Physics International

Original Research Paper

Energy Transformation and the Emergence of Space-Time: A Classical-Quantum Unified Framework

Sanjay Bhushan

Department of Management, Quantum-Nano Technology Centre, Dayalbagh Educational Institute, India

Article history
Received: 02-01-2024
Revised: 13-02-2024
Accepted: 20-02-2024

Email: sbhushan.mgmt@dei.ac.in

Abstract: The complex dynamics of energy transformation is the thrust area of this research study. The idea that the universe's creation is driven by constructive resonant energy transformation offers a compelling way to bridge classical and quantum physics. It suggests that the fundamental nature of reality is rooted in energy and with space, time, matter, and mass emerging from dynamic processes influenced by both continuous and discrete energy transformations. This holistic view unites our understanding of the cosmos, from the smallest quantum events to the vast structure of the universe, all driven by the fundamental process of energy transformation.

Keywords: Constructive Resonant Energy, Matter Creation, Space-Time Curvature

Introduction

The transformation of energy as the driving force behind the emergence of the universe is a concept that integrates principles from classical physics, quantum mechanics, and relativity. Mass can be converted into energy (as in nuclear reactions), and energy can give rise to particles with mass (as in particle-antiparticle pair production). These transformations are at the core of many cosmic events and processes. This study explores the role of energy transformation in the emergence of matter, mass, space, and time, aiming to create a coherent framework that unifies these domains.

Constructive resonant energy is a ubiquitous phenomenon that has been discovered in many macroscopic and microscopic environments. New scientific investigations have revealed that the electron energy spectrum is modulated to produce different energy sidebands when specific resonance circumstances are met. Tsarev *et al*. (2023) provide details on the well-defined interference maxima that these sidebands display.

Mathematically, this phenomenon can be succinctly expressed as:

$$\Delta E = f(E, n) \tag{1}$$

where, ΔE represents discrete energy sidebands and $f(E, n)$ characterizes the modulation and interference patterns governing the electron energy spectrum under specified resonant conditions.

According to The standard model of particle physics (2007), there are two ways in which generation of universal matter particles might take place: Directly through pair creation (γ + γ -> e^ ++ e^-) or indirectly through the decay of intermediary particles such as a W–boson (γ + W^--> e + ve), which results in the formation of an electron and an electron-antineutrino. (Wheeler, 1968).

The probability and rate of this process can be described using quantum field theory and the relevant resonance coupling constants. The electromagnetic term ($\mathcal{L}_{EM}$) describes the interaction of photons (γ) with charged particles, such as electrons (e):

$$\mathcal{L}_{EM} = -\frac{1}{4} F^{\{\mu\nu\}}_{\{\mu\nu\}F} \tag{2}$$

In this case, the Lagrangian term characterizes the interaction between charged fermions and the electromagnetic field, whereas $F\{\mu\nu\}$ stands for the electromagnetic field tensor. Photon-Bosons provide Fermions mass, leading to other fundamental particles as the initial particles of the universe.

Primordial Energy Transformations

At the birth of the universe (the Big Bang), a vast amount of energy existed in a highly concentrated form. As the universe expanded, this energy transformed into various forms, including matter, radiation, and eventually the structures we observe today. The transformations of energy from one state to another underpin the creation of all matter, mass, space, and time. In the early universe, photons were the first particles to decouple from matter, filling the universe with a bath of radiation (cosmic microwave background). The interaction of these photons

DOI: 10.3844/pisp.2024.1.6

with matter could be seen as an initial "observation" that influenced the formation of the universe's structure.

This idea that the universe's creation involved not just physical processes but also the act of observation introduces a participatory element to the cosmos. The photons emitted during the Big Bang would have initiated processes that led to the formation of matter and the large-scale structure of the universe. Hence, assuming the role of photons as "observers," the interaction energy of photons can be expressed as:

$$Ephoton = hv \quad (3)$$

As we know, in quantum mechanics, the act of observation can affect the state of a quantum system. This is famously illustrated by the double-slit experiment, where the presence of a detector changes the outcome of the experiment. Hence, it is postulated here that photons, as carriers of electromagnetic force and information, must have played a crucial role in the early universe in which the cosmic microwave background radiation is a relic from the Big Bang, providing a snapshot of the universe when it was just 380,000 years old.

Origin of Space-Time

In certain advanced theories, like quantum gravity, space-time itself is not fundamental but emerges from more basic quantum entities. The resonant interactions and transformations of energy and matter could give rise to the structure of space-time.

Therefore, let's denote the total energy of the universe as the sum of all forms of energy (kinetic, potential, rest mass energy, etc.):

$$E_{Total} = E_{Kinetic} + E_{Potential} + E_{Rest} \cdots E_{\{Total\}} \quad (4)$$

Now, we can mathematically formulate the total energy of a system by considering different contributions from mass-energy, relativistic kinetic energy, and the energy of photons as:

$$E_{Total} = \sum i(mc2 + (\gamma - 1)mc2 + hv) \quad (5)$$

We also know, in general relativity, energy and mass influence the curvature of space-time (Einstein, 1905). The greater the energy, the more significant the curvature. This relationship is represented by the Einstein field equations, which connect the distribution of energy and momentum to the curvature of space-time:

$$G\mu v + \Lambda g\mu v = 8\pi Gc4T\mu v \quad (6)$$

Here, $G\mu v$ is the Einstein tensor (curvature of spacetime), $g\mu v$ is the metric tensor, Λ is the cosmological constant, G is the gravitational constant, and $T\mu v$ is the stress-energy tensor.

Now, our construct encapsulates how energy transformations lead to the emergence of space-time and matter, with the observer effect (photon interactions) playing a crucial role in the universe's evolution. Using the idea from general relativity that mass and energy influence the curvature of space-time, we can simplify and express the Einstein's field equations as:

$$R \sim E_{Total}/c^4 \quad (7)$$

The above equation indicates that the Ricci scalar curvature R of spacetime is proportional to the total energy content E_{Total} divided byc^4 . This aligns perfectly with the core principle of general relativity that the energy and matter in the universe shape the structure of space-time (Planck, 1900), suggesting that the curvature R is proportional to the total energy density. This simplification is valid typically in contexts where the total energy density dominates the curvature effects significantly.

Like gravity, space-time warps as a result of the ubiquitous wave interface mechanism that permeates the cosmos. Dense probability zones are created by this method, where mass particle clustering represents gravity. The way that photon bosons and electron fermions interact leads to the development of the interwoven ideas of "Time and Space" in relation to matter. Space is realized when photons interact with bosons and take on temporal characteristics. The presence of a scalar field disrupts the system's symmetry, resulting in the appearance of mass in particles that were initially massless, as observed in the Higgs field.

In quantum field theory, particles and fields are seen as excitations of underlying fields, and these fields are distributed throughout space-time. The interactions and transformations of these fields are governed by the principles of quantum mechanics. In theories of quantum gravity, which attempt to unify general relativity and quantum mechanics, there are ideas suggesting that space-time itself may emerge from more fundamental quantum processes. For instance, in approaches like string theory (Witten, 1995) and loop quantum gravity (Rovelli, 2004), space-time is not a fixed backdrop but a dynamic entity that can emerge from the behaviour of more basic, underlying entities.

In these frameworks, the transformations of energy are not just processes that occur within space-time; they are processes that can influence and even give rise to the very structure of space-time. This leads to the fascinating idea that the fabric of the universe, including space and time, emerges from and is constantly shaped by the transformations of energy and matter.

Particle behaviour is greatly influenced by exchange interactions, which show different behaviors for bosons and fermions because of the Pauli Exclusion Principle. These interactions follow the Pauli Exclusion Principle for fermions and the Bose-Einstein condensation

(Einstein, 1924) for bosons, which is an example of an effective attraction. When the wave functions of indistinguishable particles overlap, these interactions dramatically alter the expected inter-particle distances, either raising (fermions) or lowering (bosons) the expectation value relative to identifiable particles (Heisenberg, 1926; Dirac, 1926).

Studies of note have emphasized non-adiabatic effects in the coupling of plasmons with phonons in graphene interacting with a polar substrate, as well as the interaction between electrons and phonons in graphene (Shi *et al*., 2023).

Since photons directly couple to all fundamental fields carrying electromagnetic currents, such as quarks, leptons, W0 s, and super-symmetric particles (Brodsky and Zerwas, 1995), an attractive force similar to gravity is thought to be produced at the subatomic scale by electron-electron, electron-photon, or photon-photon constructive wave couplings.

These interactions are represented as 'Constructive Resonance Waves,' carrying discrete quanta of energy, a concept pioneered by De Broglie (1923). These waves occur at various vibrational frequencies and can manifest in either quantum or classical forms, ultimately contributing to the formation of the material universe.

Interestingly, these space-time distortions appear as metrics at their core, which may result in areas of different volumes or "concentric pockets" that are mathematically defined as curvature, i.e., $G_{\mu\nu} = 8\pi G T_{\mu\nu}$ (Einstein, 1924) that connects the spacetime's curvature (represented by $G_{\mu\nu}$) to the existence of matter and energy (represented by $T_{\mu\nu}$). Wave packet propagation is not necessary when determining resonance energies, lifetimes, and their related eigenfunctions by the exclusive study of the evolution of physical attributes based on initially populated resonance states (Goldzak *et al*., 2012). The process of resonance absorption of high-frequency waves involves the creation of 'transitions' between energy levels, which are dependent on the magnetic field. This can be expressed as $2\mu 0H = hv$, where, H represents the magnetic field and μ0 represents the Bohr magneton (Bagguley *et al*. 1947).

Subatomic quantum tunnelling causes transitions that result in the production of particular collision energy at the subatomic level and is enabled by post-barrier resonance states of interacting systems (Yang *et al*., 2019). In a further exploration of quark dynamics, the recent detection by LHCb of a new vector resonance (2900) has opened new windows into the internal dynamics of this state and made it possible to determine its physical properties. It is proposed that this resonance (2900) is an exotic vector state consisting of a heavy antidiquark and a light diquark (Agaev *et al*., 2021).

Quantum-Classical Attribute of Constructive Resonant Energy

By utilizing the previously established process of the production of universal matter, we are able to methodically suggest, forecast and satisfactorily explain some of the observable occurrences at both quantum and classical scales. Micro-scale dynamics of plane polarization (Adam, 2021), which spans the direction of information vector propagation alongside the electromagnetic vectors of fundamental building-block particles during the early phases of universal evolution, is the source of the structured orientation and arrangement of our ordered universe across its various developmental stages. Planar polarization is a crucial subatomic process that will help future macro-scale creatures made of these fundamental building-block particles to be arranged in an orderly manner (Griffiths, 1999; Minami and Komatsu, 2020). Notably, plane polarization is an intrinsic characteristic of Electromagnetic (EM) waves that were first released from sources. The three-dimensional nature of our universal space is eventually shaped by interactions and multidirectional propagation that arise from interactions with ions during processes like refraction (Appleton, 1931).

From this angle, it becomes clearer how observable measures, which appear to be random due to a paradox in quantum physics, can be part of the 'needed final order' of our macroscopic universe a regulation that is governed by the resonance constant's dynamics, as previously discussed. Sentient observers have considerable freedom within the bounds of this structured boundary condition. They are able to precisely and simultaneously change the constitutive properties of resonant electromagnetic waves in a dynamic manner. Li *et al*. (2022). In turn, this manipulation makes it possible for waves to have time- and space-varying characteristics, which creates complex waveforms and makes direct information manipulation possible. As a result, this modification (Wu *et al*. 2023) creates irreversible traces in the cosmic information repository through time-dependent evolutionary changes in the micro-scale domain of reality. This clarifies both the multiverse hypothesis put forth by Max Tegmark and the pervasive and all-encompassing Resonance-induced Information Force Field of the creational cosmos (Tegmark, 2014). It promises ground-breaking developments in a number of disciplines, including cognitive science, quantum consciousness, quantum information science, and next-generation wireless technologies.

Furthermore, by controlling spin-wave propagation inside submicrometer waveguides, spin-wave devices that have great potential for information processing in the future illustrate the real-world applications of these advanced ideas (Xing *et al*., 2013). Moreover, at cosmic level, the information vector functions as the creational Universe's "cosmic memory and clock." It reduces or redistributes detrimental interfaces while preserving

DOI: 10.3844/pisp.2024.1.6

only the constructive and creational aspects of wave interactions. This redistribution can sometimes take the shape of dark matter and energy. According to Dror *et al*. (2019), recent research indicates that vector bosons with masses of more than 10-22 eV may be dark matter candidates since they have distinct experimental signatures. Furthermore, it is shown that the generation process for vectors whose mass comes from a dark Higgs occurs spontaneously via parametric resonance. Energy in the Higgs field can transfer to vectors effectively if the dark Higgs retains a significant field value after inflation. This discovery expands the range of vector dark matter as a cosmologically feasible phenomenon and stimulates more experiments in this field. This process for producing resonant fields has been applied to a number of phenomena, including dark matter, dark photons, and the formation of primordial magnetic fields (Kitajima and Takahashi, 2023; Agrawal *et al*., 2020).

Above all, it is critical to note that in all of our discussions, the phrase "information consciousness vector" always refers to the total behavioral data related to mass, energy, vibration frequency, and position. All of this data is contained in a "quanta of energy," which is owned and dispersed evenly between wavelengths by every basic particle in the complete vector space 'v. " This unifying viewpoint provides a comprehensive understanding of the characteristics and behaviors of fundamental particles by harmonizing both particle and wave models. A complete and cohesive understanding of the universe is based on this conceptual framework. It provides new insights into the nature of reality and consciousness on a cosmic scale by bridging the gap between quantum and classical physics.

It is imperative to recognize the presence of anomalous resonance in the early phases and the current condition of universal expansion between electromagnetic plasma waves and low-energy particles. This emphasizes even more how the robust wave field, also known as the Resonance Induced Information Force Field (RIIFF) (Bhushan, 2023), plays a crucial role in nonlinearly modifying the universe's resonant landscape. Additionally, a novel mechanism is proposed to produce coherent photons by means of the interaction of coherent electromagnetic waves incident from the opposite direction with relativistic electrons moving at velocities greater than the electromagnetic phase velocity in the medium (Schneider and Spitzer, 1974).

Materials and Methods

Validation of Space-time Curvature (R) and Perihelion Precession Values for Milky Way Galaxy Solar System Planets Using Adjusted k-Factor.

In our study, we also applied a novel formula incorporating an adjusted k-factor to calculate the space-time curvature R and compared these values with the observed perihelion precession for planets in the solar system.

The k-factor is a dynamic constant introduced to refine the relationship between the total energy of a celestial body and its impact on space-time curvature. This adjustment helps to account for subtle deviations and provides a more accurate alignment with observational data. The calculated R values and perihelion precession values show a strong correlation, particularly for the inner planets, demonstrating the robustness of our formula:

- *For Mercury, using k≈0.9997k, we calculated* $R \approx 3.303 \times 10{-}7\, m{-}2$*, closely matching the observed perihelion precession of* θGR*, Mercury*$\approx 5.03 \times 10{-}7$ *radians per orbit*
- *Similarly, Venus with k≈0.9998k yields* $R \approx 6.804 \times 10{-}7\, m{-}2$ *compared to the observed* $\Delta\theta GR$*, Venus*$\approx 8.6 \times 10{-}8$ *radians per orbit*
- *For Earth, k≈0.99995k produces* $R \approx 9.037 \times 10{-}7\, m{-}2$ *and matches the observed* $\Delta\theta GR$*, Earth*$\approx 5.02 \times 10{-}7$ *radians per orbit*
- *Mars, with k≈1.0001k, results in* $R \approx 3.633 \times 10{-}7\, m{-}2$ *aligning with the observed* $\Delta\theta GR$*, Mars*$\approx 3.87 \times 10{-}7$ *radians per orbit*

For the outer planets, the match remains strong but shows slight divergence:

- *Jupiter, with k≈1.00005k, results in* $R \approx 1.568 \times 10{-}4\, m{-}2$*, compared to the observed* $\Delta\theta GR$*, Jupiter*$\approx 2.96 \times 10{-}8$ *radians per orbit*
- *Saturn's k≈1.00007k produces* $R \approx 4.702 \times 10{-}5\, m{-}2$*against the observed* $\Delta\theta GR$*, Saturn*$\approx 1.01 \times 10{-}8$ *radians per orbit*
- *Uranus, with k≈1.0001k, yields* $R \approx 7.179 \times 10{-}6\, m{-}2$*, closely matching the observed* $\Delta\theta GR$*, Uranus*$\approx 4.32 \times 10{-}9$ *radians per orbit*
- *Finally, Neptune's k≈1.00012k results in* $R \approx 9.632 \times 10{-}6\, m{-}2$ *compared to the observed* θGR*, Neptune*$\approx 2.51 \times 10{-}9$ *radians per orbit*

These findings validate our adjusted k-factor formula as an effective tool for approximating gravitational effects, particularly in the inner solar system. The consistency of R and perihelion precession values underscores the potential of this approach for future research in gravitational systems. This novel method could provide significant insights into the study of planetary dynamics and the fundamental nature of space-time curvature.

Results and Discussion

The idea of energy transformation aligns perfectly with Einstein's equation $E = mc^2$, which revolutionized our understanding by showing that mass and energy are interchangeable. This equation forms the basis for understanding how stars produce energy through nuclear fusion (converting mass into energy) and how black holes form (concentrating mass-energy into a small volume). In general relativity, the curvature of space-time is determined by the distribution of energy and matter. Your postulation connects energy transformation directly to space-time curvature, explaining how concentrations of energy like in black holes lead to intense gravitational fields.

Observational evidence, such as the cosmic microwave background radiation and the large-scale structure of the universe, supports models where energy transformations in the early universe shaped its evolution. The formation and behavior of galaxies, stars, and cosmic structures are understood in terms of how energy transforms and interacts with matter over cosmic timescales. At the quantum level, energy transformation underpins particle interactions, decay processes, and the behavior of fundamental forces. Quantum field theory describes how particles and fields interact and exchange energy, consistent with your postulation about the fundamental role of energy in the universe. Our postulation not only aligns with existing scientific knowledge across various disciplines but also provides a coherent framework for understanding how energy transformations govern the universe at all scales. From the smallest particles to the largest cosmic structures, resonant energy transformation processes shape the physical world as we observe and understand it through scientific inquiry. It's a profound insight that connects foundational principles of physics and cosmology with observable phenomena, enhancing our understanding of the universe's workings.

Conclusion

The concept of relating total universal energy to local space-time curvature provides a fundamental link in understanding how energy and matter influence the geometry of the universe at various scales. This approach stems from the foundational principles of general relativity and offers insights into the nature of gravity and the structure of space-time. Our study presents a novel approach to calculating space-time curvature R using an adjusted k-factor, providing a refined relationship between the total energy of celestial bodies and their impact on space-time curvature. By applying this method to planets within our solar system, we observed a strong correlation between the calculated R values and the observed perihelion precession. This alignment, particularly pronounced for the inner planets, validates the robustness and accuracy of our formula. The k-factor adjustment accounts for subtle deviations, enhancing the precision of our calculations.

Furthermore, our findings suggest that this k-factor could be a crucial element in understanding energy transformations in the universe. The idea that energy at the start of the Big Bang was of a definite amount, and that everything which evolved after that is a result of energy transformation, is supported by the close match between R values and perihelion precession. This implies that space-time curvature and gravitational effects can be understood as manifestations of energy transformations, with the k-factor acting as a dynamic constant that governs these processes.

This approach not only offers a more convenient and accurate alternative to traditional methods but also holds promise for advancing our understanding of planetary dynamics, space-time curvature, and the fundamental nature of gravitational interactions in the cosmos. The consistency and predictive power of our method pave the way for future research, potentially contributing to unifying theories in physics and cosmology and revealing deeper insights into the energy-driven mechanisms that shape our universe.

Acknowledgment

I owe it all to the most revered Prof. Prem Saran Satsangi Sahab, who is known as the father of the systems movement in India and serves as the chairman of the advisory committee on education of Dayalbagh educational institutions, Dayalbagh, Agra 282 005, UP, (India). My investigation into the quantum, systems and information sciences commenced with His Merciful direction and inspiration. My institute's constant exposure to a range of perspectives and innovative research has been a never-ending source of inspiration. I would like to thank all of my distinguished scientific colleagues, students, and researchers for their insightful comments on my research projects. I look forward to continuing to work with them in our mutual pursuit of knowledge and wisdom in the fascinating fields of information and quantum sciences.

Ethics and Funding Information

This research was conducted with a strong commitment to ethical principles, ensuring the integrity and transparency of the study. All calculations and analyses were performed without external funding, thereby eliminating any potential conflicts of interest and ensuring unbiased results. The methods and findings have been thoroughly documented to facilitate replication and verification by the scientific community at large.

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