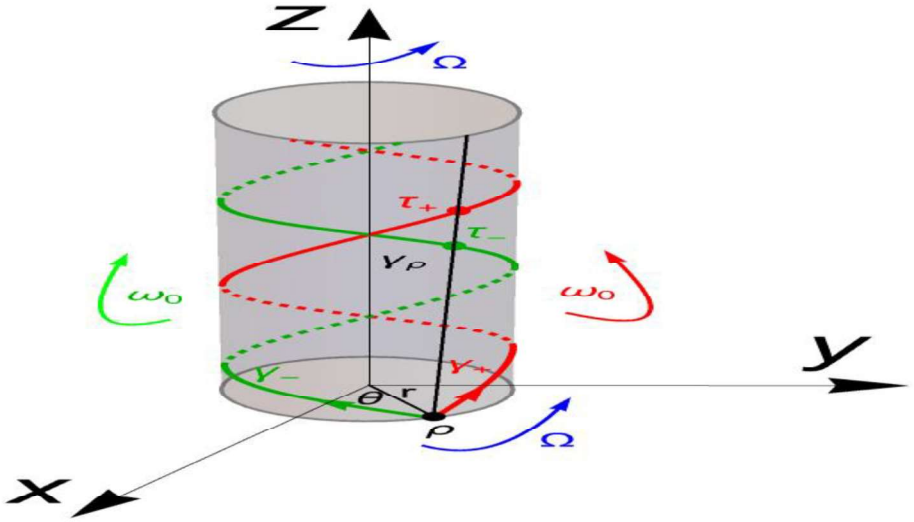
Article 14

Dark Energy and Anti-Matter

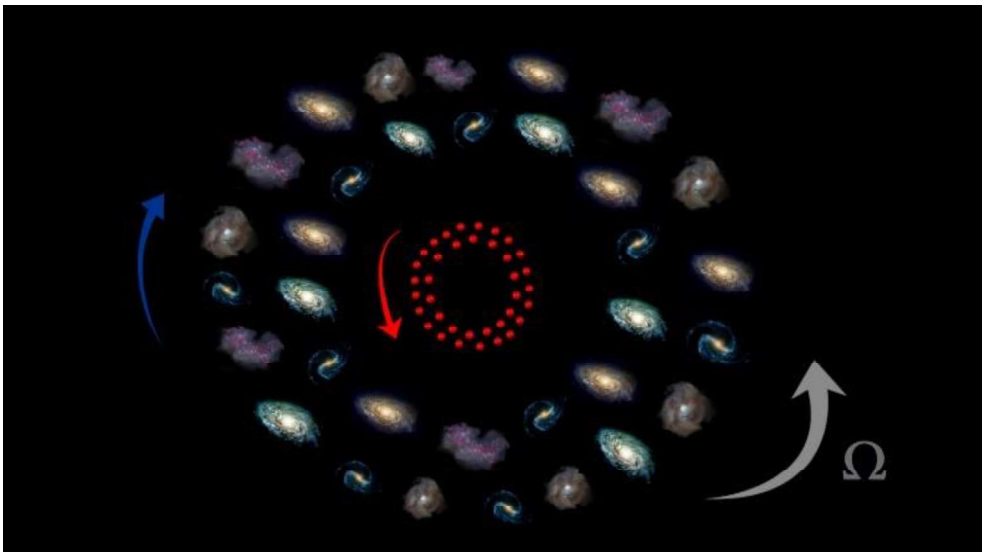
T. M. El-Sherbini*
Physics Department, Faculty of Science, Cairo University, Egypt
*Correspondance: elsherbini@sci.cu.edu.eg

Abstract:
In this brief review article, the author is going to discuss two of the most intriguing questions that physicists face in the present times, based on two of his previously published articles. Firstly, why our universe is composed entirely of ordinary matter and why there is hardly any free anti-matter that can be observed. Secondly, what the origin is of dark energy. For solving these two problems, he has previously proposed a hypothesized model with at the heart of it a primordial *S-particle* responsible for the formation of our universe . The *S-particle* together with its anti-particle counterpart were created immediately following the **Big Bang,** around 13.8 billion years ago. The *S-particle* differentiates itself from its counterpart through its course of rotation. The angular rotation of the anti-particle, in accordance with space-time rotation, together with the counter rotation of the *S-particle,* resulted in a time difference in the formation processes of both our universe and its dual counterpart (formed by the anti-particles). This led to a large distance between the spatial locations occupied by both universes (our universe and its counterpart) in the same space-time continuum.

The model proposed that simultaneously with the ejection of the S-particle, its anti-particle was ejected with the same linear velocity but with its angular rotation being in the opposite direction (El-Sherbini, 2024). During the expansion and cooling of the universe after the Big Bang, the particles were subjected to two geometrical phase transitions that gave them their mass and altered their dynamics of motion, hence leading to the formation of fundamental particles (electrons, quarks, neutrinos, etc.) and their anti-particles (El-Sherbini, 2022). An anti-universe was formed due to the course of the counter-rotating part of the primordial S-particle and its evolution with time (El-Sherbini, 2024). Both particles, together with the space-time mesh which rotates with constant angular velocity Ω in counter-clockwise direction similar to the (anti-) S-particle's rotation, define a symmetrical surface of right-angled cylinder (see Figure 1). The co-rotating and counter-rotating S-particles, relative to the space-time rotation, follow with time helical paths around the cylindrical surface (El-Sherbini, 1985). The variation principle as a guiding fundamental principle and the "relative space of rotating disks" introduced by Cattaneo (1959) and developed by Rizzi and Ruggiero (2002) as a general physical system of reference were adopted in the study.



The world lines of the co-propagating and counter propagating *S- particle* with respect with space-time. Υ_P is the world line of a point P on the rim of the base of the cylinder rotating with the angular velocity of space-time. The first intersection of Υ_+ and Υ_- with Υ_P are shown at time τ_+ and τ_- respectively, for one round trip as measured by an observer at rest in the rotating frame (LCIF) F′.



The following approximation for the time lapses between the two particles in one complete round trip was obtained [1]:

$$\Delta\tau \approx (4\pi\beta^4) / \Omega\,(1-\beta^2)\,[1 - \omega_0/\Omega], \quad (1)$$

where $\beta = \Omega\, r/c$ and c is the velocity of light. ω_0 is the *S-particle* and its anti-particle's angular velocity. With more round trips, say n-times, the time difference between the two particles will increase linearly (where n = 1, 2, ……. ϖ). After an infinitesimal fraction of a second from the **Big Bang** when the universe was filled with S and (anti-) *S-particles*, these primordial particles gave rise to the formation of the known fundamental and anti-fundamental particles (El-Sherbini, 2022). The above separation between the particles and their counterparts, thus led to the formation of two separate

universes i.e. our universe and its dual counterpart in different spatial locations. We can assume that the formation of the anti-matter universe followed evolutionary stages similar to those of our universe (i.e. formations of anti-atoms from anti-quarks etc.), but in later time (El-Sherbini, 2022; El-Sherbini, 2024). The expansion and cooling of the counter universe followed a slower rate due to the lagging in time between the formations of the two universes, which is illustrated in Fig. 2.

Figure 2: An artistic illustration of a cross-sectional area for the dual universe with our universe in blue and its antimatter counterpart in red, earth being a mere point in between the (clusters of) galaxies. Ω is the angular velocity of the space-time mesh and as can be seen from the figure, our universe and its dual counterpart are in opposite rotation. The dual universe was initiated about 13.8 billion years ago following the Big Bang, which was located in the middle point in the figure.

Dark Energy and Anti-Matter

The counter rotation of the anti-matter universe with respect to our universe's rotation formed anti-gravitational waves that have been built up, exerting a repulsive force on our universe. This anti-gravitational force took around eight to ten billion years to be built up to its maximum value, which might explain why at this time the expansion of our universe started to accelerate (Riess et al., 2004; Ethan, 2023).

It is worth mentioning here that the repulsive anti-gravitational force from the clusters of anti-particles in the anti-matter universe as a whole upon our universe and which is due to the opposite course of rotation of the two universes, is completely different from the electrostatic repulsive force between similar charged particles. It is also different from the force that is due to possible gravitational or anti-gravitational interaction between individual matter and anti-matter or particle and its anti-particle that might violate the CPT invariance, the theory of general relativity or the law of energy conservation. It is rather, a kind of negative gravity that affects our universe as a whole due to the opposite course of rotation of the dual anti-universe relative to ours. The effect of this opposite rotation of the dual anti-universe can cause anti-gravitational waves that penetrate our universe interacting with the vast voids of the space-time mesh between the galaxies in our universe, resulting in a negative- like curvature in the shape of the space around them. This negative curvature pushes the galaxies outward, away from each other, leading to the accelerated expansion of our universe. Moreover, the continuous anti-gravitational waves that permeate and fill our universe might cause constant background ripples (space fluctuations) in the space of our solar system that can be experimentally observed. The repulsive force exerted by our counter (anti-) universe could together with the expansion of space-time, influence our universe and might yield more insight on the origin of dark energy.

Finally, the proposed *S-particle* model might participate in solving two of the greatest mysteries in physics and astrophysics of our times: namely the question why our universe is composed almost entirely of ordinary matter while hardly any free anti-matter is observed, and the question of the origin of dark energy.

References

- Cattaneo, C. (1959). General relativity: Relative standard mass, momentum, energy, and gravitational field in a general system of reference. Il Nuovo Cimento, 13, 237.
- El-Sherbini, T. M. (1985). Geometrical model for the electron. Lettere al Nuovo Cimento, 44, 307.
- El-Sherbini, T. M. (2022). A cosmological model for the early universe: The formation of fundamental particles. Journal of High Energy Physics, Gravitation and Cosmology, 8, 1073.
- El-Sherbini, T. M. (2024). A model for a dual universe. Journal of High Energy Physics, Gravitation and Cosmology, 10, 52.
- El-Sherbini, T. M. (2024). The evolution of physicists' perception of the universe. Egyptian Journal of Physics, 52, 1.
- Ethan, S. (2023). Ask Ethan: How does dark energy accelerate the universe? Big Think. https://bigthink.com/starts-with-a-bang/dark-energy-accelerate-universe/
- Riess, A. G., et al. (2004). Type Ia supernova discoveries at z > 1 from the Hubble Space Telescope. The Astrophysical Journal, 607, 665.
- Rizzi, G., & Ruggiero, M. L. (2002). Space geometry of rotating platforms: An operational approach. Foundations of Physics, 32, 1525.