Possibilities for the detection of pseudo-protons

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Abstract

Recently, R. M. Santilli [1] suggested the possible existence of a new particle under the name of *pseudo-proton* originating from the synthesis of the proton with two sequential electrons in singlet coupling, thus being negatively charged but having no antimatter content. In this paper, we study the experimental verification of the pseudo-proton as also suggested in a subsequent paper by Santilli et al. [2] on the laboratory synthesis of the neutron from a proton and an electron according to hadronic mechanics [3], which synthesis emerges as an intermediate step prior to that of the pseudo-proton [1, 2]. The experimental verification of Santilli pseudo-proton is important because some of its properties (specifically its mass and charge) are similar to those of the anti-proton. Therefore, it is possible that particles currently considered to be anti-protons are in reality pseudo-protons. It should be noted that the pseudo-proton constituents are ordinary matter and not anti-matter and that the latter can easily capture a positron by forming a *pseudo-hydrogen atom* which is however, essentially formed of matter [1, 2]. Consequently, the ongoing experiments with anti-protons and related anti-Hydrogen atoms for the measurement of an anti-gravity effect would yield a full gravitational attraction in the event the claimed anti-protons are in effect pseudo-protons. In view of the paramount importance of anti-gravity for the advancement of scientific knowledge, it should be made absolutely certain that there is no shadow of a doubt on the type of particles used in gravity experiments.

1 Introduction

Recently, Santilli et al. called for the experimental verification of the so-called *pseudo-proton* [2]. The pseudo-proton is a particle predicted by Santilli [1] based on the hadronic mechanics he has derived since the 1970's (for an overview see [4]). The experimental verification is important because some of the properties of the pseudo-proton (specifically its mass and charge) are similar to that of the anti-proton and hence it is possible that particles that are claimed to be anti-protons are in reality pseudo-protons. This can yield doubts on claims derived from experiments with anti-protons. It should be noted that the pseudo-proton constitutes are ordinary matter and not anti-matter. Consequently, results derived from experiments with anti-protons and related anti-Hydrogen atoms for the measurement of an anti-gravity effect are predicted by hadronic mechanics to yield a full gravitational attraction if instead of anti-protons in reality pseudo-protons are used. In view of the paramount importance of an effect of anti-gravity for the advancement of science specifically and human kind in general it should be made absolutely certain that there is no shadow of a doubt on the type of particles used in these experiments.

2 Pseudo-proton

Essential the bases for the prediction of the pseudo-proton is the natural assumption that mathematical point particles do not exist in nature. In real life particles will have a finite size and there is a finite probability that particles will overlap. When particles overlap the intrinsic properties of the particles can change and are recovered when they are released

Name	Sym	Description	Charge[1]
Electron	e^-	Elementary particle	-1
Proton	p^+	Elementary particle	+1
Neutron	n	Elementary particle (standard model) or particle composed of proton and electron (Santilli)	0
Hydrogen atom	H	Proton + orbit electron	0
Hydrogen ion	H_2^+	Ionized hydrogen molecule	+1
Pseudo-proton	$\tilde{p}^-$	Synthesis of neutron and electron (Santilli)	-1
Hydride ion	H^-	Hydrogen atom with 2[nd] electron in orbit	-1
Anti-proton	p^-	Anti particle of proton	-1

Sym	Mass 10^{-27} kg	amu	MeV	Magnetic moment 10^{-26} J/T
e^-	0.00091	0.00055	0.511	928.477
p^+	1.67262	1.00728	938.272	1.410608
n	1.67493	1.00866	939.565	0.966237
H	1.67353	1.00783	938.783	
H_2^+	3.34615	2.01511	1877.055	
$\tilde{p}^-$	$1.672 \ldots 1.677$	$1.0069 \ldots 1.0099$	$937 \ldots 941$	≈ 1
H^-	1.67444	1.00838	939.294	
p^-	1.67262	1.00728	938.272	1.410608

Table 1: Properties for several particles. For the pseudo-proton the range in which the property is expected is indicated. [1] in units of 1.602177×10^{-19} C

again in vacuum. A more elaborate overview is given in [3]. Hence, when, somehow a hydrogen atom consisting of a proton, p^+ and an electron, e^- is sufficiently compressed (so that its radius is of the order of 1 fm) they can form a neutron via the hadronic reaction

$$p^+ + e^- + a^o \rightarrow n^o$$

The particle a^o is referred to as *etherino* to reflect the interactions of the compressed proton and electron with the vacuum field.

The properties of proton, electron and neutron are well known and a summary is given in table 1. The rest mass of the neutron, n^o is 0.782 MeV larger than the sum of the rest energies of both proton and electron, so that this reaction can only occur in sufficiently strong fields, for instance in the inside of stars or in the arc of a very strong discharge [2]. The magnetic moment of the electron is much larger than that of the proton or neutron, hence during the above reaction also magnetic moment is exchanged with the etherino.

Based on hadronic mechanics, Santilli [1] predicts the repetition of above reaction forming the neutron compressing a second electron into the neutron according to

$$n^o + e^- \rightarrow \tilde{p}^- + a^o$$

forming the pseudo-proton. The pseudo-proton will have a spin 1/2, a negative unit charge, essentially the same charge radius and rest energy of the proton, and a mean life (when isolated) of the order of that of the neutron. Note that the particle is constructed from matter particles so that it is itself also a matter particle. The properties of the pseudo-proton are summarized in table 1. It is expected that the magnetic moment is of the same order as that of the proton and neutron as the charge radius and rest energy are also of the same order. It will be determined by the precise shape and velocity of the constituting charge distribution. Again, the magnetic moment of the electron is much larger than that of the neutron or pseudo proton so that during the above compression also magnetic moment is exchanged with the etherino. The charge and mass of the pseudo-proton will be similar to that of the anti-proton or hydride ion so in general the particles can easily be mixed up.

Both compression reactions can be combined so that the interaction with the etherino does not become explicitly visible according to the synthesis of the proton and an electron pair in singlet coupling (as normally existing in atomic orbitals or between the spins of the two electrons of the hydrogen molecule)

$$p^+ + (e^-_\uparrow, e^-_\downarrow)_{J=0} \to \tilde{p}^-$$

The pseudo-proton can quickly capture a proton to form a kind of pseudo hydrogen atom, $\tilde{p}p$ where the proton and pseudo-proton circle around each other like in a 2-body system. Hence, one can imagine that in a strong electrical discharge in hydrogen gas the following reaction might occur

$$p^+ + H_2 \to \tilde{p}^- + 2p^+ \to \tilde{p}p + p^+$$

One can see that the number of protons before and after this reaction is the same and hence it will have no impact on the discharge properties in the hydrogen gas itself as long as the pseudo hydrogen density is much smaller than the molecular hydrogen density. This explains why nor pseudo hydrogen nor pseudo protons have been detected in hydrogen discharges up to now.

From the above it is clear that it is expected that neutrons and pseudo-proton will be produced in a sufficiently strong discharge in hydrogen gas as has been performed by Santilli [2]. That neutrons can be produced in hydrogen gas is well known and experimentally verified by many experiments [5],[6],[7],[8] and developed for industrial applications [9]. In general it is assumed that neutrons are produced as a by-product of the fusion of two protons, deuterons, tritons or their combinations resulting in the production of neutrons with high kinetic energies, so-called fast neutrons. The discharge acts as a means to accelerate the hydrogen ions to such high energies that the Coulomb repulsion can be over won so that the fusion reaction can occur. However, the energy needed to overcome the Coulomb repulsion so that two ions can come as close to each other as several femtometer (the size of the proton, or range of the strong force) is of the order of 1.4 MeV which is much larger than the kinetic energy available. As a recourse for this problem it is assumed that quantum tunneling exists. In that case the ion nuclei need to overlap and the tunneling probability will be large enough to give a reasonable yield. In such a case also the possibility for the above mentioned reactions exists and neutron or pseudo-proton production can occur.

3 Detection possibilities

In the above it has been made clear that it is possible that neutrons, pseudo protons and pseudo hydrogen atoms can be created in a hydrogen gas discharge. In the following it is discussed how these particle might be detected.

3.1 Neutrons

Neutrons are neutral and have limited interaction with most materials. One should differentiate between fast neutrons that are created during fusion of fission reactions and thermal neutrons that are created by the Santilli synthesis or by moderation (i.e. slowing down) of fast neutrons. The kinetic energy of fast neutrons is of the order of MeV while the kinetic energy of thermal neutrons is of the order of several tens of meV. When fast neutrons have collisions with cores of the material constituting atoms or molecules, part of their energy will be released to the core and the neutrons energy decreases. After many collisions the fast neutron is slowed down to a speed comparable to the speed of the atoms or molecules of the material. At room temperature this corresponds to an average kinetic energy of 25 meV. Only after the neutrons are slowed down their energy is low enough to be absorbed during the interaction with the nucleus.

Thermal neutrons are detected by a nuclear absorption process inside the detector. The nuclear absorption creates a charged particle pair that is detected by means of an appropriate mechanism. This can be an avalanche detector in case of a gas-filled detector like a ^{3}He or BF_3 detector. This can also be a photo-multiplier in case of a scintillator detector like a LiF crystal or Li-glass. The key point is that one can discriminate between fast and slow neutrons by means of a time-of-flight technique or be means of an appropriate thermal neutron absorbing material or fast neutron moderator.

The time-of-flight technique is based on the measurement of the arrival time of the neutron in the detector after it has been created. During this time the neutron has to travel the known distance from source to detector. As the travel time and travel distance are measured, the velocity of the neutron can be determined. Slow neutrons will travel with speeds of the order of 1 km/s while fast neutrons will travel with speed of at least 10000 km/s. When the source is surrounded by a thermal neutron absorber (like for instance Cadmium, Gadolinium, Lithium or Boron) no thermal neutrons can escape the source. Then any excess neutron detected by the detector after turning on the source is due to the moderation of fast neutrons created the source. When further, the source is also surrounded by a fast neutron moderator the number of excess neutrons in the detector will increase as more neutrons will be moderated. With this scheme it is possible to determine a) whether or not neutrons are created and b) whether fast neutrons or slow neutrons are created and c) when slow neutrons are created a indication of their energy distribution can be measured. The cost for a time-of-flight detection including the needed materials for absorption and moderation is estimated between 20 and 50 kUSD.

3.2 Pseudo-protons

Pseudo protons are negatively charged particle with a mass comparable with that of the hydrogen atom or proton. It can be discriminated from an electron in a mass spectrometer due to the large mass difference and from a proton because of its reversed charge. In a hydrogen discharge also hydride ions will be produced [10],[11]. The mass and charge of the hydride ion is comparable to that of the pseudo-proton. Hence, it is possible that already in experiments that have been performed in the past the pseudo-proton was detected, but interpreted as hydride ion. The mass difference between the hydride ion and the pseudo-proton is expected to be very small of the order of 0.1 % (see table 1). Hence, when using a mass spectrometer to determine what kind of particle is detected, the accuracy should be high enough to measure this small difference. An additional test might be done by measuring the magnetic moment of the detected negatively charged particle by means of an appropriate device as for example a penning trap. Mass spectrometers can be bought from the shelve, but one with an accuracy of 0.1 % for a mass of approximately 1 amu is not readily available and must be developed. In such a case it can be combined with the magnetic moment measurements. Estimated costs for such a development are between 500 kUSD and 1 MUSD.

3.3 Pseudo hydrogen atom

Pseudo hydrogen atoms can be created during the discharge process. These atoms have energy levels determined by the energy levels of a two body system. The reduced mass of this system is about half of that of the hydrogen atom, resulting in energy levels of half of that of the hydrogen atom. Hence, when light spectrometry is done on these atoms line series with half of the frequency of that of atomic hydrogen will arise. The Balmer series for this atom (transitions form level $n > 2$ to 2) is shown in table 2. The intensity of the spectral lines depends on the number density of the pseudo hydrogen atoms and hence will depend strongly on the discharge parameters and the pressure of the hydrogen

Transition of n	$3 > 2$	$4 > 2$	$5 > 2$	$6 > 2$	$7 > 2$	$8 > 2$	$9 > 2$	$\infty > 2$
Name	H-α	H-β	H-γ	H-δ	H-ϵ	H-ζ	H-η	
Hydrogen	656.3	486.1	434.1	410.2	397.0	388.9	383.5	364.6
Pseudo hydrogen	1313	972	868	820	794	778	767	729

Table 2: The wavelength in nm of the Balmer series for hydrogen atom and pseudo hydrogen atom.

gas. If these Balmer series can be found in the spectra of hydrogen gas discharges with sufficient accuracy, then also the reduced mass of the pseudo hydrogen atom and hence the mass of the pseudo-proton can be measured. Estimated costs of such an experiment are between 10 and 20 kUSD.

4 Conclusions

Following Santilli's lifelong mathematical and theoretical studies on the synthesis of the neutron from a proton and an electron [3] and its recent laboratory synthesis [2], it is possible to perform measurements for the experimental verification of the existence of Santilli pseudo-proton via a strong electric discharge in a hydrogen gas as predicted by hadronic mechanics. As the charge and mass of the pseudo-proton is comparable to the hydride ion it is possible that in previous experiments the pseudo-proton has already been measured but not identified. For the identification, sufficiently accurate measurements of its mass are needed (accuracy at least 0.1 %) or a measurement of the magnetic moment by means of a penning trap should be performed. It is also possible that another kind of pseudo-hydrogen atom is formed when a pseudo-proton and proton are in orbit around each other. When a sufficient density of pseudo hydrogen is realized, it is possible to measure its Balmer series, which is predicted to have approximately twice as large wavelength with respect to similar transitions constituting the Balmer series of hydrogen. When this property can be measured with high accuracy, it can be used to determine the reduced mass of the pseudo-hydrogen atom and hence the mass of the pseudo-proton.

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