ISSN 1062-8738, Bulletin of the Russian Academy of Sciences: Physics, 2020, Vol. 84, No. 3, pp. 284–288. © Allerton Press, Inc., 2020.
Russian Text © The Author(s), 2020, published in Izvestiya Rossiiskoi Akademii Nauk, Seriya Fizicheskaya, 2020, Vol. 84, No. 3, pp. 371–376.

Supernonradiative States, Neutrinos, and Higgs Bosons in Fractal Quantum Systems

V. S. Abramov*

Donetsk Institute for Physics and Engineering, Donetsk, 83114 Ukraine
**e-mail: vsabramov2018@gmail.com*

Received September 20, 2019; revised November 15, 2019; accepted November 27, 2019

Abstract—A theoretical study is performed for the relationships between the parameters of active objects (nanoparticles, atomic defects, and neutrinos) and the Higgs boson in fractal quantum systems and the supernonradiative states of different physical fields. Estimates are obtained for the characteristic accelerations, temperatures, and energies of active nanoobjects, neutrino oscillations, the Majorana neutrino rest energy, dark matter, and anomalies of lepton magnetic moments.

DOI: 10.3103/S106287382003003X

INTRODUCTION

Modern laser technologies [1, 2] employ active objects (nanoparticles, atomic defects, and neutrinos) in different periodic structures and metamaterials [3]. Femtosecond laser coherent spectroscopy [4] reveals behavioral features of active objects in these nonlinear systems. Experiments [5] to study neutrino oscillations have proved the existence of the neutrino rest mass (energy, 280 MeV) and the possibility of altering the type of a neutrino (transforming a μ neutrino into a τ neutrino). The use of these materials in space requires that we solve the problems of the effect relic radiation has on the key parameters of active objects in the field of low temperatures, lepton characteristics, and particle acceleration, caused by the varying intensity of radiation emitted by such objects. Problems then arise in studying the nature of the dark matter particles, dark energy [6–9], and chiral fractal structures of the Universe. A specific fundamental fractal (the Cantor random set) was used in [10], for which the Hausdorff dimension was an irrational number: $\varphi = (\sqrt{5}-1)/2$. Our models are based on the fractional calculus theory and the fractal concept [11]. There is also the problem of describing the supernonradiative states (SNS) of different fields: gravitational, relic photon, Higgs, neutrino, and physical vacuum [12]. The aim of this work was to investigate the effect the Higgs boson has on the supernonradiative states of active objects, neutrino oscillations, and anomalies of lepton magnetic moments.

TEMPERATURES, ENERGIES, ACCELERATIONS, AND NEUTRINO OSCILLATIONS

In [13], the emission of single photons by atomic defects (emitters with an energy gap of 5.95 eV) of boron nitride nanotubes (BNNT) was observed in a wide range of temperatures, including ambient temperatures. The estimated upper boundary for temperature was around 800 K. In the low-temperature region, relic radiation can influence the key parameters of active nanoobjects and atomic defects. Using the anisotropic model [8, 9], estimates were obtained for relic radiation temperature $T_{\rm r} = 2.72548$ K, relic radiation dipole anisotropy $\delta T_{\rm r}$, and mean oscillations of the relic radiation temperature δT_A. The expressions of the required characteristic temperatures and energies $\varepsilon_{\rm r}$, $\varepsilon_{{\rm r}A}$, $\varepsilon'_{{\rm r}A}$ can be written as

$$\begin{gathered} T_{\rm r} = T_{{\rm r}A} + T'_{{\rm r}A};\; T_{{\rm r}A} = u_{{\rm r}A}^2 T_{\rm r}; \\ T'_{{\rm r}A} = v_{{\rm r}A}^2 T_{\rm r};\; T_{\rm r} = a_T \varepsilon_{\rm r}; \\ u_{{\rm r}A}^2 + v_{{\rm r}A}^2 = 1;\; 1 - 2u_{{\rm r}A}^2 = (N+1)\big/ z'_{A2}; \\ T_{{\rm r}A} = a_T \varepsilon_{{\rm r}A};\; T'_{{\rm r}A} = a_T \varepsilon'_{{\rm r}A};\; N_{{\rm r}A} = z'_{A2} + N + 1. \end{gathered} \tag{1}$$

Parameters $T_{{\rm r}A} = 1.3390101$ K, $T'_{{\rm r}A} = 1.3864699$ K, $\varepsilon_{\rm r} = 469.58535$ μeV, $\varepsilon_{{\rm r}A} = 230.75328$ μeV, $\varepsilon'_{{\rm r}A} = 238.93207$ μeV, ordinary red shift $z'_{A2} = 1034.109294$, $N_{{\rm r}A} = 1052.116604$, and the maximum number of active effective particles $N = 17.0073101$ [9]. Phase transition temperatures

T'_A, T_A [9] are determined using the numbers of quanta n_{zA} (for the ordinary red shift) and $n_{z\mu}$ (for the cosmological red shift z'_μ), and the total number of relic radiation quanta N_{ra}, according to the formulas

$$T'_A = T_A + \delta T_A;\ T_A = n_{zA}T'_A;\ \delta T_A = n_{z\mu}T'_A;$$
$$n_{z\mu} = z'_\mu / N_{ra};\ n_{zA} + n_{z\mu} = 1;\ N_{ra} = z'_{A2} + z'_\mu; \quad (2)$$
$$\delta T_r = Q_{H3}T'_{rA}\delta T_A / T'_A;\ 2T'_{rA} = N_{rA}T'_A.$$

The parameters are $T'_A = 2.6355822$ mK, $T_A = 2.6173985$ mK, $\delta T_A = 18.183633$ μK, $\delta T_r = 6.7035181$ mK, and $Q_{H3} = 0.700790572$.

The expression for the ratio of acceleration can be written for cosmological fractal objects using the Dicke superradiation model [9]:

$$g_0 / g_{SE} = n_G \left(z'_{A2} - z'_\mu + I_m I_0^{-1} \right) / 2. \quad (3)$$

Here, $g_0 = 980.665$ cm s^{-2} is the acceleration of gravity on the Earth's surface; g_{SE} is the Earth's acceleration toward the Sun; and the ratio between maximum I_m and initial I_0 intensities of radiation is $I_m I_0^{-1} = 81.06580421$. From (3), we find that $g_{SE} = 0.590056$ cm s^{-2}. In light of parameters $n_{A0} = 58.04663887$ (for black holes), $N_{HG} = 1.031830522 \times 10^{16}$ from [9, 12], and based on

$$g_{SE}N_{HG} = g_{nS}n_{A0} \quad (4)$$

we estimate the acceleration of gravity: $g_{nS} = 1.0488769 \times 10^{12}$ m s^{-2} on the surface of a neutron star, which agrees with estimate 10^{12} m s^{-2} from [14]. Note that formulas (3) and (4) allow us to generalize the description of the ratios of acceleration of active nanoobjects. Femtosecond laser coherent spectroscopy enables us to monitor variations in parameter $I_m I_0^{-1}$.

Using the anisotropic model [8, 9], we obtain the expression of the susceptibility tensor $\hat{\chi}_{ef}$. The effect $\hat{\chi}_{ef}$ has on characteristic energy $E_{H\nu} = 1627.379629$ meV determines energy tensor $\hat{\varepsilon}_{H\nu} = \hat{\chi}_{ef}E_{H\nu}$ with components $\varepsilon_{ij} = \chi_{ij}E_{H\nu}$ $(i, j = 1, 2, 3)$. This allows us to estimate the neutrino rest energy: $\varepsilon_{HG} = |\varepsilon_{21}\varepsilon_{12}|^{1/2} = 280.0460475$ meV. Using the model, we estimate the energies that describe neutrino oscillations:

$$\varepsilon_{\tau L} = \varepsilon_{HG} + \varepsilon_{\tau G};\ \varepsilon_{\tau G} = \varepsilon_{2u\tau} + \varepsilon_{hL};$$
$$\varepsilon_{2u\tau} = z_{2u\tau}\varepsilon_{HG};\ \varepsilon_{hL} = \Omega_{hL}\varepsilon_{HG}; \quad (5)$$

$$\varepsilon_{\tau L}^2 - \varepsilon_{HG}^2 = z_{\tau G}(z_{\tau G} + 2)\varepsilon_{HG}^2;$$
$$z_{\tau G} = z_{2u\tau} + \Omega_{hL};\ \Omega_{hL} = n_{h2}E_e / E_{H0}; \quad (6)$$

$$n_{F\tau} + n'_{F\tau} = 1;\ n'_{F\tau} = \Omega_{\tau L}^{1/2};$$
$$\Omega_z = \Omega_{z0} + \Omega_{hL} = 0.5 + \Omega'_{c2} + \Omega_{0\nu} + \Omega_{\tau L}. \quad (7)$$

Based on energies $E_{z0} = 91.188$ GeV of the $z0$ boson and $E_e = 0.51099907$ MeV of an electron [15]; Higgs boson energy $E_{H0} = 125.03238$ GeV, the number of quanta of a second black hole $n_{h2} = 29.02331944$ before its merger with the first black hole n_{h1}; density $\Omega'_{c2} = 0.224091707$ of cold dark matter in neutron stars and density $\Omega_{0\nu} = 0.002939801$ of a neutrino [8, 9], we obtain $\Omega_{z0} = E_{z0}/E_{H0} = 0.729315078$, $\Omega_{hL} = 1.186165 \times 10^{-4}$, $\Omega_z = 0.729433695$, $\Omega_{\tau L} = 0.002402187$, $n'_{F\tau} = 0.049012111$, $n_{F\tau} = 0.950987889$. In light of spectral parameter $S_{2u} = 0.033051284$ and expressions (5) and (6), we find parameters $z_{2u\tau} = 0.5n_{F\tau}S_{2u} = 0.015715686$, and $z_{\tau G} = 0.015834303$, which allow a neutrino field interpretation of the cosmological red shift. The energies are $\varepsilon_{hL} = 33.218082$ μeV, $\varepsilon_{2u\tau} = 4.401115748$ meV, $\varepsilon_{\tau G} = 4.43433383$ meV, and $\varepsilon_{\tau L} = 284.4803813$ meV. The difference between squared energies $\varepsilon_{\tau L}^2 - \varepsilon_{HG}^2 = 2503.298642$ (meV)^2 and the value of $\Omega_{\tau L}$ virtually coincide with the difference between squared energies 2500 (meV)^2 and lepton number 0.0024 from the experiment with neutrino oscillations in [5].

SUPERNONRADIATIVE STATES

Dynamic models allow us to describe not only superradiation but SNSes as well. We can write intensity $J(t)$ of radiation [9] as

$$J(t) = J_0(a_0 + a_m)[(a_0 - a_m) + 1]. \quad (8)$$

Here, J_0 is the initial intensity of radiation; $a_0(t)$, and $a_m(t)$ generally depend on time t and other parameters. SNSes are states with $J(t) = 0$. These states can be achieved during the evolution of different transition effects (induction, avalanche, echo, and self-induced transparence). The possibility of describing them within the two models follows from (8).

Model A_0

In this model, we assume that $a_0 = -a_m$, where

$$a_m = \left(z'_{A2}\right)^{1/2};\quad a_0^2 = a_m^2 + z'_\mu\left(z'_\mu + 2\right)/4;$$
$$a_m^2 = z'_{A2};\ N_{\mathrm{ra}} = z'_{A2} + z'_\mu. \tag{9}$$

Two variants follow from (9). Variant $B1$ is when $z'_\mu = 0$, and $N_{\mathrm{ra}} = z'_{A2}$; variant $B2$ is when $z'_\mu = -2$, and $N_{\mathrm{ra}} = z'_{A2} - 2$. We introduce row vectors $\hat{N}_{d1}$ and $\hat{N}_{d2}$ and column vectors $\hat{N}^+_{d1}$ and $\hat{N}^+_{d2}$, respectively, for variants $B1$ and $B2$

$$\hat{N}_{d1} = \left(N_{ra}, z'_{A2}, z'_\mu\right) = \left(z'_{A2}, z'_{A2}, 0\right);$$
$$\hat{N}_{d2} = \left(z'_{A2} - 2, z'_{A2}, -2\right). \tag{10}$$

We find norms $|N_{d1}|$, $|N_{d2}|$ and angle θ_{d12} as functions of argument z'_{A2}:

$$\hat{N}_{d1}\hat{N}^+_{d1} = 2\left(z'_{A2}\right)^2 = |N_{d1}|^2;$$
$$\hat{N}_{d2}\hat{N}^+_{d2} = 8 + 2z'_{A2}\left(z'_{A2} - 2\right) = |N_{d2}|^2;$$
$$\hat{N}_{d1}\hat{N}^+_{d2} = \hat{N}_{d2}\hat{N}^+_{d1} = 2z'_{A2}\left(z'_{A2} - 1\right); \tag{11}$$
$$\cos\theta_{d12} = \hat{N}_{d1}\hat{N}^+_{d2}|N_{d1}|^{-1}|N_{d2}|^{-1}$$
$$= \sqrt{2}\left(z'_{A2} - 1\right)\left[8 + 2z'_{A2}\left(z'_{A2} - 2\right)\right]^{-1/2}.$$

It follows from (11) that we can change the sign of $\cos\theta_{d12}$, depending on z'_{A2}: at $z'_{A2} = 0, 1, 2$, we have $\cos\theta_{d12} = -0.5, 0, 0.5$, respectively. We then introduce the Fermi-type density distribution functions n_{d12} and n'_{d12}:

$$n'_{d12} + n_{d12} = 1;\quad n'_{d12} = \cos^2\theta_{d12}$$
$$= 2\left(z'_{A2} - 1\right)^2\left[6 + 2\left(z'_{A2} - 1\right)^2\right]^{-1};$$
$$n_{d12} = \sin^2\theta_{d12} = 6\left[6 + 2\left(z'_{A2} - 1\right)^2\right]^{-1}; \tag{12}$$
$$B_{d12} = n'_{d12} - n_{d12}$$
$$= \left[\left(z'_{A2} - 1\right)^2 - 3\right]\Big/\left[\left(z'_{A2} - 1\right)^2 + 3\right].$$

We can interpret parameter B_{d12} from (12) as the difference between the populations of states (10) and (11). The state with $B_{d12} = 0$ is observed at either $z'_{A2} = 1 + \sqrt{3}$ or $z'_{A2} = 1 - \sqrt{3}$. Here, $\cos^2\theta_{d12} = \sin^2\theta_{d12} = 1/2$, indicating there is a transverse component of the effective vector from (10) and (11). This allows us to apply the interpretation in terms of SNSes with possible chirality (polarization) of the structures from (10) formed by z'_{A2}. We introduce functions of the Bose-type distribution density of N_{zA}, N'_{zA} and n_{zA}, n'_{zA}:

$$N'_{zA} - N_{zA} = 1;\quad N_{zA} = \left(z'_{A2} - 1\right)^2/3;$$
$$n'_{zA} - n_{zA} = 1;\quad n_{zA} = N^{-1}_{zA}. \tag{13}$$

Based on (13) and $z'_{A2} = 1034.109294$, we find the number of bosons in the equilibrium state: $N_{0A} = N_{zA}\left(z'_{A2}\right) = 3.5577160 \times 10^5$. This allows us to introduce typical energy $E_{0A} = N_{0A}E_G$ = 4.3110733 eV of the gravitational field and write energy spectrum $E_{0Ai} = 2E_{0A}S_{iu}$ $(i = 1, 2, 3, 4)$. The energies of the spectrum's branches are: acoustical, $E_{0A1} = 403.01271$ meV, and $E_{0A2} = 284.97302$ meV; optical, $E_{0A3} = 3.9080606$ eV, and $E_{0A4} = 4.5960463$ eV. Energy E_{0A} is close to threshold energy 4.3 eV, as was observed at neutrino-less double β decay in experiments with the ^{136}Xe isotope [15]. This allows us to interpret this energy as the Majorana neutrino rest energy.

Based on E_{0A}, and spectra $E_{\mathrm{HS}i} = E_{\mathrm{H}0}S'_{0i}$, and $E_{\mathrm{H}iu} = E_{\mathrm{H}0}S_{iu}$ we find energies $E_{d\nu} = E_{\mathrm{H}0}\left(1 + S'_{02}\right) = N_{0\mathrm{H}\nu}E_{0A}/2$ = 129.29473 GeV and $E_{\mathrm{HS1}} = 4.94394060$ GeV, $\varepsilon_{du\nu} = E_{\mathrm{H}2u}/Q_{\mathrm{H}6}$ = 2.6873617 GeV, where $Q_{\mathrm{H}6} = 1.537746366$, and estimate the total number of neutrinos: $N_{0\mathrm{H}\nu}$ = 5.9982619×10^{10}. Energy $E_{d\nu}$ is close to the local minimum between the local maxima on the dependences of the number of photons on their energy, determined by detectors in the LHC experiments. Energies E_{HS1}, E_{HS2}, $E_{\mathrm{H}1u}$, $E_{\mathrm{H}2u}$, and $\varepsilon_{du\nu}$ contain information on the transmitted momenta, and energy interval ($\varepsilon_{du\nu}$, E_{HS1}) can describe strong interactions (hadrons), and condensed baryon matter [7].

Below, we estimate the energies of the acoustical branch of dark relic photons (virtual relic photons in the condensate), $\varepsilon'_{dm2} = N_{0A}\varepsilon_{\mathrm{r}}$ = $2\varepsilon'_{dm}S_{2u}$ = 167.07461 eV, and dark matter, $\varepsilon'_{dm} = 2.5275057$ keV. Between energies $\varepsilon'_{dmi} = 2\varepsilon'_{dm}S_{iu}$ and $\varepsilon_{dmi} = 2\varepsilon_{dm}S_{iu}$ of the spectrum branches, the following conditions are satisfied for dark matter with ε'_{dm} and $\varepsilon_{dm} = 1.7872164$ keV:

$$\varepsilon'_{dm} = \varepsilon'_{dm4} - \varepsilon'_{dm2} = \varepsilon'_{dm3} + \varepsilon'_{dm1};$$
$$\varepsilon_{dm} = \varepsilon_{dm4} - \varepsilon_{dm2} = \varepsilon_{dm3} + \varepsilon_{dm1}. \tag{14}$$

The energies of the spectrum branches are: acoustical, $\varepsilon'_{dm1} = 236.27919$ eV, $\varepsilon_{dm1} = 167.07461$ eV, and $\varepsilon_{dm2} = 118.13959$ eV; optical, $\varepsilon'_{dm3} = 2.2912264$ keV, $\varepsilon'_{dm4} = 2.6945803$ keV, $\varepsilon_{dm3} = 1.6201418$ keV, and $\varepsilon_{dm4} = 1.9053560$ keV. Direct experiments (the DAMA/LIBRA, CoGeNT, and CRESST-II collaborations) [6] to observe the spectrum and angular distribution of γ radiation along with the modulation spectrum from the Galactic center revealed a major local maximum near 2.4 keV and two major local minima near 1.9 and 2.7 keV against the background of stochastic behavior.

In this model, energies ε_{dm4} and ε'_{dm4} correspond to local minima (potential wells) of the optical energy branches of dark matter with rest energies ε_{dm}, ε'_{dm} and virtually coincide with the positions of local minima in the modulation spectrum. The energy $\varepsilon'_{dm3} + \varepsilon_{dm2} =$ 2.4093661 keV almost coincides with the major local maximum position. Energy ε_{dm2} is positioned on the acoustical branch of the spectrum and contains information about the transmitted momentum of γ radiation. Information about the presence of SNSes, dark matter, and dark relic photons can therefore be detected by the local minima in the experimental γ radiation spectra against the background of the stochastic signal behavior. Information can also be obtained about the SNSes of the gravitational field, detected via the presence of local minima with energies E_{0A3} and E_{0A4} (strain fields) in the optical branches; transmitted momenta of the gravitational field with energies E_{0A1}, E_{0A2} (stress fields) in the acoustical branches; and rest energy E_{0A}.

Model A_1

In this model, we assume that $a_0 = a_m - 1$. We introduce distribution density functions a_m and a'_m for Fermi-type particles and N_{zg}, N'_{zg}, n_{zg}, and n'_{zg} for Bose-type particles:

$$a_m + a'_m = 1;\ 2a_m = 1 - b_m;\ 2a'_m = 1 + b_m;\quad 4b_m = z'_\mu\left(z'_\mu + 2\right);\ z'_{A2} = N_{ra} - z'_\mu; \tag{15}$$

$$N'_{zg} - N_{zg} = 1;\ N_{zg} = (1 + b_m)/(1 - b_m);\quad N'_{zg} = 8\Big/\left[4 - z'_\mu\left(z'_\mu + 2\right)\right]; \tag{16}$$

$$n'_{zg} - n_{zg} = 1;\ n_{zg} = (1 - b_m)/(1 + b_m);\quad n'_{zg} = 8\Big/\left[4 + z'_\mu\left(z'_\mu + 2\right)\right]. \tag{17}$$

Parameter $b_m = a'_m - a_m$ from (15), which allows the interpretation of the difference between populations for Fermi-type particles, confirms there is a superstate related to cosmological red shift z'_μ. On the other hand, occupational numbers N'_{zg} and n'_{zg} from (16) and (17) confirm the possibility of describing the SNSes of dark matter using a gluon field ($n_g = 8$) renormalized by contributions due to z'_μ. Expressions (15)–(17) are subject to the condition $-1 \le b_m \le 1$. When z'_μ grows, parameter b_m exceeds 1. Functions (15)–(17) transform into new distribution density functions for Bose-type particles: $a'_m - |a_m| = 1$, $|N_{zg}| - |N'_{zg}| = 1$. For Fermi-type particles, $n'_{zg} + |n_{zg}| = 1$, respectively. When $z'_\mu = 7.18418108$, we obtain numerical values $|a_m| = 7.7476025$, $|N'_{zg}| = 0.1290729$, $|n_{zg}| =$ 0.885682963, and $n'_{zg} = 0.1143170$. This allows us to determine frequency $\nu'_{zg} = n'_{zg}\nu_{G0} = 335.00053$ MHz, close to that of 330 MHz, at which dark matter dominates, according to radiofilament observations [6].

ANOMALIES OF LEPTON MAGNETIC MOMENTS

Relic radiation can induce effects of the renormalization of initial parameters: fine structure constant α_0, electron charge e, top speed of photon propagation in vacuum c_0; rest masses m_e, m_μ, and m_τ, and magnetons μ_B, μ_μ, and μ_τ for electrons, muons, and τ leptons, respectively:

$$\hbar c_0 = e^2\alpha_0;\ \mu_B = e\hbar/2m_e;\ \mu_\mu = e\hbar/2m_\mu;\quad \mu_\tau = e\hbar/2m_\tau. \tag{18}$$

Here, lepton magnetic moments $\langle\hat{\mu}_e\rangle$, $\langle\hat{\mu}_\mu\rangle$, and $\langle\hat{\mu}_\tau\rangle$ for electrons, muons, and τ leptons, respectively, are determined by the expressions

$$2\langle\hat{\mu}_e\rangle = (2 + \Omega_{\mu e})\mu_B;\ 2\langle\hat{\mu}_\mu\rangle = (2 + \Omega_{\mu\mu})\mu_\mu;\quad 2\langle\hat{\mu}_\tau\rangle = (2 + \Omega_{\mu\tau})\mu_\tau. \tag{19}$$

Anomalous contributions to the magnetic moments and renormalization effects are described by parameters $\Omega_{\mu e}$, $\Omega_{\mu\mu}$, and $\Omega_{\mu\tau}$ for electrons, muons, and τ leptons, respectively, based on leptonic number $\Omega_{\tau L}$:

$$\Omega_{\mu e} = \Omega_{\tau L} - \Omega_{HL};\ \Omega_{HL} = E_{HL}/E_{H0};\quad E_{HL} = n'_{H3}E_e; \tag{20}$$

$$\Omega_{\mu\mu} = \Omega_{\tau L} - \Omega'_{NL};\ \Omega'_{NL} = E'_{NL}\Big/E_{H0};\quad E'_{NL} = N'E_e;\ (N' - N)\cdot\chi_0 = n'_{\mu F}; \tag{21}$$

$$\Omega_{\mu\tau} = \Omega_{\tau L} - 0.5(\Omega_{HL} + \Omega_{GL});\quad \Omega_{GL} = E_{GL}/E_{H0};\ E_{GL} = n_G E_e. \tag{22}$$

Additional contributions Ω_{HL}, Ω'_{NL}, and Ω_{GL} are determined on the basis of energies E_{HL}, E'_{NL}, E_{GL}, and Higgs boson rest energy E_{H0}. It follows from (20)–(22) that these additional energies are determined by quantum numbers n'_{H3}, N', n_G, and electron rest energy E_e. At the same time,

$$n'_{H3} = n_{H3}/(1+\Omega_{0\nu}); \quad 1+\Omega_{0\nu} = 1+\left(n'_F\right)^2 = 1+(N'_p - N)^2 \cdot \chi_0^2; \tag{23}$$

$$n_{H3} = Q_{H3}n_{h2} = 0.5Q_{H3}n_{A0}; \quad n_{A0} = z'_\mu\left(z'_\mu + 1\right) - n_Q\Big/n_g;\ n_Q = 2n_G. \tag{24}$$

Here, $\chi_0 = 0.257104198$ is the effective susceptibility when the Higgs field is zero [12]; $n_g = 8$, $n_Q = 6$, $n_G = \left\langle \hat{c}_G\, \hat{c}_G^+ \right\rangle = 3$, and $n'_G = \left\langle \hat{c}_G^+\, \hat{c}_G \right\rangle = 2$ can be interpreted as the numbers of the quanta of the gluon, quark, excited, and ground states of the gravitational field, respectively. Based on (24), we find $n_{H3} = 20.33926863$. In light of (23), we obtain $n'_{H3} = 20.27965049$, and $N' = 17.21088699$. Based on (20)–(22) we find energies $E_{HL} = 10.36288254$ MeV, $E'_{NL} = 8.794747246$ MeV, and $E_{GL} = 1.53299721$ MeV; plus additional contributions $\Omega_{HL} = 82.88159067\times10^{-6}$, $\Omega'_{NL} = 70.33975716\times10^{-6}$, and $\Omega_{GL} = 12.26080164\times10^{-6}$. Obtained parameters $0.5\Omega_{\mu e} = 1159.652705\times10^{-6}$, $0.5\Omega_{\mu\mu} = 1165.923621\times10^{-6}$, and $0.5\Omega_{\mu\tau} = 1177.307902\times10^{-6}$ virtually coincide with the data in [15] for the anomalies of lepton magnetic moments.

Based on parameter n_{H3}, and spectral parameters S_{iu} and S'_{0i} from [12], we write the spectra for the occupational numbers: $n_{Hui} = 2n_{H3}S_{iu}$ and $n_{HSi} = 2n_{H3}S'_{0i}$. Spectrum branches n_{Hu4}, n_{Hu3}, n_{HS4}, and n_{HS3} are optical, while n_{Hu2}, n_{Hu1}, n_{HS2}, and n_{HS1} are acoustical. The laws of conservation are true for the spectrum branches:

$$n_{H3} = n_{Hu4} - n_{Hu2} = n_{Hu3} + n_{Hu1}; \quad n_{H3} = n_{HS4} - n_{HS2} = n_{HS3} + n_{HS1}. \tag{25}$$

The possibility of spectrum branch intersection follows from (25). Variations in lepton parameters $\Omega_{\mu e}$, $\Omega_{\mu\mu}$, and $\Omega_{\mu\tau}$; hyperfine splittings of atomic defects in fractal quantum systems; transitions from the discrete to the continuous energy spectrum; and manifestations of hystereses are possible.

CONCLUSIONS

Two models describing the supernonradiative states (SNSes) of different physical fields of active objects in fractal quantum systems were proposed on the basis of the theoretical Dicke superradiation model. It was shown that information on the presence of SNSes, dark matter, and dark relic photons can be extracted from the spectra of γ radiation by detecting local minima against the background of stochastic signal behavior. Estimates of typical accelerations, temperatures, and energies were obtained for examples of active objects (nanoparticles, atomic defects, and neutrinos).

The possibility of describing mutual transformations of Bose- and Fermi-type particles was demonstrated using the description of neutrino oscillations. Using leptons as an example, magnetic moment anomalies were estimated with allowance for interconnections with the Higgs boson.

The results from this work can find application in neutrino physics, neuromedicine (to describe neuromediators), quantum information science, and quantum optical technologies.

REFERENCES

1. Ashkin, A., *Optical Trapping and Manipulation of Neutral Particles Using Lasers*, World Scientific, 2006.
2. Strickland, D. and Mourou, D., *Opt. Commun.*, 1985, vol. 56, no. 3, p. 219.
3. Kivshar', Yu.S. and Rozanov, N.N., *Nelineinosti v periodicheskikh strukturakh i metamaterialakh* (Nonlinearities in Periodic Structures and Metamaterials), Moscow: Fizmatlit, 2014.
4. Samartsev, V.V. and Nikiforov, V.G., *Femtosekundnaya lazernaya spektroskopiya* (Femtosecond Laser Spectroscopy), Moscow: Trovant, 2017.
5. Agafonova, N., Alexandrov, A., Anokhina, A., et al., *Phys. Rev. Lett.*, 2018, vol. 120, no. 21, p. 211801.
6. Hooper, D., *Phys. Dark Universe*, 2012, vol. 1, nos. 1–2, p. 1.
7. Ablyazimov, T., Abuhoza, T, Adak, R.P., et al., *Eur. Phys. J. A*, 2017, vol. 53, no. 3, p. 60.
8. Abramov, V.S., *Proc. 11th Int. Conf. on Chaotic Modeling, Simulation and Applications* (Rome, 2018), Berlin: Springer, 2019, p. 1.
9. Abramov, V.S., *Bull. Russ. Acad. Sci.: Phys.*, 2019, vol. 83, no. 3, p. 364.
10. El Naschie, M.S., *J. Mod. Phys.*, 2016, vol. 7, p. 1420.
11. Abramov, V.S., in *Applied Non-Linear Dynamical Systems*, Awrejcewicz, J., Ed., Springer, 2014, p. 337.
12. Abramov, V.S., *Vestn. Donetsk. Nats. Univ., Ser. A*, 2019, no. 1, p. 59.
13. Ahn, J., Xu, Z., Bang, J., et al., arXiv:1806.06146 [quant-ph].
14. Reimann, R., Doderer, M., Hebestreit, E., et al., arXiv: 1803.11160 [physics.optics].
15. Barnett, R.M., Carone, C.D., Groom, D.E., et al., *Phys. Rev. D*, 1996, vol. 54, no. 1, p. 1.

Translated by N. Semenova