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Antiprotons or pseudoprotons?

Emanuele Velardo *

Abstract

The author, an undergraduate physics student, reviews in this paper: 1) positive mass negative charge antiprotons according to 20th century particle physics; 2) positive mass negative charge pseudoprotons according to hadronic mechanics; 3) the notion of antiprotons according to the isodual theory of antimatter; 4) a theorem recently proved by R. M. Santilli essentially implying that, under the spinorial Poincaré symmetry, the 20th century conjugation from particles to antiparticles prohibits partlcle-antiparticle annihilation into light; and 5) consequential doubts on the recent gravity test for the anti-hydrogen atom. Therefore, the author examines the possibility that antiparticles are actually gravitationally rejected by matter and 20th century antiprotons are in reality pseudoprotons with a consequential number of intriguing open problems in antimatter, like the astrophysical origin of true antiprotons from cosmic rays, and others. We conclude by examining: the 1994 proposal for a resolutory test on the gravity of true antiparticles, such as the positrons; the possible existence of antimatter bodies in the universe which originate cosmic antiprotons; and related aspects.

Keywords: antiprotons; pseudoprotons; antimatter; hadronic mechanics [1]

*Department of Physics, University of Rome La Sapienza, Rome, Italy; emanuelevelardo1999@gmail.com

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1 Pseudoprotons according to hadronic mechanics

The positive mass, negative charge pseudoproton [1] is a *particle* predicted by hadronic mechanics [2] which proposes an alternative description of the structure of unstable particles compared to the standard model. More precisely, hadronic mechanics predicts that the multitude of known *unstable* particles are composed by generalized bound states of physical, i.e., detectable particles produced free in their spontaneous decays. Thanks to the first known exact representation of all characteristics of the neutron as a hadronic bound state of an electron and a proton in the core of stars [3], hadronic mechanics has confirmed the historical conception of stable matter in the universe as being solely composed by the permanently stable protons and electrons [4]. Additionally, hadronic mechanics has achieved industrial means for the resolution of the historical Coulomb barrier opposing controlled nuclear fusions [5].

1.1 Pseudoproton's structure

The characteristics of the pseudoproton resemble those of a proton in terms of mass, but the charge is negative since it is composed by a hadronic bound state of a proton and two singlet-coupled electrons (see Figure 1) or a proton and two unpaired electrons inside the proton (see Figure 2) which are two variants that differ in the overall spin. Pseudoprotons have been synthesized by using the Rutherford compression mechanism for the synthesis of the neutron from an electron and a proton [3] applied to the synthesis of an electron and, this time, a neutron [1]. Despite being unstable, the pseudoproton has a half-life on the order of seconds or fractions thereof, which is long enough for technological applications.

1.2 Experimental evidence of the existence of pseudoproton

The existence of pseudoprotons has been experimentally indicated in [6] where the pseudoprotons were detected by irradiation of a sample of silver by verifying the expected reaction

$$\begin{aligned} & Ag(47,109,1/2) + \bar{p}(-1,1,1/2) \rightarrow \\ & \rightarrow Pd(46,110,0) + 2\gamma(0,0,1), \end{aligned} \tag{1}$$

where $\bar{p}\,(-1,1,1/2)$ indicates pseudoprotons.

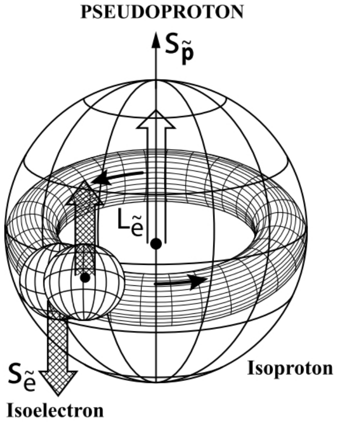

Figure 1: *Pseudoproton structure according to hadronic mechanics [1].*

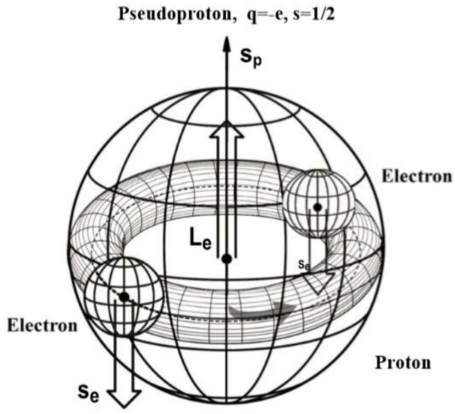

Figure 2: *Another possible structure of the pseudoproton that differs from that of Fig. 1 in spin [6].*

2 Basics elements of isodual mathematic

The most useful branch of mathematics for the rappresentation of antimatter's behavior appears to be the isodual mathematic developed by R. M. Santilli [7]. Some of its basic concepts can be outlined as follows:

2.1 Isodual numbers

In mathematics, a "numeric field" is an algebraic structure in which a set of elements and two operations (an addition and a multiplication) are defined in such a way that, when applied to elements of the set, result in an element belonging to the same set.

The property that distinguishes the inverse of an element is that by applying the multiplication operation between an element and its inverse the unit is always obtained. The fundamental property of unity is that it is equivalent to its inverse.

Santilli conceived the isodual mathematics to study the numeric field in which the fundamental unit is *negative*,

$$1^d = -1, \tag{2}$$

in which case the multiplication, symbolized by $\times^d$, provides numeric values opposite those of a field of real numbers.

$$a \times^d b = a(1^d)^{-1}b. \tag{3}$$

It is then evident that in a theory where this type of multiplication is defined all numeric values are opposite those of an ordinary matter theory. More precisely, you can define for each given number its isodual which is anti-Hermitean

$$n^d = n1^d = -n^\dagger \tag{4}$$

2.2 Antimatter is represented as isodual matter on a isodual space over an isodual field

The isodual field turns out to be able to represent the properties of the antimatter that can in fact be considered matter with the values of all the physical properties (for example mass) corresponding to the isodual values and placed in an isodual space over an isidual field.

For example consider the charge conjugation applied to a quantum wave function

$$C\psi\,(r) = -\psi\,(r)^\dagger\,, \tag{5}$$

it is evident that a wave function under the isodual transformation correctly represents the charge of the antiparticle

$$\psi^d\left(r^d\right) = -\psi\left(-r\right)^\dagger \tag{6}$$

with the sognificative difference that the isodual transformation, unlike charge conjugation, also applies to all other quantities (as in this case the variable r)

It is noteworthy that also the space and time that host antimatter are isodual with respect to space and time of matter (see also the excellent recent review by A. Muktibodh [8]).

3 The gravity of matter and antimatter

There is still no unanimous consensus on the behavior of antimatter in relation to matter gravity. The question is whether there is no gravitational difference between matter and antimatter, as expected from the positive mass of 20th century antiparticles, or antimatter produces an antigravity field in the fiekd of matter, as expected from their negative mass, that rejects matter by therefore that matter and antimatter experience a *gravtational repulsion,* also called antigravity..

3.1 Behavior predicted by the isodual theory of antimatter

The isodual theory of antimatter [7] makes use of the isodual unit $1^d = -1$ to "conjugate" matter formulas and make them valid for the description of antimatter. By recalling Newton's gravitational *attraction* between two positive mass particles in the Euclidean space $\mathcal{E}$ with local coordinates r over the field of real numbers $\mathcal{R}$ with unit $1 > 0$

$$F = \frac{G \times m_1 \times m_2}{r^2} > 0 \tag{7}$$

the corresponding attraction between two negative mass particles in the isodual Euclidean space $\mathcal{E}^d$ with local coordinates $r^d = r1^d$ over the isodual field of real numbers $\mathcal{R}^d$ is given by

$$F^d = \frac{G^d \times^d m_1^d \times^d m_2^d}{r^{d2d}} < 0 \tag{8}$$

and denotes attraction because the negative value of F^d is measured in terms of the negative unit $1^d < 0$ of $\mathcal{R}^d$.

It then follows that the gravitational force between a positive mass particle and a negative mass antiparticle is *repulsive* in our Euclidean space $\mathcal{E}$ over $\mathcal{R}$

$$F = \frac{G \times m_1 \times m_2^d}{r^2} < 0. \tag{9}$$

as well as in the antimatter space $\mathcal{E}^d$ over $\mathcal{R}^d$

$$F^d = \frac{G^d \times^d m_1^d \times^d m_2}{r^{d2d}} > 0 \tag{10}$$

were, again, the negative value of F^d, this tine, denotes repulsion because of the negative value of 1^d.

Consequently, the isodual theory of antimatter predicts that a matter particle and an antimatter particle should experienhce antugravity. Santilli [7] has proved the validity of this property at all levels of treatment, from Newtonian mechanics to the Riemannian geometry.

3.2 CERN's gravity experiment on antimatter

The mainstream interpretation of the 2023 experiment at CERN [9] is instead that antimatter would be gravitationally attracted by matter and there would be no gravitational difference in their behavior. In fact, the statistical data of of the CERN's experiment indicates that anti-hydrogen atoms *fall* towards the center of the Earth.

3.3 Comparison between two lines of thought

A theorem recently proved by R. M. Santilli in Refs. [10] [11] states that, under the invariance by the spinorial Poincarè symmetry, the particle-antiparticle conjugation

$$PTC|p, j, \psi(t,r) >= |p, -J, -\psi(t,r)^\dagger > \tag{11}$$

is incompatible with the experimental evidence of electron-positron annihilation into light.

This suggests that antimatter particles actually have a negative mass as historically predicted by P. A. M. Dirac [12] who discovered himself that *negative energy antiparticles represented in our spacetime over the field of real numbers violate causality.*

Santilli [7] resolved Dirac's causality problem via the construction of the new isodual mathematics, which is inclusive of isodual spaces and isodual numbers, according to which *a negative energy antiparticle represented in the isodual spacetine over the field of isodual numbers all having the basic unit* $1^d = -1$ *are as causal as positive energy particles represented in our spacetime over ordinary numeric fields all having the basic unit* 1 [7]. In particular, the isodual map coincides with charge conjugation at short distances and, therefore, the isodual theory of antimatter correctly describes all the experimental data known to date on antimatter [11].

4 Antiprotons or Pseudoprotons?

A different but valid interpretation of the CERN experiment that would resolve the apparent contradictions proposed iun Ref. [11] is that, in reality, the nuclei of the anti hydrogen atoms are pseudoprotons since the latter have a positive mass and a negative charge and, therefore, can be easily mistaken for antiprotons.

4.1 Laboratory antiprotons could be pseudoprotons?

Antiprotons are produced in laboratory by sending high-energy protons against a matter target. It is possible that this process produces in reality pseudoprotons because the collision of high energy protons against the target does produce neutrons from the collision of protons with the target electron clouds with ensuing finite probability for the subsequent synthesis of pseudoprotons.

A strong argument in favor of the latter view is that laboratory antiprotons colliding with protons give rise to a rain of massive particles [13] instead of annihilating themselves into light,as expected in the event they were true antiprotons.

4.2 Cosmic antiprotons or cosmic pseudoprotons?

The presence of antiprotons among cosmic rays is the most reasonable explanation for the visions of light flashes witnessed by several astronauts during their travels in the upper Earth's atmosphere. These flashes could be caused by the interaction of antiparticles with the photoreceptor cells in the retina of the eye. Photoreceptor cells may be stimulated by photons emitted by particle antiparticle annihilation reactions. So it is extremely likely that there are true antiprotons among the cosmic rays.

However, the first detection of a negative-charged heavy cosmic ray was carried out by Chamberlain and Segre with the Bevatron in 1955 [14]. The crucial point on which we want to bring attention is the possibility that the particle detected, may not have been an antiproton, although it was logically considered such by the experimenters, but it's probably a pseudoproton as it shows the typical scattering of a particle of matter (see Figure 3) rather than annihilation at Dirac.

In fact, true antiprotons are expected to annihilate at contact with atmospheric nuclei, by therefore rendering virtually impossible they reaching us at sea level (the average free path appear to drop below 1 m already at 100 km elevation). The case for high energy pseudoprotons is different because they would have conventional scattering with atmospheric nuclei, rather than annihilation by therefore reaching us at sea level.

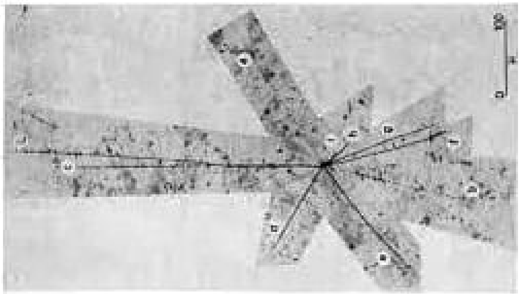

Figure 3: *Historical image of the first detection of an alleged antiproton. The visible scattering suggests that it was actually a matter particle, presumably a pseudoproton*

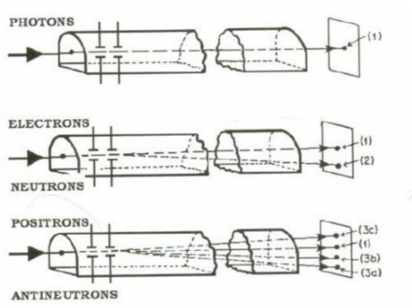

Figure 4: *Santilli's 1994 resolutory test on the gravity of antiparticles [15].*

5 A resolutory antimatter gravity test

A resolutory test on the gravity of antimatter was proposed by Santilli in 1964 [15] (see also the more recent study [16]) and submitted to CERN Directorate by the R. M. Santilli Foundation as well as by experts in antimatter. The proposed test essentially uses a beam of very low-energy positrons in a horizontal high-vacuum supercooled tube. The test was stated to be resolutory by A. P. Mills [17] [18], by V. O. de Haad [19] [20] and by others experts in antimatter because the positrons are unquestionable antiparticles and the point of incidence of positrons on a terminal scintillator can be visually detected and compared with the downward incidence due to gravity of a very low-energy electron beam and a thin beam of photons denoting lack of gravity deflection (see Figure 4).

6 Cosmic antimatter?

The current, widespread cosmological view is that the universe in which we live contains matter in an immensely greater quantity than antimatter and, consequently, the latter would have a marginal role in the processes taking place in the natural world. In fact, it is believed that the Big Bang produced matter and antimatter in equal quantities and that, in view of matter-antimatter annihilation, only a small part of antimatter "survived". Nevertheless, the author believes that the lack of antimatter at cosmological scale is far from having been resolved in a scientific way due to the *new light* emitted by antimatter, called isodual light [21] which is not expected to be visible by available telescopes [7].

6.1 Comments on particles decays

It is widely assumed that, during the Big Bang, positrons are converted into protons, in an attempt to explain the imbalance in favor of matter. However, such an assumption implies the prediction that low energy protons should decay into positrons in a finite period of time (the estimated half-life is of the order of 10^{33} years [22]). However, all attempts to detect proton decay have failed to date. This suggests that hadronic mechanics is a more accurate description of reality since it does not predict proton decay.

It may be useful to check whether the anti-hydrogen atoms produced at CERN do decay because in the event they really are antiparticles they should remain stable until they come into contact with the matter. On the other hand, in the event their nuclei are composed of pseudoprotons, hadronic mechanics foresees their rapid decay.

6.2 Antimatter asteroids

It is possible that there is no conversion between matter and antimatter and in this case it would be possible that matter and antimatter are still present in equal quantities in the universe since antimatter is predicted to emit the new isodual light [21]. Hence, there may be galaxies and celestial bodies in the universe composed entirely of antimatter since that would be the most logical origin of the true antiprotons detected in cosmic rays jointly with antimatter asteroids.

In the event the latter enter the gravitational field of the Sun, they are pushed back outwards according to the isodual theory of antimatter according to a a trajectory that could intersect the orbit of our planet and impact our upper atmosphere under special conditions [23] [24].

Some past events are consistent with the entry of antimatter asteroids into the atmosphere. The famous and enigmatic event of Tunguska that devastated

2150 km^2 of taiga remained is not explained by the simple impact of a celestial body. For example there is no crater. Among the hypotheses about what may have caused the disaster is the encounter with an antimatter asteroid. But even if an isolated case can receive alternative explanations, there are other cases that can be explained by this origin, such as the Chicago fire of 1871, a highly destructive event that triggered a fire that spread very quickly, or the meteorite visible in the skies of Russia in 2013 that did not cause craters.

7 Concluding remarks

In this paper, we have reviewed:

1) positive mass negative charge *antiprotons* according to 20th century particle physics;

2) positive mass negative charge ordinary *partcles* called pseudoprotons accrding to hadronic mechanics;

3) the notion of antiprotons acording to the isodual theory of antimatter;

4) a theorem recently proved by R. M. Santilli essentially implying that, under the spinorial Poincaré symmetry, the 20th century conjugation from particles to antiparticles prohibits partlcle-antiparticle annihilation into light; and

5) consequential doubts on the recent gravity test for the anti-hydrogen atom.

The tentative conclusion of our comparative analysis is that 20th century antiprotons are, most likely, pseudoprotons, by therefore questioning the results of CERN gravity experiment [9] and leaving basically open the gravity of true antiparticles in favor of R. M. Santilli [15] 1964 antigravity test with clearly established antiparticles, such as the positrons (see also [16]- [20]).

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