To Theory of Everything.
β^+-Orthopositronium with a Magnetic Monopole in "through the Looking Glass". Phenomenology

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According to the phenomenological model to Theory of Everything, single-quantum annihilation of orthopositronium, forbidden by the law of conservation of momentum in quantum electrodynamics/*QED*, is realized under "resonance conditions" with participation of magnetic monopole acting outside the limits of the light cone.

Phenomenology is justified in theory – a precedent for the complete degeneration of ortho-para-superpositronium in supersymmetric *QED* (1985) and the structure of vacuum in chiral supersymmetric quantum electrodynamics (1986).

Key words: *QED*-positronium, β^+-positronium, a magnetic monopole, "trough the looking glass", Theory of Everything.

Positronium (symbol *Ps*) is a hydrogen-like atom in which the proton (p) is replaced by a positron (e^+) – the electron (e^-) antiparticle. Therefore, *Ps*, unlike a hydrogen atom, is unstable and with the necessity annihilates, turning into gamma quanta (γ_a) for fractions of millionth (orthopositronium $^3/e^+e^-/_1$ – spin 1, odd number γ_a, symbols *o-Ps*, $^T Ps$) or billionths of second (parapositronium $^1/e^+e^-/_0$ - spin 0, even number γ_a, symbols *p-Ps*, $^S Ps$).

This representation of *Ps* corresponds to *quantum electrodynamics* (*QED-Ps*) as part of the modern Standard Model/*SM*. Today, the reason for stagnation of *SM* (from the mid-1970s) is already visible: experiments of a number of laboratories (USA, Russia, England, and Canada) with positrons from decay of nuclei of type $\Delta J^\pi = 1^\pi$ (^{22}Na, ^{64}Cu, ^{68}Ga and so on), from the mid-1950s to the mid-1980s, definitely indicate the fundamental difference between the annihilation of β^+-*Ps* $^3(e^+_\beta e^-)_1 \setminus {}^1(e^+_\beta e^-)_0$ and *QED-Ps*.

It is assumed that in the system "$^{22}Na/3^+$/-gaseous neon ($^{22}Ne/2^+$/) of natural isotopic composition (~9% $^{22}Ne/0^+$/)" ("*resonance conditions*") due to *topological quantum transitions*/*TQT* implements single-quantum annihilation of orthopositronium ($\cong 1{,}022$ MeV) in the presence *atom of long-range action*/*ALRA*, which is forbidden in *QED* due to violation of the law of conservation of momentum.

The observed paradoxical implementation of the Mossbauer Effect [1] allows one to substantiate the phenomenology of the discrete structure of *ALRA* (the number of nodes $N^{(3)} \cong 1{,}302 \cdot 10^{19}$ with the *ALRA* core $\overline{n} \cong 5{,}278 \cdot 10^4$) "*outside*" the light cone instead of the counterproductive phenomenology "tachyon".

To substantiate the phenomenology of *ALRA*, particular attention is required to the registration of the single-quantum annihilation mode of the β^+-orthopositronium (γ_a-quantum/γ°_a-*notoph* [1,2] $E_{\gamma_a} \cong 1{,}022$ MeV) by the lifetime method, since the γ_n("start")-γ_a("stop") delayed coincidences method excludes registration of the γ_a-quantum with $E_{\gamma_a} \cong 1{,}022$ MeV energy.

Indeed, the thresholds of the differential discriminator of the lifetime spectrometer are set to register γ_a-quanta in the range (0,34-0,51) MeV.

The ban on registration is lifted if we take into account the interaction of the γ°_a-notoph with the two-digit ($\pm$) structure of the *ALRA*. As a result, half the energy of the notoph ($0{,}511$) MeV is compensated by the interaction of the γ°_a-notoph with quasiparticle $\overline{e}^-$ in the $ALRA_{(-)}$ of negative mass

$$E_{\gamma^{\circ}_a}(\cong 1{,}022 \text{ MeV}) + ALRA_{(-)}(\cong -0{,}511 \text{ MeV}) \rightarrow E_{\gamma^{\circ}_a}(\cong 0{,}511 \text{MeV}),$$

and the single-quantum (single-notoph) annihilation mode of the β^+-orthopositronium can be detected by lifetime spectrometer.

The forerunners of the phenomenology of *ALRA* in theory were the concept of "*vacuum-like states of matter*" by E.B. Gliner (1965) based on the general relativity/*GR*, the "*full relativity*" by A.F. Andreev (1982) and the mathematical extension of *GR* by L.B. Borissova & D.D. Rabounski ("zero-space" – a new long-range action, 1997) based on the method of chronometric invariants by L.A. Zelmanov (see [2]).

The presentation of the experimental anomalies of "quiet physics" under consideration, for expanding the *SM*, was made possible on the basis of the transition from considering positronium in the framework of *QED* to supersymmetric *QED*, in which the precedent was established in theory – "… *complete degeneration for para- and ortho-superpositronium*" [3].

In *QED*, the mixing of ${}^{T}Ps$ and ${}^{S}Ps$ occurs in a magnetic field. Operator of energy of interaction of positronium with a magnetic field

$$H_m = \frac{e\hbar}{2m_e c}\left[(\vec{\sigma}_- - \vec{\sigma}_+)\,H\right]$$

it is not invariant to replacing an electron with positron and therefore does not preserve of the charge parity; it mixes the singlet and triplet (**m** = 0, where **m** is the magnetic quantum number) states. In sufficiently strong magnetic fields, the "good" quantum number is no longer the positronium spin, but the magnetic quantum number: $\mathbf{m} = \pm 1$ – annihilation by $3\gamma_a$ or $\mathbf{m} = 0$ – annihilation by $2\gamma_a$. The splitting of the levers of triplet positronium in a magnetic field is determined by the expression

$${}^{T}E_{\mathrm{m}=0} - {}^{T}E_{\mathrm{m}=\pm 1} = \frac{\Delta W}{2}\left[(1+x^2)^{1/2} - 1\right]$$

where $x = \dfrac{2e\hbar}{m_e c}\dfrac{H}{\Delta W}$, $\Delta W = {}^{T}W - {}^{S}W = W\alpha^2(\frac{4}{3}+1) \cong 8{,}4\cdot 10^{-4}$ eV ($W \cong 6{,}8$ - binding energy *Ps*, see [4]).

Positronium is a truly neutral system, since during charge conjugation the positron is replaced by an electron and electron by a positron, again forming positronium. Nevertheless, the ambiguity due to the spin of the compound of a truly neutral particle – ${}^{T}Ps$ (S = 1) and ${}^{S}Ps$ (S = 0) is obvious here. At this stage of phenomenology, certainty is restored by referring to magnetic properties – the magnetic moment ${}^{T}Ps$ is 0, and ${}^{S}Ps$ is equal to two Bohr magnetons ($\mu_B = \dfrac{e\hbar}{2m_e c}$). Consideration of superpositronium [3] removes the uncertainty ($\Delta W = 0$): one can consider oscillations of orthopositronium (a degenerate state of ortho-/para-superpositronium), which admits single-quantum annihilation in the "trough the looking glass", which, unlike the "mirror Universe" by S. Glashow [5] it is realized ***in finite* 4-*volume*** of space-time in the *TQT* process at β^+-decays of the mentioned type [2].

As a result, the phenomenological analysis admits: by the action of an effective magnetic field in the through the looking glass, we can justify the small contribution to the energy of mirror quanta $|W\alpha^2|$ at one-quantum annihilation $\beta^+ \_ {}^{T}Ps \backslash {}^{T}Ps'({}^{S}Ps') \rightarrow \gamma^{\circ} \backslash (2\gamma^{\circ})'$.

Let us imagine the magnetic field H' as the field of a magnetic monopole placed at the center of mass of a supersymmetric ("complete degeneracy" [3]) β^+-positronium $\beta^+ \_ {}^{T}Ps \backslash {}^{T}Ps'({}^{S}Ps')'$. Let its intensity be sufficient to compensate for the positronium in substate **m** = 0 binding energy W with an accuracy $|\Delta W|$ (equal to the total energy of two photons/notophs in the "looking glass"). Then, from the connection

$$\frac{\Delta W}{2}\left[(1+x^2)^{1/2} - 1\right] \xrightarrow{x >> 1} \frac{\Delta W}{2}\cdot x \equiv W$$

we get the strength magnetic field of monopole

$$H' = \frac{e^3 m_e^2 c}{4\hbar^3}$$

and the charge of the magnetic monopole

$$g_{H'} = H'(r_{Ps})^2 = \frac{\hbar c}{e},$$

where $r_{Ps} = \frac{2\hbar^2}{m_e e^2}$ is the positronium radius.

The Dirac-Schwinger relation of the coupling of an elementary electric charge and a magnetic charge of a monopole is obtained.

$$\frac{e\, g_{H'}}{\hbar c} = 1.$$

This phenomenology of a magnetic monopole as a part of a two-valued $ALRA_{(\pm)}$ is essentially justified by a *fundamental structure* open "*at the tip of a pen*" when studying vacuum in a chiral (invariant with respect to the direction of rotation) *supersymmetric QCD* in a finite volume, which is an "ion crystal":

"*In the case of the usual supersymmetric QCD, the lattice of monopoles of charge* –1 *is superimposed on a similar lattice of monopoles with charge* +1" [6].

As was noted by Schwinger in another context, as a result "… *a magnetic charge can be used to interpret the empirical properties of a nucleon charge*" [7].

The Dirac monopole, connected with a truly neutral compound atom – supersymmetric β^+-positronium $\beta^+{}_-{}^T Ps \backslash {}^T Ps'({}^S Ps')'$, included in the structure of *ALRA* with the *ALRA* core, also becomes a truly neutral system. In this sense, the phenomenology of the Dirac magnetic monopole can be compared with the theory of the truly neutral fermion E. Majorana.

The direct statements of Dirac about the theory of E. Majorana, which would seem to provoke a conceptual conflict, are unknown. But the exit the Theory of Everything beyond the light cone, a priori of the Project of the decisive experiment, brings together both concepts of quantum field theory [8, 9].

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