The Mystery of Detecting AntiMatter Asteroids, Stars and Galaxies

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Abstract. In this note, we indicate that the problem of detecting antimatter asteroids, stars and galaxies is fundamentally open at this writing; we identify the basic issues to be resolved for said detection; and we propose novel experiments.

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One of the largest scientific imbalances of the 20th century was the study of particles at all possible levels, from Newtonian mechanics to second quantization, while antiparticles were solely studied at the level of second quantization. The imbalance was due to the fact that Newton's equations, Galileo's relativity, and Einstein's special and general relativities have no means for distinguishing between *neutral* particles and their antiparticles, trivially, because their sole distinction is the sign of the charge. Even for the case of charged antiparticles, 20th century classical theories had problems, e.g., because the operator image of a classical charged "antiparticle" is a "particle" with the wrong sign of the charge, evidently in view of the existence of only one quantization channel.

Since Galileo's and Einstein'a relativities cannot provide a consistent classical characterization of antiparticles, a rather widespread 20th century view was that "antimatter does not exist at the classical level," the sole admitted manifestation of antimatter being that at the level of elementary particle reactions.

However, such a view is dismissed by evidence because Earth has been devastated in the past by antimatter asteroids. For instance, the 1908 Tunguska explosion in Siberia was the equivalent of one thousand Hiroshima atomic bombs, but left no crater or residue at all in the ground, thus being solely interpretable via the annihilation of an antimatter asteroid in our atmosphere. Additionally, the entire Earth atmosphere remained excited for two days during which there was full illumination at midnight even in Sidney, Australia. It is evident that such a global atmospheric excitation cannot possibly be interpreted via a matter asteroid, the sole quantitative representation being, again, that permitted by the annihilation of a large antimatter asteroids in our atmosphere.

Furthermore, astronauts and cosmonauts have systematically reported "flashes of light" in the upper atmosphere when in darkness that can only be quantitatively interpreted as being due to antimatter cosmic rays annihilating at the first contact with our atmosphere. These, and additional evidence (e.g., in astrophysics indicating the apparent existence in the universe of large aggregates of antimatter), thus mandating its study, not only on scientific grounds, but also for our own safety.

On mathematical grounds, the insufficiencies of 20th century theories for antimatter were due to the lack of the appropriate mathematics providing a consistent representation of all classical antiparticles, irrespective of whether neutral or charged. Since the map from a particle to its antiparticle is generally anti-isomorphic, and anti-Hermitean as a particular case, the consistent conjugation from classical particles to classical antiparticles requires an anti-isomorphic image of the entire 20th century applied mathematics used for matter, including anti-isomorphic images of numeric fields, functional analysis, differential calculus, Lie's theory, etc.

In the early 1980s, during his stay at the Department of Mathematics of Harvard University under DOE support, the author addressed the above problems and, following various trials and errors, constructed the anti-Hermitean image of 20th century applied mathematics via a map, today known as *Santilli isoduality* (and denoted with the upper symbol ^{d}), essentially consisting in the anti-Hermitean image of each and every quantity and all their operations of 20th century applied mathematics used for matter. For instance, given a generic vector field or operator $O(t,r,v,\psi,...)$ depending on time t, Euclidean coordinates r, velocities v, wavefunctions ψ, etc., its isodual image is given by $O^d = O^d(t^d,r^d,v^d,\psi^d,...) = -O^\dagger(-t,-r,-v,-\psi^\dagger,...)$.

The resulting mathematics is nowadays known as *Santilli isodual mathematics,* where the term "dual" denotes the duality from matter to antimatter and the prefix "iso" is intended in the Greek meaning of preserving the original topology (or axioms). Consequently, isodual mathematics *does not* introduce new mathematical axioms, but merely

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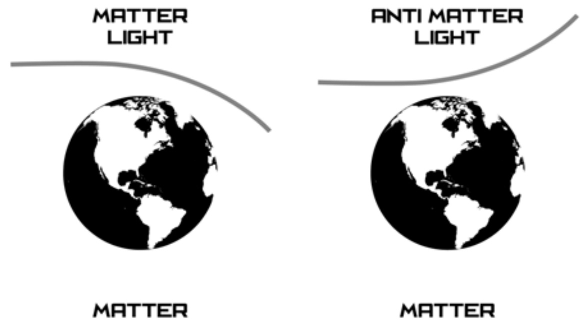

FIGURE 1. A view of the repulsion of antimatter light by a matter gravitational field predicted by the isodual theory of antimatter.

provides a *new anti-Hermitean realization* of known 20th century axioms. A general review of the literature in the field is provided by the 2006 monograph [1].

A fundamental condition for the consistent application of isodual mathematics to classical or operator antimatter is that *the isodual map must be applied to the totality of quantities and their operations used for the description of matter with no exclusion whatsoever.* The omission of the isodual map for only one matter quantity or operation generally causes catastrophic inconsistencies.

As an illustration, it is known that the description of antiparticles as having negative energy $E^d = -E$ violates causality and other laws when referred to conventional units of energy. However, the description of antiparticles with negative energy, when referred to negative unit of energy, is as physically consistent as the description of particles with positive energy referred to positive units of energy. Alternatively, due to the complete democracy between matter and antimatter at all levels, the treatment of negative energies with positive units is as inconsistent as the treatment of positive energies with negative units. Essentially the same occurrences holds for isodual time $t^d = -t$, isodual coordinates $r^d = -r$, etc.

By applying the above general rules, the fundamental unit of Santilli isodual mathematics for (point-like) antiparticles is the isodual image of the trivial unit 1 of 20th century applied mathematics., i.e.,

$$1^d = -1. \tag{1}$$

The isodual image of a numeric field $F(a, \times, 1)$ (where a represents real, complex or quaternionic numbers and $\times$ represents the conventional associate multiplication) is given by $F^d(a^d, \times^d, 1^d)$, where $a^d = -a^\dagger$ and the isodual product can be written $\times^d = \times(1^d)^{-1}\times$ under which it is easy to see that 1^d is the correct left and right unit, $1^d \times^d a^d = a^d \times^d 1^d \equiv a^d \; \forall \; a^d \in F^d$, and F^d verifies all axioms of a numeric field. The important property is that F^d is anti-isomorphic to F exactly as desired to characterize antiparticles. The sale rules are used for the isodualimage of the entire 20th cebntury applied mathematics [1].

The physical application of isodual mathematics has lead to the first known formulation of Newton's equations for antiparticles, nowadays called *Newton-Santilli isodual equations,* which can be written [1]

$$m^d \times^d \frac{d^d v^d}{d^d t^d} = F^d(t^d, r^d, v^d, \ldots), \tag{2}$$

were the insidious lack of isoduality of the fraction leads to inconsistencies. The same rules have then permitted the consistent construction of the *isodual Galileo relativity, isodual special relativity and isodual general relativity* [*loc. cit.*].

It is evident that the classical isodual representation of antiparticles represents the totality of experimental evidence available at this writing. But the isodual map coincides with charge conjugation at the operator level by conception and realization. Consequently, the isodual theory of antimatter represents all known experimental data on antimatter at the operator level too [1].

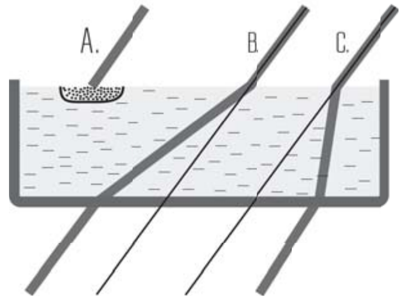

FIGURE 2. A view of the three possibilities for antimatter light when hitting a transparent matter medium such as water: 1) Absorption/annihilation; B) Isodual refraction; and C) Conventional Einsteinian refraction.

By remembering that antimatter asteroids, stars and galaxies must be assumed as being neutral, no scientific conclusion can be ventured at this time on their detection via the use of Newton's equations, Galileo's relativity, and Einstein's special and general relativities. For instance, the reflection of Sun's light on an antimatter asteroid is technically unknown at this moment. Similarly, the detection of antimatter light via matter telescope is equally unknown thus preventing any scientific conclusion at this writing on the antimatter component of the universe. In this note, we can therefore merely identify all conceivable, or otherwise plausible alternatives without any final selection.

To begin this task, let us recall that *Galileo's relativity, and Einstein's special and general relativities predict no distinction between light emitted by matter and light emitted by antimatter.* Needless to say, it is well possible that this prediction is indeed verified in nature following specific new experiments. However, serious scientific inquiries cannot assume such a conclusion as being the only one, again, due to the basic insufficiencies of said theories to achieve any quantitative distinction between neutral matter and antimatter, thus between matter and antimatter light. Consequently, the scope of this note is the identification of all possible alternatives.

The first, and perhaps most important prediction of isodual mathematics is that *light emitted by antimatter, also called isodual light (and denoted by γ^d), is physically different than light emitted by matter in an experimentally verifiable way.* In fact, isodual light must have negative energy $E^d = h^d \times^d \nu^d$, again referred to negative units. Consequently, *isodual light is predicted to be repelled by the gravitational matter field* as illustrated in Figure 1.

This prediction can be quantitatively seen by recalling that Newton's gravitation is correctly stated to be "universal" because it represents the attraction not only of two gravitational bodies, but also the attraction of matter light by a matter gravitational field. Since light has no mass, the author has *identically* reformulated since the early 1980s Newton's equations in terms of the equivalent form $m = E/mc^2$, resulting in the truly universal gravitation $F = \hat{g} \times E_1 \times E_2/r^2$, where $\hat{g} = g/c^4$ and the positive sign denotes attraction. This reformulation is also warranted because, as established by the Riemannian geometry, the energy and not the inertial mass of a body is the true origin of the gravitational field.

For the case of an isodual light $E_2^d = h^d \times^d \nu^d = -h \times \nu$ in a matter gravitational field with energy $E_1 = m_1 c2$, we have the prediction of the Newton-Santilli isodual equation formulated in our space and time, thus referred to our positive units of measurements

$$F = \hat{g} \times \frac{E_1 \times E_2^d}{r^2} = -\hat{g} \times \frac{E_1 \times E_2}{r^2}, \tag{3}$$

that, being negative, denotes *repulsion.*

The next aspect requiring a study for the detection of antimatter asteroids, stars and galaxies, is the behavior of antimatter light when hitting a transparent matter medium such as water. In this case, we have the following three possible alternatives (see Figure 2):

A) Antimatter light is absorbed by a matter medium without any reflection or refraction, according to a process that is essentially annihilation of antimatter energy when in contact with matter energy.

B) Antimatter light does indeed experience a refraction, but via an angle characterized by the *increase* of the speed within the transparent medium. This is due to the fact that, in the isodual antimatter world, the *decrease* of the speed of antimatter light must appear to us as an *increase,* evidently because the speed of antimatter light is negative.

C) When hitting a transparent matter medium, antimatter light experiences exactly the same refraction as that of matter light (Einsteinian prediction).

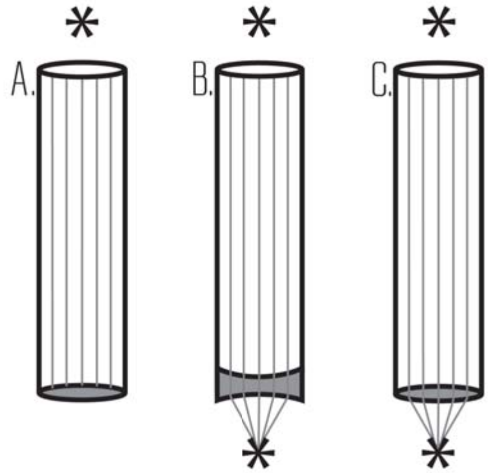

FIGURE 3. A view of the three possibilities in attempting to see an antimatter star with a telescope: A) Absorption of antimatter light by the lenses with no light reaching the eyepiece; B) Detection via concave lenses due to the isodual refraction of Figure 2; and C) Conventional Einsteinian detection via a refraction telescope with convex lenses.

When passing to the possible detection of antimatter light (that is, light emitted by an antimatter star), we have three corresponding impossibilities (Figure 3):

A') Antimatter light annihilates in the lens of the telescope without reaching the eyepiece;

B') Antimatter light is indeed detected by a refractive matter telescope, but under the condition that its lens is concave;

C') Antimatter light is detected by a conventional refractive matter telescope (that with a convex lens) in the same way as that of a matter light.

In conclusion, there is no scientific possibility to reach at this writing a *quantitative* final solution in regard to the detection of antimatter asteroid, stars and galaxies due to basic insufficiencies of our current knowledge of antimatter. The only possible scientific resolution, that is, resolution beyond the level of personal opinions, is that achieved following much needed new experiments, such as:

1) Measure the gravity of positrons in a resolutory way, such as that via a very low energy positron beam released into a horizontal super-vacuum and super-cooled horizontal tube proposed by Santilli in 1994 [1]. For the case of a 10 meter long tube (with half a meter internal diameter) and for milli electron Volts energies of the positrons, the displacement due to gravity on a scintillator at the end of the tube is visible to the naked eye (because estimated to be of the order of 1 cm). Einstein special and general relativities predict attraction of the positron beam by Earth's gravitational field, while Santilli isodual theory of antimatter predicts repulsion at all levels of study, from the Newton-Santilli isodual mechanics to the Riemann-Santilli isodual geometry [*loc. cit.*]. It is evident that a possible measurement of antigravity by positrons in Earth's gravitational field would confirm the isodual theory of antimatter, thus dismissing the Einsteinian alternatives C and C' above.

2) Bound states of particles and their antiparticles are *isoselfdual* (invariant under isoduality such as the imaginary number i) irrespective of whether treated in our reference frame and related units or referred to the corresponding isodual images. Consequently, yet another basic open problem is whether the spontaneous decay of the π^0 meson into two photons is isoselfdual, in which case we have the *new* decay $\pi^0 \to \gamma + \gamma^d$or not, in which case we have the conventional decay $\pi^0 \to \gamma + \gamma$. These decays can also be considered for possible verification of the attraction of repulsion of antimatter light in Earth's gravitational field via neutron interferometric procedures. It is evident that the possible confirmation of isoselfduality as a basic symmetry in nature would also dismiss the Einsteinian alternatives C and C' above.

3) Astrophysical data should be analyzed without the widespread posture of solely accepting data compatible with Einsteinian theories, but derive instead the applicable theory from unadulterated experimental data. As an example,

there have been rumors of already occurred detections of “anti-lens effects" in the universe for light passing near a star. These effects have been dismissed because they are incompatible with Einsteinian theories. By contrast, an objective acceptance of astrophysical data without *a priori* generally tacit assumptions of preferred theories, may likely allow the achievement of a deeper knowledge of antimatter.

In the final analysis, the very security of our small planet is at stake in the above alternatives because, as indicated earlier, Earth has been devastated in the past by antimatter asteroids. Additionally, as it was the case for the 1908 Tunguska explosion in Siberia, matter-antimatter annihilation causes very powerful radiations at all frequencies at times lasting in the atmosphere for days, with evident consequential disruption of all civilian as well as military electronic equipment in addition to physical damage. Therefore, the possible occurrence of similar events without the clear capability of advance detection of an antimatter asteroids because of the tacit preference of Einsteinian doctrines, would be an sinister historical blunder.

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