Dark Matter and Energy in symmetric dual Universe

Paul K. Suh, Mike Stauber, and Milton Hoenig

Cosmo.One Group, Fairbanks Court, Woodbury, New York

ABSTRACT

Based on the unified theory of electromagnetism and gravity, this paper identifies the origin of dark matter and energy, and explains their various anomalous behaviors observed.

KEYWORDS

PACS: Dark matter: 95.35.+d ; Dark energy: 95.36.+x; Cosmology: 98.80.-k; Unified Theory (gravity): 045.50.-h

1. Introduction

The electromagnetism and gravity interactions have been unified [1], realizing the Einstein's cherished dream. That demanded dual (dispersion) Planck Constants {ħ , ħ*}, respectively, for the EM and gravity interaction, where ħ* is greatly larger than ħ. The role of this gravitational (disprsion) Planck Constant ħ* is far-reaching and embracing, for examples, from help warranting the authenticity of the mass formulas for the primary particles—quarks, leptons, and bosons that include the {Z,W} bosons and the 125 GeV mass state without requiring the Higgs mechanism—to explicating the rudimentary, yet unexplained puzzle why all bodies regardless their weights fall at the same speed in the free fall.

The conventional theories assert that the dark matter and energy are conformal something that become non-observable—e.g. the Weakly Interacting Massive Particles (WIMPS) [2]—by interacting only in gravitational interaction, never in EM interaction. After the excruciating efforts over the several decades with publications of many thousands of acclaimed papers, dark matter and energy remain as yet unexplained mystery [3].

On the other hand, the dual (dispersion) Planck Constants { ħ, ħ*} explain the disparate propagation properties observed with radiations from the black holes; while the EM energy with the diminutive (dispersion) Planck Constant, ħ, are trapped inside the black hole event horizon with vanishing tunneling probability, the gravity with the large (dispersion) Planck Constant, ħ*, escapes the grip of the black hole with the optimum tunneling probability to influence its surroundings and produce the blazing swirls of materials being sucked down, or even form black hole binary system with another star.

what appears to have more than casual parallels with the equally baffling behaviors of the observed {EM, Gravity} of the {dark matter, dark energy}. In fact, the black hole dynamics in the local space-time leads to the symmetric (dual) Universe linked in terms of the dual (dispersion) Planck Constants { ħ, ħ*}.

2. Hermitean-antiHermitean Symmetry Physics

Nature is simple in essence, being operative in mathematics to the amazing exactitude [4], but the upshots often require insurrectionary deciphers. The space is decisively perceptive in 3D {x,y,z} with a singular time t, where the Hermitean (H) physics and antiHermitean (aH) physics—the primary symmetric principle in the basic quantum mechanics textbooks [5,6], not a makeshift postulates—emerges as mathematically equivalent.

Bohr had advocated the principles of complementary [7]: "The (symmetry) opposite of a profound truth will be another profound truth." That has been proven right, for example, by the Dirac's negative energy states—which are the symmetric opposite of the positive energy states, but was rejected to be nonphysical—had actually been realized to be the positrons.

It doesn't take much imagination to see that the symmetry of the H physics would require (aH) physics, and the H-aH symmetry as a whole could be a mathematical mien written in the genesis of creation. The Universe of H physics is capable of breeding humans, who realized that the aH physics (in term of their sentient time t) was non-observable to them, and outright rejected it. The half of the Universe became obscure; it is as if one-H-eyed (the other aH eyes blindfolded) amateur baseball team is competing the two-(H-aH)-eyed champion (nature) team.

Though the idea of dual (or parallel) Universes may stretch credulity, the possibility of a Universe parallel to the human sentient H-Universe (in perspective different from the symmetric H-aH Universe [1,6]), however, has fascinated humans. The mathematics behind the string theory in fact seems to make sense only when there are multiple dimensions beyond those that can be perceived by humans, and the experts in the field consider that the existence of the hidden Universe is more likely than not [8,9]. Moreover, the veracity of the dual Universe could have been hinted by the high-profile, space-based dark matter detector [10].

Although the space is observationally ascertained in 3-dimensions {x,y,z}, the time {t} is inconspicuous, running furtively, and what it does sub rosa is only a matter of imagination. The time in fact was found fiddling with physics, causing the time dilation in Special Relativity and space-time warping in the presence of matter and energy in General Relativity. Stephen Hawking widened the reach of time, and showed that the imaginary time "$\tau = it$" is actually more real than what is called real time "t" [11].

It is no surprise that, although the aH physics in terms of the human sentient time "t" is non-observable to human in the H Universe, the aH physics in terms of time "τ" is observable in the aH Universe, its baryon matter and EM energy revealing themselves to the H Universe across the universal quantum partition [6] in terms of the dual (dispersion) Planck Constants { ħ, ħ*} in the whimsy replication of the physics realized with the black hole mechanism. In contrast to the unfolding of the black hole in the local H Universe, however, the dual (H)-(aH) symmetry can be realized universally, consummating in the infant big-bang stage [1,6].

3. Dual H-aH Universe

In terms of the {τ = it }, the momentum in the aH Universe becomes real. This makes the aH physics observable commensurate to the H physics, with a notable dissimilitude: the directions of the EM force among charges reverse as indicated below [6].

H Universe: (+e) ←→(+e), (-e)←→(-e), (+e)→← (-e)
aH Universe: (+e) →← (+e), (−e)→←(e), (+e)←→ (-e) (1)

As the fundamental particles settle into the baryons in the big-bang, the number of particles and antiparticles are exactly equal. Their magnetic moments μ also are evenly split into

Proton: +2.79275 , Anti-neutron: +1.91128
Antiproton: -2.79275 , Neutron: -1.91128 (2)

Recent observations revealed that magnetic field exists in unimaginably strong and surprisingly large scale in the extragalactic space [12]. It is not associated with any galaxy or clusters, indicating it had been created in the primordial Universe, where it converges to become singularly strong in the big-bang. This strong primordial magnetic field H would polarize and split the baryons across the quantum partition potential

$V = - \boldsymbol{\mu} \bullet \mathbf{H}$, where

$V > 0$ for the protons and anti-neutrons transposing into the H Universe,
$V < 0$ for the anti-protons and neutron transposing into the aH Universe. (3)

The H Universe would end up with an excess protons of $N_{p,excess}$, which is balanced by the excess antiprotons of $N_{ap,excess}$ in the aH Universe. The rest of the baryons and antibaryons would balance in both Universes, resulting in an cosmoscopic (extrinsic) symmetric structure for the matter and antimatter

$$N_{p,excess} + N_{p,balance} + N_{an,balance} \text{ (in the H. Universe)}$$

$$= N_{ap,excess} + N_{ap,balance} + N_{n,balance} \text{ (in the aH Universe),} \quad (4)$$

where $N_{p,excess} = N_{ap,excess,}$ $N_{p,balance} = N_{an,balance}$, and $N_{ap,balance} = N_{n,balance}$.

Since the protons and anti-proton attract each other in the H Universe, the anti-neutron decayed into anti-proton, the $N_{p,balance}$ and $N_{an,balance}$ portion there in no time annihilate each other, contributing to the photon teaming primordial H Universe. This leaves the H. Universe only with the $N_{p,excess}$ protons, part of which convert to neutrons, and there arose an universal (extrinsic) matter and antimatter asymmetry in the primordial H Universe [6], i.e.,

$$N_H \rightarrow N_{p,excess\,/\,H} \quad (5)$$

On the other hand, it has been shown [1] that the matter and antimatter symmetry is also imbedded intact in the femtoscopic substructure of quarks and leptons. On the other hand, since

the proton and anti-proton repulse each other in the aH Universe, they shall not be annihilated, remaining in $N_{aH} > N_H$ with

$$N_{aH} \rightarrow N_{ap,excess} + N_{ap,balance} + N_{n,balance} \quad (6)$$

Thus the dark matter is the congregation of baryons and ant-baryons in the aH Universe, whose msses can also be determined by the single parameter dependent formula [1].

Since the protons and anti-protons (as well as the electrons and positrons) are attractive to themselves in the aH Universe, they would charge clump together. Their interactions would generate immense radiative energy, forming a perpetually coupling plasma. It has been estimated [6] that the charge clumped protons and anti-protons over the 13.8 billions became as heavy as $3.2 \times 10^4 m_p$,which agrees with the Minimal Dark Matter theory suggestion of about $10^4 m_p$ [13].

The dark matter and energy as the permanently coupled plasma in the aH Universe could reveal its presence to humans in the H Universe when its highly sensitive plasma electric resistivity become bolstered, for instance, in the collisions of galaxy clusters. In the Bullet Cluster [14], however, the collision was only a brief encounter, and the estimated electrical resistivity through the collision was negligible [6]. The dark matter moved on practically collision free without revealing its presence.

On the other hand, the Abell 520 [15] was a tremendous galaxy cluster collision, and the dark matter plasma from the crashing clusters must have participated in a concentrated high speed head-on collisions. This would have lifted the battle-ground electrical resistivity for highly collision sensitive dark matter plasma, interacting like the observable (H) matter. The dark matter as expected had revealed their presence in the Abell 520 collision.

The charge clumping dark matter gradually transform itself into the dark energy, maintaining the conservation of the total mass/energy in the Universe, i.e.,

$$\rho_{dm,aH} + \rho_{de,aH} = 21.8\, \rho_{om,H} \quad (7)$$

where $\{\rho_{dm}, \rho_{de}, \rho_{vm}\}$ is the respective densities. In contrast to the conventional claim, the $\rho_{de,aH}$ was not negligible in the big-bang; it was shown [6, 17] that

$$\rho_{dm}/\rho_{vm} \approx 16.3 \text{ and } \rho_{de}/\rho_{vm} \approx 5.5 \quad (8)$$

in line with Eq. (7) , and the data in Eq.(8) had been verified by observation [16]

The distribution $\{\rho_{dm}, \rho_{de}, \rho_{vm}\}$ of Eq. (8) working together in the primordial Universe could create the seeds of the galaxies and black holes in correlations [17], many of them to be matured to full galaxies and black holes within a billion years. This contradicts the conventional cosmology, where the galaxies and black holes are formed slowly over a few billions of years. The problem is that the primordial Universe is difficult to survey. With the development of improved detectors, however, the very early formation of galaxies and black holes is looming [18]. With this identification of the dark matter as the baryons in the aH Universe, the theory [1] has identified the 100 % origin of mass in the Universe.

4. EM and Gravity Quantum Tunneling

One of the remarkable consequences of the quantum mechanics is quantum tunneling effect. For a simple demonstrative purpose, the EM quantum tunneling probability can be approximated by assuming a particle of energy Є with mass m incident on a quantum partition potential $|V| >> Є$ of width "a", yielding

$$T(\hbar) = 16\,(Є/|V|)(\exp\{-2[2m|V|]^{1/2} a/\hbar\}. \quad (9)$$

The corresponding quantum tunneling probability in the gravitational interactions is

$$T(\hbar^*) = 16\,(Є/|V|)\exp\{-2[2m|V|]^{1/2} a/\hbar^*\}. \quad (10)$$

This simple approximations of Eqs. (9) and (10)--applied stepwise--are equipped with the needed transparency via the negative exponential factors, where the dominant deterministic agents are the contrasting values of {ħ, ħ*}. Because of the diminutive ħ, the EM radiation from the aH Universe to the H Universe is fully shielded with

$T(\hbar) \rightarrow 0$ in,

$$2[2m|V|]^2 a/\hbar >> 1, \text{ or } |V| >> V_{ph} = \hbar^2/(8ma^2). \quad (11)$$

On the other hand, because of the inordinately large ħ*, the gravity fully tunneling through from aH Universe to the H Universe with $T(\hbar^*) \rightarrow 1$ in,

$$2[2m|V|]^{1/2} a/\hbar^* << 1, \text{ or } |V| << V_{gr} = \hbar^{*2}/(8ma^2). \quad (12)$$

V_{ph} <<.....|V|.....<<V_{gr}
(Full EM shielding) (Full Gravity tunneling)

Pending a more scrupulous analysis, the exponential factors can be opined for a demonstrative purpose with $m_{ph} = O(3 \times 10^{-22}\ GeV/c^2)$ and $m_{gr} = O(8 \times 10^{-29}\ GeV/c^2)$ based on the wave-particle duality [19],

$$V_{ph} = O[10^{-7}\ GeV/a^2(cm)] \text{ and } V_{gr} = O[10^{85}\ GeV/a^2(cm)]. \quad (13)$$

The quantum partition potential |V| would be large enough than V_{ph} to completely shield off the EM radiation from the aH Universe, while the V_{gr} is so large that the most of the gravity would tunnel through the barrier. The observed nature of dark matter and energy according to this prescription are the verification of the dual (or parallel) Universe, and the effective quantum partition potential width "a" has a wide room of adaptability.

This earmark property as opined proves to be universal, being also operative in the black hole phenomena inside the H Universe itself, where—while the photons in terms of ħ are trapped inside the event horizon—gravity in terms of ħ* transmits through it. Even though its interior is very hot, the Earth is dark because its surface is cold. Gravity, on the other hand, completely

reveals every little bit of mass in the Earth by tunneling through its entire solid volume.

The aH Universe loaded by the perpetual plasma, would at times subject to violent turmoils that make the mutually repulsive proton clumps and antiproton clumps to collide and partly, or wholly annihilate. Since they are as heavy as O ($3.2 \times 10^4 m_p$), the annihilation could produce gamma rays up to the energy of O(10^4 GeV). This solves another puzzle; because the powerful gamma rays may drive through (not by quantum tunneling) the quantum partition barrier between the aH and H Universes, and emerge as the unusually high energy gammas being observed in the H Universe [9].

5. Dark Energy Equation of State

The Mawell equation in the H Universe leads to the transverse electromagnetic waves in vacuum. The Friedman acceleration force of a perfect fluid of density ρ_x is estimated by

$$F_x \propto (1 + 3\,\omega_x)\,\rho_x \,. \qquad (14)$$

where $\omega_{em} = 1/3$, giving $F_{em} \propto 2\rho_{em}$ for the (vector) EM radiation to intensify the attraction [20].

However, the EM energy from the perpetually coupling plasma in the aH Universe would be longitudinal (scalar waves) [21]. The scalar modeling [22,23] gives

$$\omega_{de} = (\dot{\phi}^2/2 - V) / (\dot{\phi}^2/2 + V). \qquad (15)$$

Under the condition of $\dot{\phi}^2/2 \rightarrow \epsilon << |V|$, Eq. (15) renders a clear and unequivocal determination of

$$\omega_{de} \approx -1 \qquad (16)$$

for the dark energy. The measuring the equation of state for dark energy is one of the largest efforts in observational cosmology, and $\omega_{de} \approx -1$ explains the perpetually accelerating expansion of the Universe in $F_{de} \propto -2\,\rho_{de}$.

6. Brief Summary

In association with the work that unified the electromagnetism and gravity, the dark matter and energy is determined to be the contrivance of Hermitean-antiHermitean symmetry physics in the dual Universe. Its implication is far-reaching, solving many deep-rooted conundrums, for example, how the dark energy can cause the accelerated expansion of the Universe as well as what is the real posture of the matter asymmetry in the Universe.

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