Where is Anti-Matter?

Shlomo Barak

Where is Anti-Matter?

Shlomo Barak

Taga Innovations   28 Beit Hillel St. Tel Aviv 670017 Israel

Corresponding author: shlomo@tagapro.com

Abstract

We contend that, in the universe, the amount of matter exactly equals the amount of anti-matter. In [1] we show that a quark (anti-quark) is a topologically twisted positron (electron), which is a circulating longitudinal wavepacket of space contraction (dilation) namely positive charge (negative charge). This explains the confinement **of** quarks, and enables us to derive and calculate the masses of the d and u quarks, and the radius of the proton charge. Based on this, we have constructed a model of the electron (positron) and muon (anti-muon), which yields their radii and masses. Our results comply well with experimental data of CODATA 2014.

Mesons, baryons, protons and neutrons are made of quarks and hence are made of electrons and positrons. We prove our contention by showing that neutral atoms are constructed of nothing but an equal number of topologically twisted electrons and positrons.

Key Words: Anti-matter, Quark, Meson, Baryon, Strong force

1   Introduction

Where is Anti-Matter is a long standing issue.

The New Scientist journal [2] summarizes the situation:

> There are two plausible solutions to this mystery.
>
> **First**, there might be some subtle difference in the physics of matter and antimatter that left the early universe with a surplus of matter. While theory predicts that the antimatter world is perfect reflection of our own, experiments have already found suspicious scratches in the mirror. In 1998, CERN experiments showed that one particular exotic particle, the kaon, turned into its antiparticle slightly more often than the reverse happened, creating a tiny imbalance between the two.
>
> **Second** plausible answer to the matter mystery is that annihilation was not total in those first few seconds: somehow, matter and antimatter managed to escape each other's fatal grasp. Somewhere out there, in some mirror region of the cosmos, antimatter is lurking and has coalesced into anti-stars, anti-galaxies and maybe even anti-life.

We**, in contrast,** suggest that quarks are topologically twisted electrons or twisted positrons, see [1] and Section 2 here, and hence, as we show, each and every neutral atom is constructed of nothing but an equal number of topologically twisted electrons and positrons.

The spin of the proton and that of the neutron is $s = ½$ and, so far, it is not clear where it comes from. Our model of the nucleons suggests a possible answer to this "spin crisis".

We also raise the possibility that the strong force, between quarks and between nucleons, is an electromagnetic force. In the case of nucleons, the force, as we show, is a result of a Yukawa pion exchange. Our suggestion is based on Feynman's explanation as to how an exchange of a particle can generate an attractive force [3].

2   Quarks

Fig. (1) shows a trio of d quarks which are sub-tracks of a twisted electron at "rest" [4]. In a translational motion the trio becomes a trio of spirals [4].

In our model of quarks, we assign charge to each sub-track according to the time the electron (positron) spends on this sub-track. We, of course, assume that the tangential velocity is c.
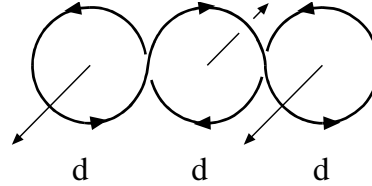

Fig. (1) The Quarks

The electron spends one third of its full revolution time in each of the sub-tracks. We therefore assign it a charge of $1/3 \, Q_0$. The resultant spin of this trio of quarks is $S = \frac{1}{2}$, due to the quarks individual spins, as Fig. (1) shows. Each sub-track has the same spin as that of the electron. We refer to the sub-track of an electron as the quark, d, and to the sub-track of a positron as the anti-quark, $\tilde{d}$.
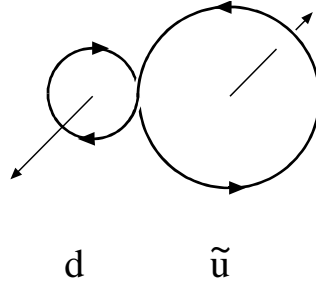
It is still not fully clear why the track is twisted.

It is thus clear that the quarks are **not** independent fundamental particles, and therefore individual quarks do not exist.

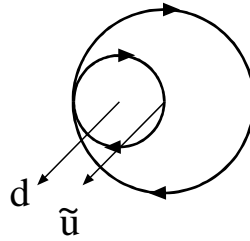Fig. (2) shows again a trio of d quarks, but in this case with $S = 3/2$:

Fig. (2) Quarks

3
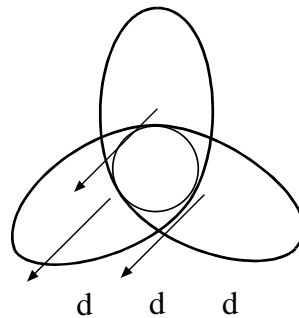
If one twist in Fig. (1) opens up; we get the structures shown in Fig. (3) and Fig. (4), which represent **mesons**.

d   ũ

Fig. (3) Meson S = 0

d
ũ

Fig. (4) Meson S = 1

An electron spends two thirds of its time in the sub-track with the double radius, therefore, we assign it a charge 2/3 Q_0 and refer to it as the quark $\tilde{u}$. For a positron, we refer to it as the quark u.

This simple model of quarks enables us to derive, for the first time, and accurately calculate their masses [1].

3   A Derivation and Calculation of the Quarks Masses

We know the electron mass M_e, see [1]. From this mass, based on our quark model, we derive the masses $M_{\tilde{u}}$ and M_d of the first generation quarks, which are also the masses M_u and $M_{\tilde{d}}$ of their anti-particles. The electron angular momentum $L = M_e R_e^2 \omega$ must be conserved [4]. Hence it is the same L for each of the sub-tracks of the d quark, see Fig. (1). For the ũ quark it is 2L, since the L of its companion d quark points in the opposite direction, see Fig. (3). For

4

the quarks, ω is the same, but R and M are different and conversely related. In a twisted track, which is a set of three quarks, ddd, the radius of each sub-track is $R = \dfrac{1}{3} R_e$.

The length of the electron wavepacket is conserved [4], hence: $2\pi R_e = 2\pi \dfrac{1}{3} R_e \times 3$.

The known relation $L = MR^2\omega$ gives:

$$M_d = \frac{L}{\omega R^2} = \frac{L}{\omega} \frac{1}{\left(\dfrac{1}{3}R_e\right)^2} = 9 \frac{L}{\omega R_e^2} = 9 M_e \tag{1}$$

For a twisted track of a pair of quarks, like $d\tilde{u}$, we get for $\tilde{u}$ a sub-track with $R = \dfrac{2}{3} R_e$, spin 2L and a mass:

$$M_{\tilde{u}} = 2 \frac{9}{4} M_e = 4.5 \, M_e \tag{2}$$

From (1) and (2) and $M_e = 0.51$ MeV we obtain the following results (3) and (4):

$$M_d = 4.5 \ \text{MeV} \tag{3}$$

A recent experimental value [5] is: $M_d = 4.8 +/- 0.5$ MeV.

$$M_{\tilde{u}} = 2.25 \ \text{MeV} \tag{4}$$

A recent experimental value [5] is: $M_{\tilde{u}} = 2.3 +/- 0.8$ MeV.

4   The Mesons

Fig (3) and Fig. (4) show mesons, which are a twisted electron or positron with only one twist. Fig. (5) shows a meson composed of a twisted electron together with a twisted positron.

Overlapped dashed and solid circles represent the electromagnetic bond, of opposite charges, between the relevant quarks. These quarks that create a bond are **not numbered** as originating quarks of a particle, be it a meson, baryon or any other particle.

5

Note that in particle diagrams a **solid line** indicates an electron, and a **dashed line** a positron.

It seems that this electromagnetic bond, of opposite charges, between the relevant quarks is the known "strong force". But, in this paper, we do not provide any formal proof that this is indeed the case.
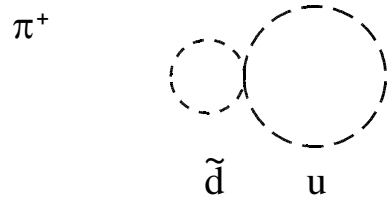
This subject is also discussed in Sections 8 and 9.
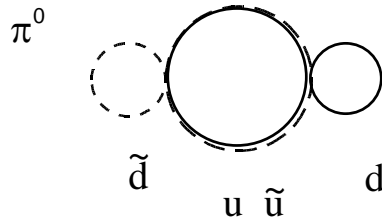
4.1 The Π Family with Spin S=0

A single twisted track has a very short life time, as can be seen for the Π^+ and Π^- mesons.

For the Π^0 meson, the life time is much shorter due to annihilation.

$$\pi^+ \to e^+ + \nu_e \quad 2.6 \cdot 10^{-8} \ \text{sec}$$
$$\pi^0 \to 2\gamma \quad\quad 0.8 \cdot 10^{-16} \ \text{sec}$$

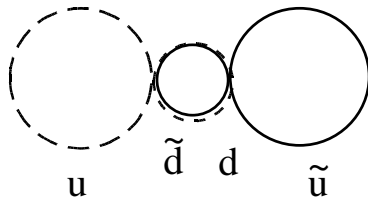π^+
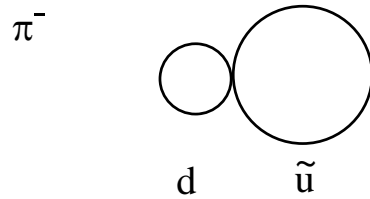
$\tilde{d}$ u

$\pi^+ = u\tilde{d}$

π^0

$\tilde{d}$ u $\tilde{u}$ d

The coupling is due to the opposite charges of $\tilde{u}$ and u.

$\pi^0 = \dfrac{1}{\sqrt{2}}\left(u\tilde{u} - d\tilde{d}\right)$

u $\tilde{d}$ d $\tilde{u}$

The coupling due to the opposite charges of $\tilde{d}$ and d.

The current paradigm does not take the coupling quarks into consideration, nor do they appear in the notation.

π^-

d $\tilde{u}$

$\pi^- = \tilde{u}d$

Fig. (5) The Π Mesons

A possible decay is:
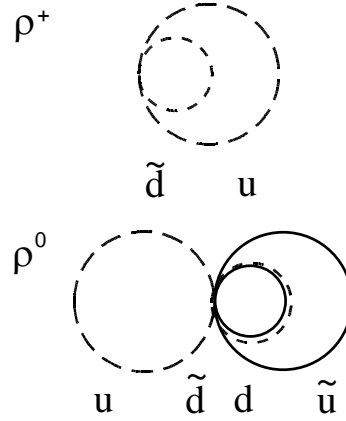
$$\pi^0 \; \rightarrow \; \gamma \; + \; e^+ \; + \; e^-$$ and even:
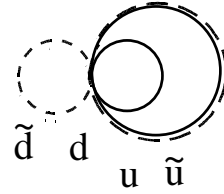
$$\pi^0 \rightarrow 2e^+ + 2e^-$$

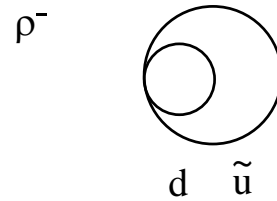See the table in [6].

7

4.2 The ρ Family with Spin S=1

$\rho^+ = \tilde{d}u$

ρ^+

$\tilde{d} \quad u$

ρ^0

$u \quad \tilde{d} \quad d \quad \tilde{u}$

$\rho^0 = \dfrac{1}{\sqrt{2}}\left(\tilde{u}u - \tilde{d}d\right)$

$\tilde{d} \quad d$

$u \quad \tilde{u}$

ρ^-

$d \quad \tilde{u}$

$\rho^- = \tilde{u}d$

Fig. (6) The ρ Mesons

From the reaction $\pi^+ \to e^+ + \nu_e$ and similar reactions, it seems as if a neutrino is incorporated in the π^+ construction (as in similar particles). We speculate that this neutrino causes the electron (positron) to change from one sub-track to another, as if it circulates around the twist.
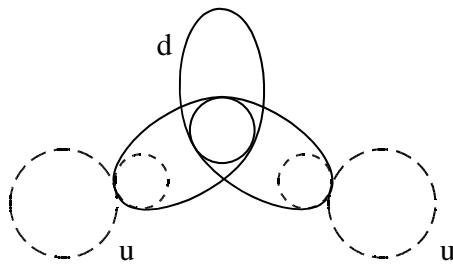
5 Baryons

The **baryons** are composed of three quarks. As an example, consider the family, with the members: $\Delta^{++} \Delta^+ \Delta^0 \Delta^-$, that have the spin S = 3/2.
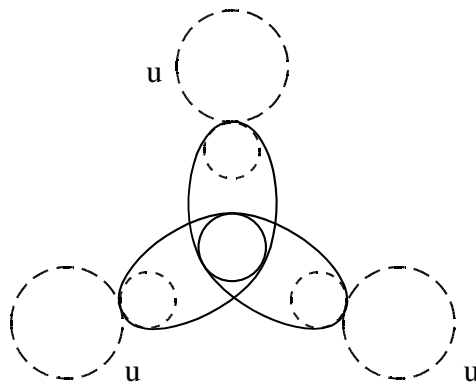
8
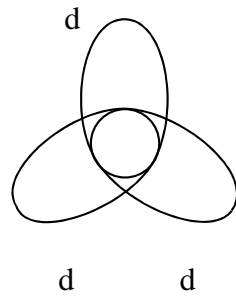
$$Q = -1$$

$$\Delta^-$$

$$S = 3/2$$

ddd
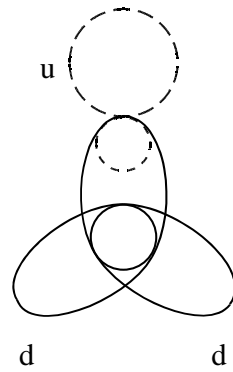
$$Q = 0$$

$$\Delta^0$$

$$S = 3/2$$

udd

$$Q = +1$$

$$\Delta^+$$

$$S = 3/2$$

uud

$$Q = +2$$

$$\Delta^{++}$$

$$S = 3/2$$

uuu

Fig. (7) The Baryons Δ

6   On the Neutron and the Proton

We model the nucleons as kind of a motor with a neutral stator cage, which contains a large number of quarks, and a rotor, which contains only a few valance quarks, which determine the charge of the nucleon.

Our rotor models of the proton and neutron enable us to derive and calculate the "proton charge radius" [1]. Our result is well within the error range of the experimental result, see [1].

6.1   The Rotor Model

The **neutron** rotor, see the simplistic model in Fig. (8), is composed of an electron and a positron in the form of three **valence quarks,** which are a pair of d quarks and one u quark. The mass of this rotor is $M_{neutron\ rotor} \sim 2M_d + 1M_u \sim 11.25$Mev.

Q = 0

N

S = 1/2
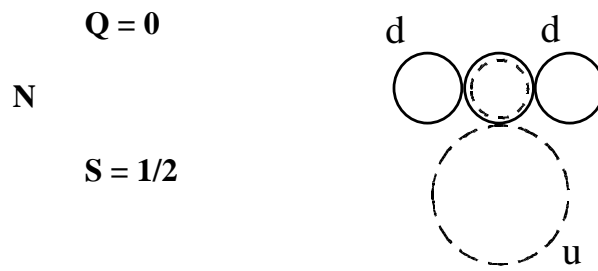
Fig. (8) The Neutron Rotor

Fig. (9) shows the spatial charge distribution, known from scattering experiments. This is compatible with Fig. (8), and with the fact that, despite having no charge, the neutron has a magnetic moment opposite to its spin direction.
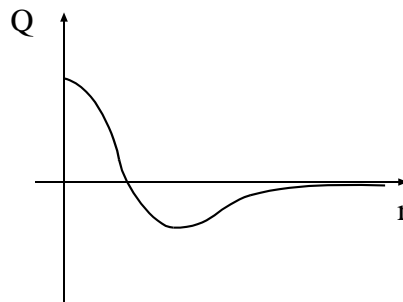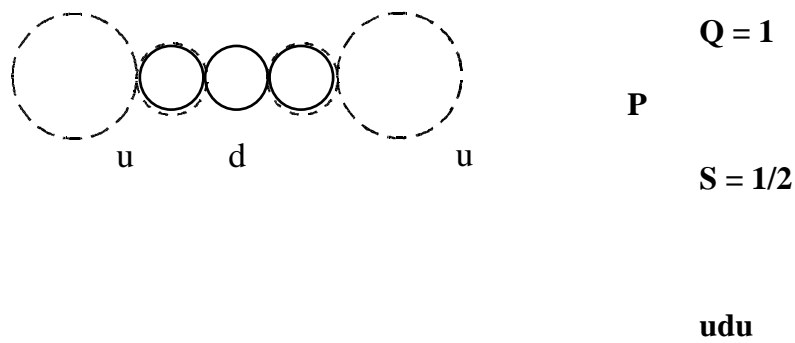
Fig. (9) Neutron Charge Distribution

10

The **proton** rotor, see the simplistic model in Fig. (10), is composed of one electron and two positrons in the form of three valence quarks, u, u, d. The charge distribution, shown in Fig. (11), is compatible with the proposed model.
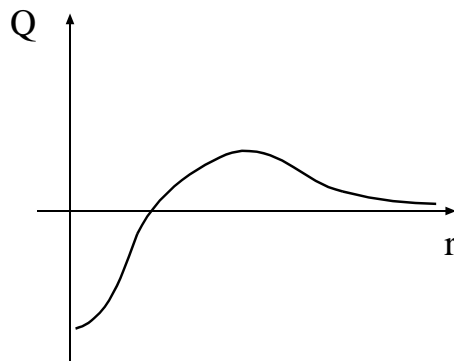
The mass of this rotor is $M_{proton\ rotor} \sim 1M_d + 2M_u \sim 9$ Mev.

Hence $M_{neutron\ rotor} - M_{proton\ rotor} \sim 2.25$ Mev, whereas $M_{neutron} - M_{proton} = 1.29$ Mev.

We, thus, arrive at a heavier neutron than the proton, which complies with experimental data.
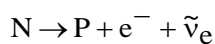

Q = 1

P

S = 1/2

udu

u   d   u

Fig. (10) The Proton Rotor

Fig. (11) Proton Charge Distribution

The disintegration reaction of a free neutron, with a life time of ~10 minutes, is:

$$N \rightarrow P + e^- + \tilde{\nu}_e$$

And now we know **where the electron comes from**.

6.2   The Stator Model

If the stator is composed of three (3) twisted positrons and three (3) twisted electrons, the total number of quarks in the stator is 3x3 + 3x3 = 18, see Fig. (12).
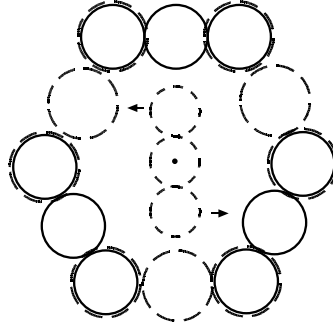
Fig. (12) The Stator Structure

Note that the total number of quarks that construct the stator can also be 3x4 + 3x4 = 24 or 3x5 + 3x5 = 30.

The spin contribution, of the stator type cage, to the total spin of the nucleon, might be zero, since in this case the magnetic interaction lowers the cage energy. The spin of the nucleon is thus the spin of its "rotor" which is S = ½ , as Fig. (8) and Fig. (10) show. This issue, of where the spin of the nucleon comes from, is known as the "proton spin crisis".

Based on our understanding of what are quarks, and how the building blocks of matter are constructed, we arrive at the conclusion in Section 7.

7   In the Universe the Number of Electrons Equals the Number of Positrons

A Neutron is made of an equal number of electrons and positions (twisted topologically to become quarks). A Proton is made of electrons and positrons, as is the Neutron, but has one electron (three quarks) less. An atom is made of an equal number of protons and electrons

Hence, an Atom is made of an equal number of positrons and electrons (as should be evident from the pair production process).

12

8 Remarks on the Strong Force

8.1 The Force between Quarks

Figures in this paper, which represent mesons and baryons, show couples of sub-tracks of an electron and a positron, which construct a bond. This indicates that the holding force of these structures, the force between quarks, is probably electromagnetic.

8.2 The Force between a Proton and a Neutron, and between Two Protons

Fig. (14) shows how an electric field between three pairs of charges, of the neutron rotor and proton rotor, create an attracting force that binds them. This is **an attractive force only,** and **spin independent** (ignoring weak magnetic interactions) as is the **strong force**.

Note that when the neutron and proton are far apart, the inner distribution of charge is blurred and the effective field decays rapidly, which explains the short range. Note also that according to our model of the electron (positron) [4] the radii r_e and R_e of the electron (positron) is reduced, at high velocities, by the relativistic factor γ, and hence close to their surface the field is stronger.
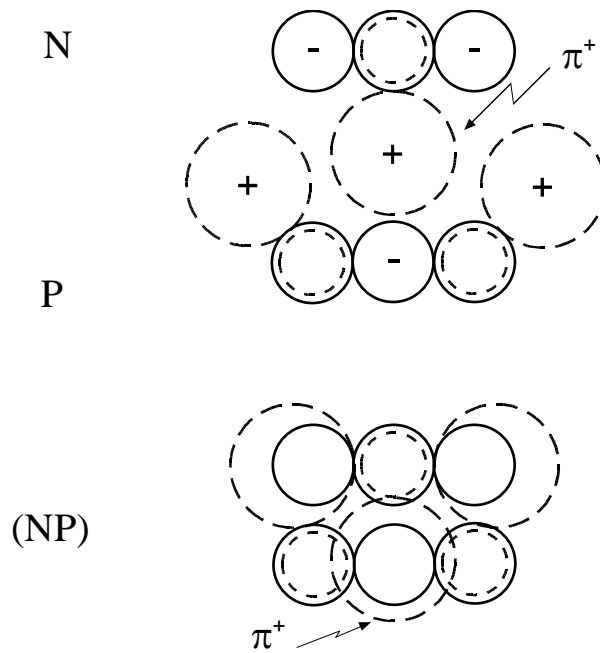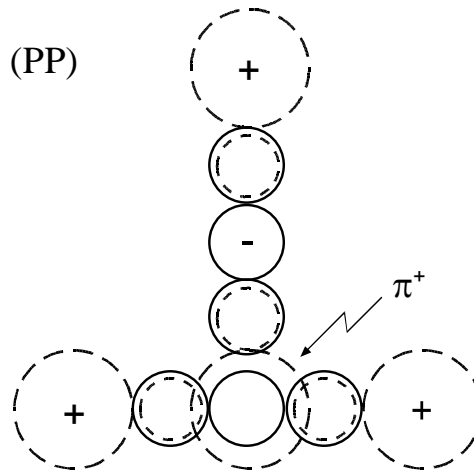

Fig. (14) The (NP) Strong Force

We now consider the force between two protons.

Fig. (15) The (PP) Strong Force

Here, as well, there is an attractive force at short range, but as the distance increases this force becomes repulsive since the particles have the same charge sign.

We consider the binding force, for both the neutron and proton, and proton and proton cases, to be the result of a Π^+ meson exchange. This meson is merely a twisted positron, and its movement back and forth, is the "exchange". This is the Yukawa theory of meson exchange, as the source of the Strong Force.

Feynman [3] explains how an exchange of a particle can generate an attractive force. In Chapter 10-1, there is a description of the force between two protons of the ion H_2^+. This force is the result of the electron exchange between the protons. The reaction is:

$$(H, P) \underset{\leftarrow}{\overset{\rightarrow}{}} (P, H)$$
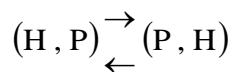
The attractive force comes from the reduced energy of the system due to the possibility of the electron jumping from one proton to the other. In such a jump the system changes from the configuration (hydrogen atom, proton) to the configuration (proton, hydrogen atom), or switches back.

14

In Chapter 10-2, Feynman shows how the force between a proton and a neutron can be explained by the exchange of a Π^+ meson. Feynman concludes:

> Now we might ask the following question: could it be that forces between other kinds of particles have an analogous origin? What about, for example, the nuclear force between a neutron and a proton, or between two protons? In an attempt to explain the nature of nuclear forces, Yukawa proposed that the force between two nucleons is due to a similar exchange effect - only, in this case, due to the virtual exchange, not of an electron, but of a new particle, which he called a meson.

The exchange in this case is:

$$P^+ \underset{\leftarrow}{\overset{\rightarrow}{}} N^0 + \Pi^+$$
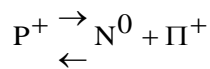
The Π^+ meson is emitted from the proton to convert it into a neutron, and by combining with the other neutron to convert it into a proton, and vice versa.

The Standard Model, however, considers meson exchange as a complex effect of color interactions, and not a primary cause.

Based on the above we suggest to reassess the idea of a Strong Force and to explore again the possibility that it is an electromagnetic force.

9   Summary

So far, there is no evidence for the existence of stars and galaxies made of anti-matter (anti-hydrogen was first created in the laboratory in 1997).

The question: Why, at large, is the universe composed of matter only?

Now becomes: Why we do not see in nature atoms made of anti-protons and positrons?

In the GDM there is no charge conjugation. A negative charged nucleus curves space around it negatively. This might be the reason for instability in the orbital motion of a positron around it (hence anti-hydrogen created in the laboratory should have a limited lifetime).

References

[1]   S. Barak: On the Essence of Electric Charge, Part 2: How Charge Curves Space

hal-01402667 (2016)

[2]   A. Gefter: Antimatter mysteries, New Scientist 27April 2009

[3]   R. Feynman: Lectures on Physics III Addison-Wesley (1965), Chapters 3-4 and 10.

[4]   S. Barak: On the Essence of Gravitation and Inertia A**,** Part 1: Inertia and Free Fall of

an Elementary Particle hal-01404143 (2016)

[5]   K.A. Olive et al. (Particle Data Group): Review of Particle, Physics Chinese Physics C

38 (9) 090001. (2014)

[6]   Y. Ne'eman, and Y. Kirsh: Particle Hunters, Cambridge (1986)

16