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EXECUTIVE SUMMARY ON THE IMPLICATIONS OF DIRAC'S NEGATIVE ENERGY ANTIPARTICLES FOR PARTICLE PHYSICS, ANTIGRAVITY AND COSMOLOGY

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Biographical Notes

<http://www.i-b-r.org/Sir-Santilli-bionotes-05-15-21.pdf>

PART I: Implications for particle physics

1. Paul Dirac [1] conceived in 1928 antiparticles as having negative energies, by therefore allowing the representation of electron-positron annihilation into light, but violating special and general relativities.

2. To achieve compatibility with special and general relativities, J.R. Oppenheimer [2] assumed in 1930 that all antiparticles have positive energy, an assumption that persists in full to this day throughout particle physics.

3. In support of Oppenheimer's view, mainstream physics opposed Dirac's view on grounds that negative energy particles, referred to our conventional positive units of measurements, violate causality. In the early 1980s, when I was in the faculty of the Department of Mathematics of Harvard University under DOE support, I initiated the construction of a new mathematics, today known as Santilli isodual mathematics, and related world called isodual spacetime, which was specifically conceived to resolve Dirac's causality problem. The new mathematics is essentially based on "isodual units" (which, in their simplest possible form, are "negative units") at all levels of study, from functional analysis to algebras and geometries. As a result, negative mass antiparticles referred to negative units of energy are as causal as positive mass particles referred to our positive units. The main steps in this long journey are: in 1993 I proved that numbers with negative units verify the axioms of a numeric field, thus being usable for measurements [3]; in 1996 I generalized the Newton-Leibniz differential calculus for isodual units [4]; in 1996 I also showed that antimatter with negative energy should emit a new light with negative energy which I called "isodual light" [5].

In 2001 I published the Springer Nature monograph [6] that studies Dirac's negative energies at all possible levels, from Newtonian mechanics to the most advanced geometries including the proof of the validity of special and general relativities for negative energy antiparticles only reformulated on isodual spaces over isodual numeric fields. Note that these studies include the first and only known rigorous formulation of the gravity of antiparticles, although having a negative curvature tensor referred to negative units.

One should know that isodual mathematics and physics are a branch of hadronic mechanics with contributions too many to be reviewed in an Executive Summary (a partial list of contributors can be seen in the profile of the independent reviews by the British journal Scientia [7]).

DISMISSAL OF MAIN OBJECTION: The body of research honoring Paul Dirac (including isodual mathematics, isodual spacetime and related antiparticles) is dismissed on ground that it violates Einstein's equivalence principle. The idea that general relativity, a theory purely conceived for matter, is also applicable to antimatter is clearly political because intended to dismiss advances over a pre-existing theory without technical knowledge and due process. The isodual theory of antimatter admits a full isodual formulation of general relativity for antimatter on isodual Riemannian

spaces by providing their first and only known rigorous representation of gravity [6]. The indicated dismissal is therefore equivalent to the nonscientific statement that general relativity is wrong because it does not describe the gravitational field of antimatter. The reality is that matter and antimatter worlds are structurally different, thus requiring individual, specialized, mathematical and physical descriptions with very complex interconnections

4. Recently, I published a theorem [8] proving that positive energy particles and positive energy "antiparticles" cannot annihilate into light, by therefore indicating that the 20th century notion of antiparticles may be fundamentally flawed.

5. More recently, E. Velardo [9] has indicated the possibility that the "antiproton" of the "anti-hydrogen atom" may be in reality a Santilli's pseudo-proton, which is essentially a bound state between a neutron and an electron created in the core of stars, and expectedly, in contemporary hadron colliders.

6. Recently, I published essay [10] showing that the isodual representation of antiparticles [6] is the sole compatible with all available experimental evidence on antimatter, including Dirac's particle-antiparticle annihilation into light, under the full validity of special relativity only formulated on the isodual space-time over an isodual numeric field.

PART II: Implications for antigravity

7. In 1994, I published paper [11] (see also [12]) showing that Dirac's conception of antiparticles implies particle-antiparticle antigravity and proposed the comparative measurement of the gravity of very low energy electrons and positrons in a horizontal, supercooled and supervacuum tube. This prediction was confirmed in monograph [6] at all levels of study, including the representation of antiparticles via the isodual general relativity. It should be noted that the proposed antigravity test can nowadays be done with limited funds because very low energy electrons and positrons are available from commercially sold radioactive isotopes, by therefore restricting the main cost to the construction of the supercooled and supervacuum tube.

8. The proposed antigravity test [11] was discussed at the 1996 Sepino International Workshop on Antimatter and stated to be resolutory by antimatter experts such as Prof. A. P. Mills [13] from UCLA - Los Angeles, Prof. V. O. de Haan [14] from the Netherland [14]. The proposed test was also discussed at the 2011 San Marino International Workshop in Astrophysics for Matter and Antimatter, at the 2020 International Workshop on the EPR argument, and at other meetings.

9. In 1997, The R. M. Santilli Foundation filed a formal request to the Directorate of the CERN laboratories to test Santilli comparative gravity of electrons and positrons; Prof. Mills, and independently, Prof. de Haan and other scholars, filed similar requests in subsequent years; but CERN has elected to ignore all these requests to this day (Dec. 3, 2024).

10. In 2023, physicists from CERN published paper [15] in the Springer Nature journal reporting that their "anti-hydrogen atom" in Earth's gravitational field experiences conventional gravitational attraction. It should be indicated that CERN "anti-proton" has 99% the mass of the "anti-hydrogen atom," but said mass is theoretically assumed to be positive to comply with special relativity [2] and consequently, the resulting conventional gravity is obvious.

Part III: Implications for cosmology

11. In 2012, I pointed out in paper [16] that negative energy antimatter light should have an angle of refraction in transparent media which is opposite that of matter light, thus being invisible to all current telescopes on Earth as well as in orbit, because per our current knowledge, the detection of isodual light requires a "concave lense" for its detection.

12. In 2013, my wife Carla and I created the publicly traded Thunder Energies Corporation (now Hadronic Technologies Corporation) for the development of the new optics for concave lenses. This corporate setting provided the funds necessary for the construction and test of pairs of Galilei and Santilli telescopes with 60 mm, 100 mm, 150 mm and 200 mm as well as the construction and test of a pocket size pair (see pictures in website [17] currently under re-organization).

13. Subsequently, systematic scans of the night sky under 30 seconds exposure via pairs of Galileo and Santilli telescopes indicated the apparent existence of an antimatter galaxy in the Vega [18] and Capella [19] regions of the night sky which can only be quantitatively explained via negative energy photons since the detected streaks are generated by the annihilation of the positive energy background.

14. The apparent detection of antimatter galaxies [18] [19] has been confirmed by a number of independent astrophysicists via Santilli isodual telescopes [20]-[22].

15. My personal view is that there exists "visual" evidence of Dirac's negative energy antimatter which is given by numerous, quite big, mid air explosions in Earth's atmosphere, such as the 1908 Tunguska explosion in Siberia [22] with energy equivalent to one thousand Hiroshima nuclear bombs, which explosions leave no debris or craters in the ground and Ionize the entire Earth's atmosphere for days. In the absence of nuclear bombs at the time of said explosions, the ionization of the entire earth's atmosphere can be scientifically explained only via the annihilation of large antimatter asteroids at contact with Earth's atmosphere, which asteroids can solely originate from far away antimatter galaxies.

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