birth, the Manifest Universe was never under the gravitational control of its total mass-energy. If it were subject to the enormous g-hold of its total mass-energy, it would be buried deep inside its R_s and R_c from where it could never arise much less undergo expansion. You can verify these conclusions from the data illustrated in Table 2, *which assumes a homogeneous and isotropic Cosmic Globe at various sizes*, comprising the total mass-energy of 1.8×10^{71} J. The different radii are chosen just to illustrate and facilitate the arguments developed in the text, during the expansion and contraction cycle. Tabulation has not been detailed further down the scale, as it is not certain when and where the known laws of physics break down marking the transition of the Manifest Universe to the Nonmanifest state!

Comments on Table 2: First of all, due to the assumed isotropic homogeneity of the cosmic globe during the expansion and compression cycle, its total mass-energy is always conserved by the volume & pressure (mass-energy density) relationship, $P_1 \times V_1 = P_n \times V_n$, despite the fact that we are not dealing with an ideal gas. And in the second place, *I would like to point out that the advocates of Big Bang model argue that in spite of being extremely dense when very young and during part of its early expansion – far denser than required to form a black hole – the universe did not re-collapse, because calculations for g-collapse are based upon constant size stars and do not apply to the rapidly expanding space of the Big Bang* [see “Density of universe during expansion” - 4a].

Well, this ambiguous argument may apply to the adequacy or inadequacy of the Schwarzschild equation for the non-rotating stationary black holes, but certainly does not reflect the vital role gravitation has been playing, since the very early stages of the expanding universe for its development, differentiation, and evolution: the Big Bang Nucleosynthesis (BBN) in the 1st three minutes, followed by gathering/clumping of the fleeting Hydrogen and Helium – the lightest of the gases – into billions of proto galaxies & galaxies, igniting the cascade of uncountable celestial fusion reactors – providing the chemical elements of the periodic table – then extinguishing the light-weights as cinders of the dead stars, while help blow up the heavy weights as supernovae, resulting in neutron stars or even some black holes - *a very impressive list of accomplished celestial tasks, indeed!* And let us bear in mind that during all these very significant transformations carried out on matter caught up in the grip of gravity – the expansion of the universe was independently going on all the time!

Now focusing on the individual entries, the extremely low density situations at the calculated R_s and R_c for the supposed total mass-energy of the cosmos (Entries 1 and 2) have already been discussed. Entry 3 would also fall in the same category, having its g-centers scattered as billions of galaxies, separated by huge voids. And Entry 4, with its greatly increased P. E. and having the average density of a gas, could be a borderline case. But the steadily denser and denser examples (Entries 5 – 11) would coalesce at some point into a single whole. Thenceforth, with higher and higher P. E., coupled with the vertical inclination of space-time, it would certainly become a no escape situation for both particles and EMR. And conditions for their escape turn worse and worse on reducing the size of the Cosmic Globe. *Furthermore, once the Universe becomes a single compact system, it would be many orders of magnitude smaller than its Schwarzschild radius (R_s) – and thus much beyond the realm of GRT and its Schwarzschild solution!* Similarly, it would also flagrantly disobey the ‘Maximum Force and Minimum Distance’ hypothesis [10]. Therefore, the final point called the “Primeval Atom” by Georges Lemaitre or “Singularity” by Penrose and Hawking, supposedly having infinite values for density, temperature, and g-forces, etc. - certainly represent a lawless state! Consequently, one wonders: How the baby cosmos broke free from its extremely forceful shackles to scatter its g-centers and become the vast universe we are trying to fathom?

But, the Big Bang model and its variations do not explain how the “Primeval Atom” circumvented the infinite g-forces to give birth to the “Baby Cosmos”, which has been growing bigger and bigger, while undergoing development and differentiation – *under the local g-forces* – to become the expanding Universe we inhabit and inquire. In fact, these models tacitly skip the extremely severe initial conditions – *where, allegedly, the Laws of Physics work no more and are beyond our reason and understanding* – and instead dwell on its growth from a “Hot Soup” of particles and EMR, without giving any detail about the size of its “Cauldron”. However, it is also a no, no proposition, because the infinitely energetic, dense and hot “*soup bowl*” would have been inconceivably denser than any of our known densest molten metals and even the **neutron stars** – the densest known celestial objects! And once again there is no explanation as to how one can ignore the enormous g-forces acting on such a “cauldron of extremely energetic goo”. Moreover, you may check yourself from Table 2 that something like a “soup” could not be available until the Cosmic Globe had expanded to about 10^{17} m.

Furthermore, starting from a mixture of particle-energy plasmatic goo-soup, one may ask: What about the forging of heavy chemical elements under the extremely drastic g-potential

and high mass-energy density prevailing, especially during the infancy of the cosmic baby? Thus, how to explain the great predominance of Hydrogen, along with a little bit of its fusion product Helium, sprinkled by a dash of lithium? And let us bear in mind that Hydrogen is the primary fuel, which drives and has been driving the evolution of our cosmos - followed by the energy liberating cascade only up to Iron; but requiring an input of energy, under the extremely forceful and drastic conditions of supernovae, for the synthesis of higher chemical elements.

8. Big Bang versus the New Proposal – Thus, it is clear that the birth and initial growth of the baby cosmos was not subject to the action of g-forces. *Instead, it indicates that the Universe was born as the fleeting EMR – under the g-free conditions. And initially it was free of any matter.* But, soon after the materialization of some suitable energy EMR into neutrons and protons, their subsequent fusion into Deuterium, Helium and some Lithium could take place – *throughout the entire cosmic globe* – under the very high energy density prevalent during the infancy of the cosmos. However, due to the high stability of Helium and the declining profile of the energy density – *caused by the relentless expansion of space-time, propelled by the radial flight of the I^{avy} EMR* – further fusion reactions and a “nuclear meltdown” of the cosmos were avoided! Fortunately, a mixture predominant in Hydrogen (75%) and Helium (25%) was saved from the nuclear fire. It is this residual mixture of Hydrogen and Helium – *subsequently caught up under the influence of the local g-forces* – which has been driving the development and differentiation of the cosmos by the stepwise and sequential burning of Hydrogen and its fusion products, eventually evolving into the Universe we now contemplate and admire.

Well, the above scenario is in good accord with the **Big Bang Nucleosynthesis (BBN)**, which is one of the supporting pillars of the Big Bang cosmology. For instance, soon after the birth of the universe, BBN requires very high photon to nucleon ratio, under very high energy-density conditions, prevalent throughout the entire expanding cosmic globe – just as portrayed above. But, the new proposal does not start with the BB matter-energy (gluons, quarks, and photons) ‘hot soup’. Thus, it avoids the instant presence of the enormous g-forces, which would agglutinate matter, retard the radial progress of EMR, and work against the cosmic expansion. Instead, as postulated just above, it starts with the radially fleeting EMR, initially free of any matter and under the g-free conditions. Nor do I subscribe to the BB ‘time chronology’, because I wonder which time estimates the cosmologists are referring to: *the local remote past or the present far off calculations? Moreover, how do they measure or calculate it in the presence of enormous g-forces, very rapid expansion or even the so*

called “**Inflation**”!? Thus, though we owe great respect to Planck and other giants of the classical and modern physics, yet the derived Planck units (mass-energy, length, time, etc.) and the so called Planck epochs are merely mathematical interconversions of a few universal constants (h , c , and G), instead of being factual entities. Therefore, arguments and conclusion based on these units and epochs are not convincing and are open to question. However, as these are debatable points, I defer further comments for a later ‘proper time’.

Furthermore, it is conceivable that the high density and close proximity of nucleons, which enabled the initial fusion of neutrons and protons into helium ions ($2n + 2p^+ \rightarrow He^{+2}$), would have also promoted the formation of the ‘Primordial Cosmic Nucleus’. Thus, an accumulation of several solar-mass worth of the neutrons, protons, and He mixture could undergo *fierce burning in its inner core*. But, **the expanding space-time of the surrounding Cosmic Globe** – *conditions and circumstances, entirely different from those surrounding the supernovae in the galactic discs* – would have prompted the “Primordial Cosmic Nuclear Bang”, scattering the core and the rest into trillions of g-centers, which avoided the consolidation of the total g-forces and liberated it from the g-hold of the total mass-energy of the Universe. Such a scenario would be compatible during the opaque (dark) period of the cosmos, when the *Expanding Cosmic Globe* was comparatively young, its average density was declining rapidly, while the g-potential and g-forces had not fully consolidated and were only moderately strong. Incidentally, the much later release of CMB estimated around 380 – 400 thousand years ($R = 3.6 - 3.8 \times 10^{21}$ m) does not conflict with such a supposition.

But in spite of the great advances in Observational Cosmology, cosmologists cannot yet see the Universe so much remote in the past – and may never see across the opaque and dark past of the cosmos. Consequently, they cannot detect the hypothetical “Primordial Cosmic Super Bang”. Instead, they are observing much later scenarios, when the Universe had become free from the g-hold of its total mass-energy, having its g-centers scattered all over as trillions of proto galaxies, which slowly evolved into galaxies and galaxy-clusters with a wide range of ages, belonging to different generations, containing their respective supernovae, which illuminate the past history of our Cosmos.

Thus, according to the preceding arguments and as already discussed in section 4 on the “**Space-Time Expansion and Contraction**”, the Manifest Universe arose from its “ashes”, when the abnormally high potential energy of the contracted inert globe with respect to the anti-gravity field of the Primordial Vacuum (Vacuum Field) restarted the P. E. \Leftrightarrow K. E. cycle, which is also driving its expansion. How far it will expand and grow depends on the total amount of kinetic energy, which is being converted into the g-field: K. E. \Rightarrow P. E.

Based on the assumed total mass-energy of 2×10^{54} kg (1.8×10^{71} J), which arose as EMR – by the reverse phase-change of the ‘inactive cosmic nucleus’, suspended in the Vacuum Field –, to evolve into the Manifest universe, it could expand to a Cosmic Globe of $R_u = 1.483 \times 10^{27}$ m, where its gravitational potential attains $c^2 = 9 \times 10^{16}$ m²/s² (Table 2, entry 2). An alternative view looks at G/c^4 (8.23888×10^{-45} s²/m kg) as the centrally directed constant g-force working against the progress of the unleashed total energy, which also provides: $R_u = 1.8 \times 10^{71}$ J \times 8.23888×10^{-45} s²/m kg = 1.483×10^{27} m. Well, the above value for the R_u corresponds to the total mass-energy of the universe as EMR. But as about 30% of the total turned into Matter (conventional + Dark Matter), the corresponding *estimates* would be: $R_{emr} = 0.7R_u = 1.038 \times 10^{27}$ m (109.65 Gly); $R_{matter} = 0.3R_u = 4.449 \times 10^{26}$ m (46.99 Gly). *Incidentally, the above calculated maximum diameter for the Material Universe (~94 Gly) is very close to the estimated diameter (93 Gly) of the presently Observable Universe - which may make one wonder if the universe is nearing the end of its expansion cycle. But let me point out right away that the expansion math or equation is not as simple as depicted above. Because, apart from the estimated 30% of the total mass-energy locked-in as the conventional plus dark matter, the 1^{ary} EMR has also expended energy invested in the intra- and inter-stellar, inter- and intra-galactic P. E. Moreover, it is also paying the bill for the ongoing expansion of the Cosmic Globe – or the ever increasing distances among its unbound parts. Well, all these expenses are being paid by the weakening or broadening of the Primary EMR. Thus, all such considerations have to be factored-in by the simulation experts to arrive at an appropriate formula for the final reach of the Primary EMR and the ultimate extent / size of the Cosmic Globe.*

Furthermore, I would like to highlight here, that the Abnormal State of the Vacuum Field – *caused by the presence of the ‘inert cosmic nucleus’ in the Primordial Void* –, could be the “**False Vacuum**” **Alan Guth**, the father of “**Inflation**”, invokes for the “**Inflationary Universe**”. But as the initial size of the ‘dormant’ cosmos (R around 10^{11} m versus nanometer), the nature of the “phase change”, and the ‘Abnormal State of the Vacuum Field’ described in the present proposal are entirely different from those invoked by the advocates of the ‘Inflationary Universe’, let us re-examine the possible behavior of the cosmos during the contraction cycle (Table 2) to evaluate and find out when and where the postulated ‘phase change’ could possibly take place.

9. Cosmos during the Contraction Cycle – Initially, when the cosmos reverses gear for the contraction cycle, billions of its scattered galaxies and galaxy clusters can still enjoy their relatively independent existence – though with increasing number of **Galaxy Mergers** – until

the radius of the shrinking globe approaches about 10^{18} m (Table 2, entries 1 – 4). But, as discussed earlier, further contraction at some point will certainly bring the scattered galaxies under the grip of the total mass-energy of the universe. *Finally, it will coalesce into a single compact system. Thenceforth, – lo and behold! –, the shrinking compact globe will be suddenly many orders of magnitude smaller than its calculated Schwarzschild radius (R_s). Thus, technically or mathematically it will be deep inside its own black hole – and much beyond (or beneath!) the GRT formulations.* And on further compression, it will progressively attain higher and higher values for its density, potential energy and g-acceleration, which will crush it even more (Table 2, entries 5 – 11) – *unless an exceptional and unknown theorem can mitigate the dire & drastic conditions deep inside the cosmic black hole!* Anyway, Table 2 has been terminated much short of the so called ‘singularity’, because the present proposal postulates a ‘phase change’ well before this hypothetical lawless stage.

In a sharp contrast, theoretical physicists and popular books have hypothesized **Einstein-Rosen Bridge**, **Schwarzschild Wormhole** and even **White Holes** to describe situations beyond the ‘Singularity’. But I think that probably they haven’t given enough thought and scrutiny to the earlier stages, preceding the supposed dead-end. For instance, since the dawn of physics, laws of motion and gravitation have treated most worldly objects as well as the celestial bodies as point-masses – without actually reducing them to dimensionless points. Thus plugging in the GRT equations the enormous values of mass-energy density, along with the modified tensors due to the unprecedentedly high g-potentials and g-fields, could possibly lead to some alternative exit – short of the supposed ‘singularity’. Well, as the GRT calculations are beyond my training, I have requested at the end of Table 2 the help of a *volunteer* to supply this information. Meanwhile, the interested readers can look elsewhere for any available investigation.

Furthermore, according to my search and knowledge, the formulators of the Big Bang model, its variations and updates – Primeval Atom, Singularity, Inflationary Universe, etc. – have not taken into account the **Gravitational Binding Energy** (B.E.) and its **Negative Mass** or the **mass defect** contribution, which can be very significant (up to 30% of the rest mass) as compared with the tiny (<1%) nuclear binding energy driving the celestial fusion furnaces up to Iron [11]. The Binding Energy of a uniformly dense spherical mass (M) is formulated as: $B.E. = -3GM^2/5R = -0.6GM^2/R$, which is 60% of the Potential Energy (P.E.) at its surface. The corresponding negative mass contribution amounts to: $-0.6GM^2/c^2R = 0.6 \text{ P.E.} / c^2$. Therefore, at the Event Horizon of a black hole, $P.E. = GM^2/R_s = Mc^2/2$; $B.E. = 0.6 \text{ P.E.} =$

$0.3Mc^2$, and negative mass = $0.3M$. Thus, it is argued that B.E. and its Negative Mass contribution cannot exceed the positive mass-energy of the spherical mass, because to do so would require compressing the sphere to below 30% of its Schwarzschild radius (R_s) or the Event Horizon – an impossible situation for a black hole [4d]. Moreover, as P.E. and B.E. are inversely proportional to the radius (R) of the spherical mass, the negative mass contribution becomes especially significant for the very dense small objects. For **Neutron Stars**, this negative mass component can approach 25% of their mass [4e, 12].

Now returning to the cosmos under analysis, the limiting compression radius would correspond to $0.3R_s = 0.3(2.966 \times 10^{27} \text{ m}) = 8.898 \times 10^{26} \text{ m}$, which is many orders of magnitude larger than the scenarios depicted in Table 2! Thus, recalling the earlier arguments, *when our cosmos coalesces to a single compact system, its negative mass-energy contribution would very much exceed and nullify its positive mass-energy several times over* – apparently, an absurd situation, whose significance I have yet to grasp! *Consequently, as Dark Energy and the Vacuum Field are postulated to have negative energy, I mused for a while, if this negative mass-energy contribution (hypothesis?) would bring the ongoing compression to a halt and restart the expansion.*

For instance, the total mass-energy of the cosmic globe could behave as a single compact system anywhere between entry 4 to 8 (Table 2, $R \sim 10^{18} \text{ m}$ to 10^{12} m – *density ranging from a gas to that of a neutron star!*), bringing about the reversal of gear and the start of the new cycle. Well, such a possibility would lead to an entirely different *cyclic model* for the life cycle of our cosmos – cutting a sharp contrast with the numerous **Cyclic Models** expounded so far, which are based on entirely different assumption and theoretical considerations [4f, 6]. And if it can be proved that the reversal of gear happens around R of about 10^{17} m – *the postulated end-point of the ‘Inflationary’ period* –, it would provide an excellent alternative to the hypothetical ‘Inflation’. Moreover, the reversal of cycle when Matter and EMR have not been pushed to extreme limits by the onslaught of the relentless ever-increasing compression, would alleviate some problems concerning the ‘birth / origin’ of the cosmos - *but it will leave the question of ‘origin and source’ of mass-energy unanswered!* However, a close examination of the compression journey outlined in Table 2, does not point out *clearly* when and where such a reversal of gear would take place. Therefore, this line of thought – *deserving serious thought and reflection* – has been postponed till a better understanding and clarification of the subject matter.

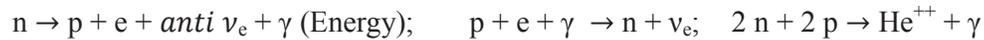
Furthermore, soon after the initial “Eureka” moment and the subsequent frustration, it dawned on me that neutron stars, black holes, and even their collisions and mergers, do not serve as good examples or analogies for the behavior of the Contracting Cosmic Globe.

Because, these celestial objects and their events are rather very small part of their respective galaxies or galaxy clusters, with which they exchange mass-energy during the normal circumstances and also during the catastrophic occurrences – such as supernova explosions. And the g-forces in the 10-20 or more solar mass progenitor stars do not approach or exceed those at the surface of their progeny – a neutron star or a black hole. Thus, they are not obliged to assimilate their P.E., which during their mergers or supernova explosions is scattered and shared with their near as well as far away neighbors. In a sharp contrast, during the contraction journey, the Cosmic Globe is always subject to enormous g-forces, *especially after it has coalesced as a single compact entity*, which are several orders of magnitude higher than those at the Event horizon of a black hole – *unless the **Shell Theorem** can be invoked to alleviate the situation, as soon as the contracting cosmic globe becomes a compact single system!* Consequently, nothing can escape from its g-hold. Furthermore, the only partners of the coalesced Cosmic Globe are its own components (EMR + Matter) and its “Progenitor” – the surrounding Primordial Void – with which it can exchange its mass-energy. But to the best of our knowledge, the Vacuum Energy (if any) is not directly detected by our instruments, nor does it produce the expected centripetal g-curvature – *instead it is believed to generate the anti-gravity force (or the centrifugal slope) of the Vacuum Field, which drives the expansion of the cosmos.* However, in spite of these new arguments, it is not clear when and where during the contraction cycle the necessary amount of P.E. is passed on to the Vacuum Field, which brings contraction to a halt and reverses the gear for the expansion cycle. *Possibly, an expert in cosmological simulations may be able to resolve this puzzle by plugging in the increasing P.E profile outlined in Table 2.* Thus, I will avoid further comments, focusing instead on the cosmic globe when it has attained the density of a neutron star, Table 2, entry 8, which ignores the undetermined negative mass contribution passed on to Vacuum Field during the process of compression.

Mass-Energy = 2×10^{54} kg; R = 1.483×10^{12} m; Volume = 1.366×10^{37} m³; Density = 1.464×10^{17} kg/ m³; Potential Energy = 9×10^{31} J/ kg; g - acceleration = 6.0688×10^{19} m/ s².

10. The Contracting Cosmic Globe vis-à-vis Neutron Stars – Well, any similarity is just limited to the calculated density, because all other parameters are several orders of magnitude different from those of **neutron stars**. Nevertheless, this unprecedented situation deserves scrutiny and further reflection, because neutrons contain all the needed ingredients to produce the Chemical Elements of the Periodic Table, which are the building blocks of our Universe.

It is well-known that free or lone neutrons are unstable, decaying spontaneously in about 1000 seconds into proton, electron, electron's anti neutrino, and the rest as energy (γ). On the other hand, protons can be forged into neutrons with the input of energy, under the drastic conditions of fusion reactions:



Thus, apart from the postulated **BBN** during the infancy of the growing cosmos – a *very fleeting and extremely rapid primordial fusion of neutrons and protons to produce Helium, Deuterium, and traces of Lithium* –, billions upon billions of Primary stars are doing it at a leisurely pace, on the cosmic scale! And depending on the mass of the primary star, the subsequent and successive burning of the fusion products may carry on the energy-liberating cascade up to Iron. However, elements beyond Iron require input of energy under very drastic conditions and are believed to be produced in supernovae explosions – or even more forceful energetic events. But Cosmology is a very dynamic field these days. Thus, very recent publications and news about the **collision of neutron stars**, apart from detecting the gravity waves, have also reported the detection of Strontium and some other heavy elements, such as, Gold and Platinum. Hence, as the forging of very heavy nuclei requires rich supply (input) of neutrons, under the extremely energetic environment, the detection of these elements provides a proof that neutron stars bear neutrons – not only in their name, but also in their contents [13].

Furthermore, though neutron stars are the densest known celestial objects, yet they are usually rather light-weight (~1.5 solar mass), small in size (R: 11 to 12 km), and are believed to be the penultimate stage on the road to a black hole. Just a little bit of more mass in the parent supernova could have resulted in a black hole. Moreover, as the neutron stars are 2-3 times larger than the respective black holes, the g-forces on their surface are much smaller than those at the Event Horizon (R_s) of a black hole. And I would like to highlight here, that 2-3 solar mass black holes have not been detected possibly due to their miniscule size. On the other hand, the SMBH observed at the center of galactic disks amount to several thousands to millions and even billions of solar masses. Consequently, they are correspondingly much larger and would be many times thinner than the neutron stars. In fact, the very first SMBH observed recently (April 2019) in the center of nearby galaxy M87, corresponds to 6.5 billion solar masses (see footnote, Table 1).

Therefore, there arise some intriguing questions about the fate and behavior of the contracting Cosmic Globe, *which having attained the density of neutron stars is still subject to progressively increasing g-forces*:

1. Would it be compressed to a stage, where it becomes a mysterious entity – *an*

unprecedented super-potent and supermassive object, shrouded by or enclosed inside its Schwarzschild radius?

2. Or maybe the progressively increasing compression and the counter-acting reaction would reach a stage, where it will expel most of its contents as photons and some neutrons, while sparing a strategic amount of mass-energy to provide a conventional black hole much smaller than the neutron globe of entry 8 – for instance, around $R = 10^{10}$ to 10^{11} m?

3. Or can it somehow *squeeze out* its entire contents as photons to start a new cycle of cosmos?

4. Or possibly, it passes on all its energy contents to the Primordial Void (Vacuum Field) and becomes ‘Inert’ - *but the abnormally high energy of the Vacuum Field restarts the expansion cycle?*

However, I have not been able to find straight-forward and easily acceptable answers to these questions, because, instead of flowing as the natural consequences of the known laws of physics, these require special or unprecedented conditions or assumptions. Anyway, I air them in the hope that some other inquisitive mind (person) may be able to formulate some satisfactory solution. *Possibly, simulation of the Cosmic Contraction Cycle could shed some light on this obscure situation.*

Nevertheless, though the shrinking as well as the expanding cosmic globe are apparently outside the realm of conventional GRT, yet several facts and hints from Nature have helped to arrive at a satisfactory, albeit a non-conventional solution. I have outlined and advocated it during the preceding sections – especially section 4 on the “**Space-Time Expansion and Contraction**”, which advanced the essence of the new proposal. Thus, a renewed visit to section 4 could be helpful. But for the normal flow of the narrative, I rephrase and reproduce here some of the principal arguments.

11. Revisiting the proposed Model – *There is a limit to the g-compression of mass-energy and space-time, as exemplified by the density of neutron stars and the delimiting Schwarzschild radius (R_s) of a black hole.* But in a glaring contrast, Table 2 is displaying items 8 to 11 with enormous mass-energy density and unprecedentedly strong g-forces. However, extremely dense media are known to impede the propagation of EMR and even block its penetration. Moreover, apart from bending or curving space-time, the progressively increasing g-forces are known to retard the pace of time – technically called the “Time dilation” –, eventually bringing space-time to a halt. Normally, this happens at the Event Horizon (R_s) of a black hole. But as the contracting cosmic globe coalesced to a single compact system only when it was several orders of magnitude smaller than its calculated R_s

and R_c , there is expected another threshold where the total mass-energy of the Manifest Universe is exhausted by defending against the relentless g-compression. At this stage, the EM fluctuations and their propagation come to a stop, bringing on the “Cosmic Phase Change”. *Thus repeating the initial arguments from section 4*, “The present proposal postulates a limit on the gravitational compression of the total mass-energy of our Universe to a finite minimum volume, reaching a maximum possible density corresponding to about $1.464 \times 10^{20} \text{ kg/m}^3$ or $1.0672 \times 10^{23} \text{ kg/m}^3$ (Entry 9 or 10, Table 2), which is several orders of magnitude higher than the estimates for the density of **neutron stars** ($3.7 - 5.9 \times 10^{17} \text{ kg/m}^3$). During the **Cataclysmic Isotropic Gravitational Squeeze**, when nothing can escape from its extremely strong g-hold, all the potential and kinetic contents of the compressed mass-energy of the Universe are spent in defending against the unrelenting compression and the extreme resistance to EM propagation in the denser and denser medium. **Finally, there occurs the most important phase change event at this stage: the EM fluctuations and their propagation, both linear and as standing waves, come to a halt. Hence, mass-energy ($E = mc^2$) along with their related parameters (mc , $mc \times r$, $mc^2 r$, etc.) are reduced to zero losing their essence, meaning and significance. Consequently, in the absence of mass-energy, there is no more gravitational interaction: $G M = \text{zero}$ and $G/c^4 \times \text{energy} = \text{zero}$. Thus, on attaining their peak, both g-compression and the counter EM reaction come to a stop! Apparently, the whole system becomes inert and unresponsive – signifying its “Death and Demise”. In other words, during the declining phase, the Manifest Universe pays back to the Primordial Void the energy invested in its birth, growth, and evolution. Thus, born as the EM agitation in the Primordial Void, it finally attains rest and becomes quiescent (dormant)”. **Instead, in its place there lays at rest an apparently “Inert” homogeneous and isotropic Cosmic Nucleus – full of Latent Energy and surrounded by the infinite Primordial Void (V_0), into which it can expand, starting a new life-cycle!** Well, this may possibly reminds us of the “**False Vacuum**”.**

As regards to the final size (R_0) of the “Dormant Cosmic Nucleus”, it is *arbitrarily* chosen to be 9×10^{16} times smaller than the calculated R_c of the Universe: $R_0 = 1.483 \times 10^{27} \text{ m} \div 9 \times 10^{16} = \mathbf{1.64778 \times 10^{10} \text{ m}}$ (Entry 10, Table 2). This choice is based on the following empirical reasons:

i) At the postulated $R_0 = 1.64778 \times 10^{10} \text{ m}$, the negative P.E. ($-1.62 \times 10^{88} \text{ J}$) would be 9×10^{16} times stronger than the total positive mass-energy ($1.8 \times 10^{71} \text{ J}$) of the Manifest Universe. Well, *though this extremely high value for P.E. appears absurd compared to the total mass-energy of the Manifest Universe – and whose significance I have not grasped – yet*

it is much better than that would be attained at the postulated “Primeval Atom” or “Singularity”. Furthermore, as the expansion and compression cycle is carried out inside the theoretical domain of its Black Hole – $1.64778 \times 10^{10} \text{ m (R}_0) \Leftrightarrow 1.483 \times 10^{27} \text{ m (Rc)}$ –, the relative decrease with respect to Rc is only 9×10^{16} fold, instead of 8.1×10^{33} times with respect to infinity. Anyway, if the extremely high decrease in P.E. can be treated as the reactionary anti-gravity centrifugal force, it could drive the expansion cycle of the cosmos!

ii) The speed of light (c) is a Universal constant which also gives life to the Planck constant ($h = 2\pi mcr$) and its reduced version ($\hbar = mcr$) – both these parameters providing the momentum, angular momentum, and energy of EMR ($E = mc^2 = hc/\lambda = \hbar c/r$) and of leptons: $m_0c^2 = hc/2\lambda = \hbar c/2r$. Furthermore, Mc^2 provides both the Rest Mass Energy (M_0c^2 ; $v = 0$) as well as the total energy of objects moving at relativistic speeds: $Mc^2 = M_0c^2 \div \sqrt{1-v^2/c^2}$. In a sharp contrast, $M_0v^2/2$ is only but very useful to calculate or estimate the kinetic energy of the slow moving objects. ***Thus, c^2 is a true parameter for the total energy of large as well as small objects, moving or at rest.***

iii) While photons are emitted and absorbed as quanta, EMR can also gain or lose energy by decreasing or increasing its wavelength. Thus, going downhill towards a g-well photons gain energy and suffer blue-shift, which contracts their wavelength. On the other hand, travelling uphill against the g-field, photons lose energy and undergo redshift, which broadens their wavelength. Similarly, EMR also undergoes cosmological redshift due to the space-time expansion. *Therefore, it is postulated that the **Primary EMR** emanated at the birth of cosmos – by energizing the **Zero Point Energy** of the **Primordial Void (V_0)** –, undergoes cosmological broadening till it exhausts the input of energy invested in its generation from **Zero Point Energy** and becomes degraded at the end of the Expansion Cycle.*

iv) Most everything in the Manifest Universe, such as galaxies, stars, planets, micro and macro flora and fauna, etc., has some life span – birth, growth, decline, decay and demise. Therefore, it is expected that the Manifest Universe, *which has the innate property, capacity, and the creative force to bring forth to life the myriads of the animate and inanimate forms, also has its own life cycle.*

v). **Apologia** - Well, for us mortals, who know so little about the mysteries of our own life and death, it sounds very pretentious to talk or write about the “Rise & Fall” or “Birth & Demise” of the Cosmos. Nevertheless, an infinitesimal part and parcel of the Manifest Universe has evolved into the “Homo-Sapiens”, whose members endowed with the reflective minds wonder, muse, and inquire into their origins and that of the Cosmos. And for some

seekers, this pursuit or quest becomes their life's goal. Therefore, with due respect and apologies for the diverse and contrary opinions and beliefs, my search and quest have brought to the conclusion that the Manifest Universe does rise from its "Latent State" to become the Cosmos we inhabit and admire!

12. Time-scale during the Contraction and Expansion Cycles

Well, as already discussed earlier, the presence of strong g-fields retards the pace of space-time, bringing it to stop at the Schwarzschild radius (R_s), which delimits the Event Horizon of a Black Hole. *Therefore, once the Manifest Universe coalesces to a single compact entity, its unprecedented enormous g-forces turn it impossible to make any sensible guesstimate for the duration of time comparable to our familiar time-scale.* For instance, a light year or a light second around the Event Horizon, for us may last forever! – Or the eons and eternity of the poets, philosophers, sages, and the religious books. On the other hand, when the "Dormant Cosmic Nucleus (Egg?)" wakes up as EM emanation under the g-free conditions, the flow of space-time would be a bit faster than presently measured by our watches! However, after the appearance of Matter and especially on its aggregation to form the galactic discs and the stellar systems, the march of time will be affected locally near the dense and massive bodies.

13. Decay and Resurgence of Cosmos

Although the final size of the "Dormant Universe" has been chosen arbitrarily at $R_0 = 1.64778 \times 10^{10}$ m, it does not signify that all the "Phase and Reverse Phase Changes" take place suddenly or only at this limiting size. Instead, it is expected that during the major part of the Contraction Cycle, EMR will undergo increasing blue-shift, while Matter will accumulate more and more energy attaining relativistic speeds. But after collapse to a single compact system, the shrinking cosmic globe will become denser and denser, making further compression of mass-energy a very difficult task, while the pace of time would become slower & slower... Ultimately, EMR and Matter (particles) will not be able to move around and proceed any further. Their EM fluctuations will begin to falter and fail – bringing on the final spasmodic EM flickers and flutters... Finally, *the Manifest Universe born as the fluctuating and fleeting EM agitations will "breathe its last" and come to rest in peace (RIP) in the Omnipresent, Omniscient, and Omnipotent, the Eternal Primordial Void – a drastic "Phase change", indeed!*

Thus, the beginning of coalescence of the Manifest Universe to a homogeneously compact single system would mark the onset of the morbid state, leading to its very slow demise (inertness), when the EM agitations come to a halt. Henceforth, there is no more

vivid mass-energy – neither further g-compression nor EM counter-reaction. And for the ‘shrunk inert globe’, the flow of time makes no sense, anymore!

However, based on the conservation of the total *Manifest energy* of the cosmos and expecting it’s even and uniform distribution in the surrounding Primordial Void (Vacuum Field), the potential-energy-rich compressed & contracted inert globe would eventually wake up – springing up from its “Latent State” as EM emanation, restarting the expansion cycle. Therefore, after an indeterminate period spent in the ‘inert state’, possibly some duration would correspond to its ‘gestation or incubation’, followed by its rise and springing up from the “Latent State” as EM radiation. I would like to add here, that were it a normal P. E. ⇔ K. E. cycle, the reversion of compression to expansion would be instantaneous. But due to the complex changes of phase (Active ⇔ Inert), makes their duration unpredictable.

And this brings us to the modern as well as the age-old inquiry about the nature of the Vacuum or Void, and how its occult energy turns into the ‘Manifest’ EM energy, which upon partial ‘Materialization’ undergoes differentiation to provide the necessary chemical elements – eventually evolving into the multi-layered, multi-colored cosmos, wherein we are born and die!

14. The Nature of Vacuum Field (V_0) and its Occult Energy

Well, to answer these queries, the religious mystics and philosophers of the past filled the spatial void with “**Ether**” – the rarest of the five elements they thought composed our universe: Earth, Water, Air, Fire, and Ether. And Ether seems to have survived up to the present times – in one garb or the other. But its relationship with modern science has gone through several ups & downs – ranging from very grateful acceptance (blessing) to a total divorce. Thus the story or history of Ether and *its present status* make an interesting reading, for which I refer the reader to an authoritative account by a Noble Laureate – **Frank Wilczek**, whose recent book devotes a full chapter replacing Ether with a new candidate named “Grid”, having the up-to-date qualities suitable for the modern science [14].

However, due to my unfamiliarity with the ‘Grid’, I treat the Vacuum Field and free space in a different manner. Furthermore, as free space and vacuum are employed synonymously, both in popular and scientific writings, I have taken care to define them separately at the very beginning of the present proposal – section 1 and 2. Thus, while the **Primordial Void (V_0)** is devoid of any EM radiation and Matter, **Free Space** constitutes the Primordial Void populated by EMR, which may also be occupied by all sorts of material objects – ranging from gases, particulate matter to celestial bodies. And the electromagnetic radiation (**EMR**) represents the energized and modulated state of V_0 , carrying momentum, angular

momentum, and energy at the speed of light.

Thus, we face now the most difficult task of deciphering the nature of the ‘Occult Energy’ of the Vacuum Field and how it turns into the ‘Manifest Energy’ (EMR), which our senses and/or scientific instruments can detect. Or inverting the inquiry: If Vacuum Field has any energy, why it is not perceived by our senses or detected by the sophisticated instruments? And when we reflect on our perceptions/ detections in scientific terms, we discover that – in one form or the other – ultimately all our perceptions/ detections are EM communication; even the so called ‘inanimate’ objects – atoms, molecules, crystals, cold and hot bodies of all sorts – impact and modulate/ polarize V_0 , providing a characteristic spectrum of EMR. And let us recall that modern physics – especially the very famous ‘Quantum’ and Quantum Mechanics – resulted from the tireless studies on the spectrum of the so called **Black Body Radiation**. Thus, after a prolonged to and fro reflection on the query, the only answer which has survived the final scrutiny is rather astonishingly simple: The **Occult Energy** of V_0 vacuum lacks any EM modulation – or has it below the detectable limit. That is, instead of EM modulated wavy trajectory, it is just a straight or practically a straight flight at speed ‘c’.

Well, despite the fact that V_0 is devoid of any E and M fields, this conclusion may or may not fit the Maxwell’s EM equations, because the EM waves require fluctuating E & M fields for their generation and propagation. However, it is in perfect accord with the quantum nature of EMR. Just check it for yourself. Quanta have three components: $h = 2\pi mcr$ or $\hbar = mcr$. While, ‘c’ is a constant, ‘m’ and ‘r’ are reciprocally related to each other. That is, if ‘r’ approaches infinity (∞), ‘m’ approaches zero (and vice versa): $r \rightarrow \infty, m \rightarrow 0$. Therefore, on approaching the undetectable limit of EM modulation, there is no measureable energy. In fact, if either ‘r’ or ‘m’ vanishes, there are no more quanta. However, on the higher end, bear in mind the deleterious and destructive effects of the high energy radiation – UV, X-rays, and gamma rays, etc. – even without reaching the (untenable) extremes. And needless to add, that in the absence of velocity ‘c’, there are no more quanta, nor their associated dynamic parameters: mc , $mc r$, and mc^2 .

Nevertheless, this conclusion has raised an unintended dilemma: Do the fluctuating E and M fields generate their velocity ‘c’, as implied/ deduced by the Maxwell’s equations? Or does the transport of ‘Energy Packets’ by V_0 impact and modulate (polarize) its 3D fabric, producing the fluctuating E and M fields? Well, based on the above conclusions about the undetectable EM fields and energy of V_0 , coupled with the fact that moving charges and currents produce magnetic field around the conducting wires, I opt for the second choice. And the **de Broglie “Matter Waves”** ($\lambda = h/ mv$) provide additional support for the above option.

Furthermore, the pioneer **Electron Diffraction** supporting evidence for the ‘matter waves’ has been successfully extended by the ongoing studies to atoms, molecules, heavy molecules – Fullerene (C₆₀) and its fluorinated derivative (C₆₀F₄₈) – and even the macro-molecules, having molecular weight of 10,123 and 25,000 atomic mass units [4g, 4h].

Therefore, the next question naturally leads to: What can and how does it impart the desired/ necessary EM modulation to the straight trajectories of V₀? Well, musing on this riddle, it may remind us, as if we were able to detect only the zig-zag path of a car or particle, but not their straight-line motion! However, that is not a big problem, because we know how to change the straight path of a car or particle: Just provide the necessary centripetal force to obtain the desired curvature.

Similarly, an invisible straight-moving thread/ string can be curved by adding a ‘load’ or applying a force perpendicular to its path. In an analogous manner, the undetectable straight trajectory of the ‘latent or potential quanta’ of V₀ can be curved/ modulated by applying an ‘energy shot’ and **raising them above their zero-energy level**, turning them detectable. But, in a sharp contrast to the fixed pivot, localized road inclination, attractive/ repulsive E & M fields, or a g-source, the ‘energetic bubbles’ of the ‘nascent quanta’ avoid their collapse to the zero level and perpetuate themselves by fleeting along the yarns of V₀, imparting during their flight a transitory modulation/ polarization to the 3D fabric of V₀.

Thus, the fact that photons’ EM integrity and energy ($E = hc/\lambda = mc^2$) is always maintained above the zero-energy level – during their flight at velocity c, reveals that the zero-energy medium (vacuum) provides the necessary centripetal force (mc^2/r) and the binding energy ($mc^2/2$). And it turns out that any input of energy can turn V₀ detectable. Thus, the added energy (E) and the known properties of the detectable quanta can provide the missing information:

$$V_0(0) + E \rightarrow hc/\lambda = \hbar c/r = mc^2. \quad \lambda = hc/E; r = \hbar c/E.$$

$V_0 \text{ ‘c’ x E T} \rightarrow E\lambda = hc; \quad E = hc/\lambda = \hbar c/r.$ And, depending on the rate and duration of the imparted energy, EMR pulse of any wavelength can be generated – higher the input energy, deeper/ steeper the impact, and shorter the $\lambda(r)$ of the photon.

At this point, I would like to inform that in an earlier study I analyzed various aspects of EMR: it’s fleeting EM structure, the dynamic properties, and generation in vacuum. *But the zero energy state of vacuum was taken for granted – without any attempt to discover its true nature, which complements but sharply contrasts with the present investigation* [8].

15. Rising of Cosmos & its Energetics

Let us see, how we can apply the acquired information/ knowledge to the shrunken Cosmic Globe, which under the extreme g-compression has lost its EM polarization and become

inert. Well, considering the conservation of the manifest mass-energy (1.8×10^{71} J) and its transformation into other forms, e.g. P.E. and B. E., during the expansion and compression phases, the extremely high values of P. E. calculated for the various stages of the compression cycle (Table 2), can baffle us and lead to think/ believe that apart from nullifying the positive energy of the universe, the remainder has turned into a huge ‘reservoir’ of negative energy. But, I do not fully subscribe to such a conclusion, because the detectable energy is always positive with respect to the undetectable energy of the V_0 . And V_0 itself would be a bit higher than the ‘Absolute Vacuum’, which hypothetically is bereft of even the undetectable quanta of V_0 . Therefore, there is nothing more negative – or having lesser energy than the Absolute Vacuum, as defined here: $EMR > V_0 > 0$ (Absolute Vacuum). In fact, negative mass-energy makes only relative sense for the mathematical book-keeping, but is not a ‘real’ thing. Moreover, by its very definition and extremely dynamic nature, $E = mc^2$, energy is always positive *and would rush into vacuum*. And needless to add, that lower the energy, more negative or colder the temperature, which makes the ‘Inert Globe’ and the Vacuum Field extremely cold indeed.

Therefore, when the spread-out inhomogeneous universe coalesces to a single compact system during the compression cycle – bringing itself under the g-control of its total mass-energy and enclosing itself inside its Black Hole! –, the resulting aggregate g-effects would extend to long distances. Thus, apart from some illustrative g-effects listed at different radii in Table 2, the surrounding empty space or the Vacuum Field is also severely affected by the very high g-fields – especially inside the theoretical domain of the Black Hole. And when the march of space-time and the EM fluctuations of mass-energy are ‘snuffed out’, their g-effects would also vanish. Hence, I conclude that the progressively increasing g-forces during the compression cycle are spent initially to contract the cosmic globe to higher & higher densities, followed by the ‘stalling’ of the EM propagation and quenching the mass-energy of the universe. Consequently, along with the cessation of the g-forces, there results an extreme vacuum surrounding the inert cosmic globe.

However, based on the extremely high energy density attained before becoming inert, the ‘dormant globe’ would have correspondingly very high concentration of the ‘dormant quanta’, as compared with the normal state of the surrounding V_0 . Therefore, as energy density plays the role of pressure, *on the arousal of the tightly compressed ‘dormant quanta’ to their energized state*, the ‘nascent quanta’ and the ‘rising globe’ would naturally expand into the surrounding cosmic sea of V_0 , undergoing evolution and differentiation, as already treated in the previous sections, especially section 8: *Big Bang versus the New Proposal*.

Now, let us estimate the possible energy of EMR emanating at the ‘birth’ of cosmos. But we cannot access this information from the inert state of the cosmic globe. Instead, such an estimate is possible from the mass-energy density of the compressed globe at its passage/transition to the inert state – which would reflect itself in the energy density of the ‘nascent photons’, diving into the surrounding sea of vacuum. The enormous P. E. of the contracted globe with respect to the vacuum field would provide the ‘dormant quanta’ the necessary force-energy to become ‘alive & active’ and fly into the enveloping void. And I may add that we are not dealing here with the slow evaporation of the “**Hawking Radiation**” from a Black Hole. In a sharp contrast, the surge of ‘nascent photons’ would dash into the surrounding emptiness at their characteristic velocity ‘c’, expanding the size of the ‘rising globe’.

Furthermore, the lack of any detectable energy of the Vacuum Field, as also of the ‘inert globe’ – *and consequently their extremely low temperature approximating the absolute zero, coupled with the absence of gravity*, bring to mind the possibility of some kind of “**Bose-Einstein Condensate**” (BEC) or the formation of “**Cooper Pairs**” in **Fermi condensates** and the solid **Super Conductors**.

But the extreme mass-energy density of the contracted globe – *before going inert* –, and the lack of any EM identities after the postulated drastic phase change, argue against such conjectures. In a sharp contrast, the above mentioned super conductors have low or normal density and do not lose their chemical identities, but just undergo reversible changes in their electronic configuration, which eliminates the resistance to the free flow of their conduction electrons [4i, 15].

Finally, to estimate the energy of the ‘nascent photons’ at the ‘birth’ of cosmos, let us focus on the mass-energy density of the cosmic globe at the postulated radius of ‘phase change’:

$$R_0 = 1.64778 \times 10^{10} \text{ m}; D = 1.0672 \times 10^{23} \text{ kg/ m}^3 = \mathbf{9.6048 \times 10^{39} \text{ J/ m}^3} \text{ (Table 2, entry 10).}$$

This potential **energy density** is expected to reflect in the energy density of the ‘nascent photons’ by the following relation: $D = \hbar c/ r \div 4\pi r^3/ 3 = 3\hbar c/ 4\pi r^4$, which provides the reduced wavelength ‘r’ and the energy of the emanating photons: $r = (3\hbar c/ 4\pi D)^{1/4} = 2.978 \times 10^{-17} \text{ m}$; $E = mc^2 = \hbar c/ r = 3.165 \times 10^{-26} \text{ J m/ } 2.978 \times 10^{-17} \text{ m} = 1.0628 \times 10^{-9} \text{ J}$, worth the mass-energy of 12,960 electrons or 3.7 Tau particles.

On the other hand, if due to the prior activation of the V_0 ‘dormant quanta’, there is some initial ‘incubation’ and increase in the size of the ‘rising globe’ to, say $R_0 = 1.483 \times 10^{11} \text{ m}$; $D = 1.464 \times 10^{20} \text{ kg/ m}^3 = 1.3176 \times 10^{37} \text{ J/ m}^3$ (Table 2, entry 9), the nascent photons would have $r = 1.5475 \times 10^{-16} \text{ m}$; $E = 2.0452 \times 10^{-10} \text{ J}$, equivalent to the mass-energy of 2.494 electrons. The supposed gestation/ incubation and growth between these two sizes would generate photons of intermediate energy. But in all scenarios, *the super energetic gamma*

photons – surging and swirling the surrounding sea of vacuum, would provide the Primary building blocks of the cosmos (n, p, e), which under the influence of local g-forces slowly gather up into the trillions of galaxies, wherein the cascade of fusion reactions forge increasingly complex structures of the Chemical Elements of the **Periodic Table**, resulting in the development and evolution of the Manifest Universe.

And, in the vast immensity of the cosmos, on some tiny planets in the **Habitable Zone**, under some still-debated special circumstances, complex series of chemical and biochemical reactions bring forth the appearance of the primitive forms of life, which on successive differentiation, diversification, and evolution... eventually, usher in the Homo-Sapiens. Fortunately, in our case, the chosen planet in the vast cosmos happens to be the beautiful ‘**Pale Blue Dot**’, which we cherish and admire [16].

Finally, as closing remarks, I would like to add that were it not for the COVID-19 pandemic and my advanced age, I would have slept over this study some more time – trying to improve it by further reflection and meditation, but under the prevalent circumstances, I think it prudent to share it in its present state, hoping that more learned professionals and experts can answer the pending questions.

Notes and References

1. The topics discussed herein are familiar to the professionals and students of Physics and Cosmology. Important items are often **highlighted** in the text for internet search for any further and up-to-date information. Additional references are pinpointed only in some special cases, when deemed necessary or desirable. Similarly, the new ideas, novel concepts, and important conclusions are also highlighted and / or shown in *italics* to draw attention.
2. “100 Years of General Relativity – **Einstein** – How Relativity Changed The Rules Of Our Reality”, *Scientific American*, Special Issue, September 2015.
3. Internet provides diverse sources showing very spectacular pictures and valuable information gathered by **Hubble Telescope**, during the past 30 years of its observations and scrutiny of the heavens.
4. *Wikipedia*: a) – **Expansion of the Universe**; b) – **Gravitational Time dilation**; c) – **Observable Universe**; d) – **Gravitational Binding Energy**; e) – **Neutron Star**; f) – **Cyclic Model**; g) – **Matter Waves**; h) – **Wave-Particle Duality**; i) – **Bose-Einstein Condensate**.
5. Richard Panek, “A Cosmic Crisis – How fast is the universe expanding? Scientists can’t agree – and that’s a problem”, *Scientific American*, March 2020, p.p. 22 – 29.
6. “The Cosmic Life Cycle – Origins of the Universe”, Collection of Articles, *Scientific American Special Report*, **SCA50607**, 2007/ 2008; Editor in Chief – John Rennie.
7. Jaswant Rai Mahajan, “True Gravitational Constant, Schwarzschild Radius, Black Holes, and related Issues”, vixra.org/abs/pdf/1702.0279, Feb. 22, 2017.
8. Jaswant Rai Mahajan, “A Probe into the Nature of Mass, Charge, and Energy Unveils Alpha (α) – the Fine Structure Constant”, vixra.org/abs/pdf/1406.0095, June 15, 201

9. Steven B. Giddings, “Black Hole Paradox – Escape from a Black Hole”, *Scientific American*, December 2019, p.p. 42 – 49.
10. Christoph Schiller, “Maximum force and minimum distance: physics in limit statements”, **ArXiv: physics/0309118v5** [physics.gen-ph] 14Apr 2004.
11. F. J. Dyson, “The Efficiency of Energy Release in Gravitational Collapse”, *Comments on Astrophysics and Space Physics*, Vol. 1, p.p. 75 – 80; retrieved from Astrophysics Data System provided by NASA, via *adsabs.harvard.edu*. (Copy Right: Taylor & Francis).
12. Evelyn Alecian, Sharon M. Morsink, “The Effect of Neutron Star Binding energy on Gravitational-Radiation-Driven mass-transfer Binaries”, arXiv:astro-ph/0302219v2, July 9, 2004.
13. Clara Moskowitz, “The Inner Lives of Neutron Stars”, *Scientific American*, March 2019, p.p. 18 – 23.
14. Frank Wilczek, “The Lightness of Being – Mass, Ether, and the Unification of Forces”, *Basic Books*, 2008, New York.
15. Google → www.sciencealert.com > We’ve Now Been Able to Probe a Cloud of the Fifth State of Matter in Space, 11 June, 2020 – reported by Michelle Starr.
16. I dedicate this study to the memory of Albert Einstein, Carl Sagan, Astronomers, Astrophysicists, Cosmologists, other Scientists, Philosophers, and Cosmo-Priests, directly or indirectly mentioned in this investigation.