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The Disappearance-Appearance Phenomenon (DAP) A Natural Law of the Electronic Transitions in the Atoms

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Abstract

In this research paper we predicted the existence of a quantum phenomenon never discovered since the beginning of quantum mechanics, we called it the Disappearance-Appearance Phenomenon (**DAP**), it is a natural law of the electronic transitions in atoms without quantum jumps.

Keywords: *Quantum jump, DAP, Quantum mechanics, Quantum physics, Electronic transitions, Atomic physics, Antimatter.*

1. Introduction

Since the introduction of the *Bohr* model in 1913 [1], it has become evident that the binding energies of electrons in atoms take discrete values. And when the particle-wave duality [2] been confirmed experimentally, the quantum mechanics [3] developpement has began by the formulation of the wave function [4] concept to represent the particle state, and the introduction of the *Schrodinger*'s equation [5] to describing the physical states of the systems. In order to make the quantum mechanics in compliance with the special relativity theory [6], there are other equations were appeared as the *Klein-Gordon* equation [7] which is specific to describing the quantum states of bosons[1], and the *Dirac* equation [8] for describing the quantum states of fermions[2]. Quantum mechanics describes perfectly the electron motion in the hydrogen atom by using the *Schrödinger's* equation in the spherical coordinates (r, θ, ϕ). Where the electron can performing the rotational movements following the directions θ and ϕ, but the electron can moving only via the quantum jumps[9] following the radial direction r during the atomic electronic transitions[10], it cannot moving continuously from an atomic energy level to another. Instead, the electron disappears in an initial atomic energy level then appears in a final atomic energy level in the same and without crossing the spatial distance between the two levels. So, what is happening exactly in reality ? Are there electron quantum jumps in the atoms ? Is the atomic electronic transition done really in a null time via the quantum jump or there is something else that needs to be discovered ?

To answer these questions, we are going to follow a physical reasoning based on the problematic quantum jump, for predicting the existence of a natural law of the atomic electronic transitions. After that we will draft this law and we will finish our work by a conclusion.

2. Physical Reasoning

According to the *Bohr* model[1], or the quantum mechanics [3] the binding energy and the radius of the electron in the hydrogen atom have the following formulas:

$$E = 13.6/n^2 \quad (1)$$

$$r = r_B n^2 \quad (2)$$

Such as n is an integer number, is called the principal quantum number, r_B *is t*he *Bohr* radius which has the value *0.53 Å,* and the energy E is calculated by the electron-volt unit *(ev).*

It is evident that the binding energy and the radius of the electron in the atom have discrete values, which means that their values are quantified or quantized[3]. And for this reason there are electronic transitions in the atoms with quantum jumps [9]. However, the quantum jump event of the electron in the atom is not comprehensible, and moreover, the electronic transitions mechanism in the atoms via these electron quantum jumps is not in compliance also with *Leibniz* law of continuity [11] which is based on the idea : " *Nature never makes jumps* ". Everything is evaluated continuously not by miraculous jumps. For this reason we must therefore look at the cause behind the disappearance and the appearance of the electron in the atom during an atomic electronic transition.

Take a hydrogen atom free in the vacuum and is existing in its ground state (the correspondent energy level is ($n = 1$) and imagine that the electron of the atom has received a photon with a sufficient energy to have a transition towards the first excited state (the correspondent energy level is $n = 2$).

According to the *Dirac* equation [7], the motion of à fermion with the spin 1/2 cannot be described independently on its anti-fermion. So, because the electron and the proton are fermions, it is this mysterious connection between the matter and its antimatter [12] that we will base our reasoning for discovering what is happening exactly during the electronic transitions in the atoms.

[1] A boson is a particle with integer spin.
[2] A fermion is a particle with a half-integer spin.

[3] A physical magnitude is quantified or quantized when it can only take well determined values or discrete values.

We know now that the electron has an instantaneous connection between its antiparticle which is the positron. In the atom, when the electron wants to do a transition for example, from the fundamental energy level *(n = 1)* towards the first excited energy level (*n = 2*), it switches its real quantum state with the virtual quantum state of its antiparticle, the positron. At the fundamental level, the electron disappears by taking the virtual state of the positron which appears by taking the real state of the electron. The disappearance temporal duration of the electron equals to the appearance temporal duration of the positron which is determined by the following inequality time-energy of the *Heisenberg* uncertainty principle [13]:

$$\Delta t \times \Delta E \geq h/4\pi \quad (3)$$

such as $E = 10.2\ ev$ is the energy difference between the two atomic energy levels and $h = 6.62 \times 10^{-34}\ j.s$ is Planck's constant.

It is the positron which is going to cross effectively the special distance between the two atomic energy levels with the kinetic energy mean value $<E> = (1/2)m < v^2 > = \Delta E$. So the velocity mean value of the positron will equal $1.05 \times 10^6 m.s^{-1}$. And after the temporal duration of the positron radial motion $\Delta t \geq 3.2 \times 10^{-13} s$, the electron and the positron will switch again their quantum states at the final energy level where each of them will come back to its original quantum state. So, through the atomic transition if the electron existence probability is null in the space between the two energy levels, that is because the positron existence probability is equal to the unity through the temporal duration of the atomic transition.

The electron-positron united pair has a continuous value of the binding energy in the atom. The binding energy values not taken by the electron are taken by the positron.

However, we remark that the hydrogen atom does not remain neutral through the electronic transition, because the positron and the corresponding proton at the nucleus have positive electric charge. So the hydrogen electric charge becomes equal to twice the proton electric charge. The solution of this problem comes from the fact that even the proton at the nucleus switches its real quantum state with the virtual quantum state of the anti-proton which is in a virtual state before the electronic transition. So to have an atomic electronic transition, the electron and the proton at the nucleus disappear and appear simultaneously and the same thing happens for the positron and the antiproton.

Now we come back to the inequality number (3) of the *Heisenberg* uncertainty principle.

The least action principle[14] implies that when the positron is in motion from a position at an initial atomic energy level to a position at a final energy level, it will follow the straight trajectory which minimizes the time in order to minimize the action $S = \Delta t \times \Delta E$. The minimum value of the action is $S_m = \hbar/2 = h/4\pi$. So, the existence time of the positron through the atomic transition is given by the following formula:

$$\Delta t_m = \hbar /2\Delta E \quad (4)$$

In particular, we see that the hydrogen atom becomes an antihydrogen atom during an atomic electronic transition from an initial atomic energy level to a final atomic energy level.

3. Law of the Atomic Electronic Transitions (LAET)

This natural law who works to realizing the atomic transitions in the atoms without these miraculous leaps known by the quantum jumps [9], we call it the Disappearance-Appearance Phenomenon (DAP), we going to draft it as follows:

" The atomic electronic transition from an initial energy level to a final energy level do not happen simultaneously via the electron quantum jump, it takes a small time its magnitude order is 10^{-13} and it is equal to the quantity $\hbar/2\Delta E$ where ΔE is the energy difference between the two atomic energy levels. During the transition, the electron and a proton at the nucleus commutate their real states respectively by the virtual states of their antiparticles the positron and the antiproton, and this process of switching states is done simultaneously in the beginning and the end of the atomic transition. The transition is done through a simultaneous disappearance-appearance of an electron and a proton in the nucleus, and a corresponding simultaneous appearance-disappearance of a positron and an antiproton in the nucleus. It is the positron which effectively the spatial distance between the two atomic energy levels during its existence time which equals the transition temporal duration. Instead, the radial motion in the atom is realized by the positron, and the binding energy of the electron-positron united pair in the atom, takes continuous values ".

4. Proposed Experiment

We consider a hydrogen atom is in the excitation phase from the ground state to the first excited state, So, we will have an atomic electronic transition from the fundamental energy level (n=1) to the first excited level (n=2). The DAP law implies that the electron-proton pair will be replaced simultaneously by the positron-antiproton pair, and it is the positron who will effectively cross the spacial distance between the two atomic energy levels, with a minimal value of the action $S_m = \hbar/2 = h/2\pi$, correspondent the existence time $\Delta t_m = \hbar/2\Delta E$. where $h = 6.62 \times 10^{-34}$ j.s is the Planck's constant, and ΔE is the energy difference between the two atomic energy levels.

In our case we have $\Delta E = 10.2$ ev, $\Delta t_m = 3.2 \times 10^{-13}$s and a mean value of the positron quadratic velocity which is equal to $1.05 \times 10^6 m.s^{-1}$. In particular, we have seen in the last paragraph that the hydrogen atom becomes an antihydrogen atom through the transition period Δt where the positron velocity $v_p(t)$ is decreasing and the De Broglie[15] wavelength of the positron is a function of the time, is increasing the formula $\lambda_p(t) = h/m_p v_p(t)$ but the quantity $\lambda_p(t)v_p(t)$ is constant. In our case of the hydrogen atom excitation phase, we consider the following **model**:

" For an electronic transition in the hydrogen atom, we can visualizing the appeared antihydrogen atom as a sphere with variable radius, its center occupied by the

appeared antiproton which is surrounded by the antimatter surface or the could of the appeared positron through its existence time Δt_m. *. This sphere inflates and shrinks respectively through the excitation and dis-excitation cases of the hydrogen atom, with the positron velocity between the two energy levels ".*

the *De Broglie*[15] wavelengths of an electron and its antiparticle the positron are linked in the following equation:

$$\lambda e = (v_p/v_e)\, \lambda p \qquad (5)$$

We consider a non relativistic electron characterized by *a velocity magnitude order less than the magnitude order* 10^6 *of the positron quadratic velocity mean value during its radial motion through the transition temporal period* Δt_m .

The idea for confirming the existence of the DAP law, is the realization of an elastic scattering experiment of this electron by a hydrogen atom in its transition phase from the ground state to the first excited state. And the condition *is* **the synchronization of the scattering time with the positron existence time** 3.2×10^{-13}**s which is equal to the temporal period of the transition phase of the hydrogen atom between the ground state and the first excited state**. In fact, the electron wavelength will be much larger than the positron variable wavelength whenever the magnitude order of the electron velocity is less than the magnitude order 10^6 of the positron quadratic velocity mean value. So, at the time of the scattering, the cloud of the electron matter will cover all the antimatter spherical surface of the positron cloud which surrounds the antiproton of the appeared antihydrogen atom.
This spherical surface of the positron antimatter is inflating toward the external matter surface of the electron. This interaction between this electron and the appeared positron, will be terminated by an annihilation electron-positron phenomenon[16] and we will have the appearance of 2γ photons emitted in opposite directions, and each one of them will have the same energy value $E \geq meC^2$ such as the constant $C = 299\ 792\ 458\ m.s^{-1}$ is the speed of light. So, the antiproton at the nucleus will remain isolated, stable in its real state. So**,** the elastic scattering of the electron by the hydrogen atom will be an inelastic scattering and the corresponding process respects the conservation law of the electric charge through the following equation:

$$\mathbf{e^- + H \rightarrow p^- + 2\gamma} \qquad (6)$$

5. Conclusion

Through this first research paper we tried to show the existence of a quantum phenomenon behind the electronic transitions in atoms, we called it the **disappearance-appearance - phenomenon (DAP).** It is the natural law that makes the atomic electronic transitions possible without the quantum jumps of the electrons. We have also proposed a simplest experiment for the confirmation of our theoretical prediction.

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