## NUCLEAR PHYSICS

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# THE DETAILED CONSIDERATION OF THE HADRON RADIATION GENERATION BY THE NUCLEONS VIBRATIONS

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The hadron radiation is generated by the great cosmos bodies (Earth, Sun) together with the electromagnetic one. The first approximation theory describes this radiation generation as an yield of the nucleons vibration along the hadron bond. The improved theory is developed and shown for such an example as the helium nucleus. The obtained frequency values directly refer to the solar hadron radiation and can be used as an approximate estimation for the planet one.

*Key words*: nuclear physics, nuclear energetics, planet and solar nonelectomagnetic radiation.

### 1. Introduction

The modern achievements provide us to predict the formation of the new stage of the science-technological progress [1-3]. Under this stage development the planet hadron radiation (i. e. the nuclear — physical one) serves as an energetical resource. One should note that in the last century eighties this radiation was erroneously perceived as the torsion one and then it was discovered the hadron essence of the planet radiation, generated by the high temperature Earth core. The planet hadron radiation produces the stimulation of the various processes on the Earth surface under the additional stimulating action of the analogous solar radiation. The practical usage of the concentrated planet radiation provides us to develop the ecologically pure technologies for different fields: health service, agriculture, food and oil industry, nuclear and alternative energetics [3]. Under the planet technologies development we have to know the planet hadron radiation properties and first of all its spectral characteristics. This topic was studied in a first approximation [4] and now it is time to produce the detailed consideration.

### 2. The description of the model

The hadron generation process was considered on the base of the polymer model of atom nucleus, proposed by the two American scientists [5] and then used by the author [4]. This model points out the similarity between the covalent and hadron bonds. The atoms in the polymer molecule are connected by the short-range covalent bond as well as the nucleons are connected by the similar hadron bond. Besides, the saturation is inherent for the polymer molecule and for the atom nucleus as well. For example the carbon atom attaches only four hydrogen atoms and thus the molecule $CH_4$ is formed but the theoretical molecule $CH_5$ cannot be created. The nuclides are formed in a similar way: a given proton quantity can attach a certain quantity of neutrons.

The discussed properties do not prevent the bonded atoms to produce the small vibrations near the equilibrium point. Due to these vibrations the molecule serves as a source of radiation, the infrared by its name and the electromagnetic by its essence according to the essence of the covalent bond. Thus it is rather reasonable to assume that the bonded nucleons also produce small vibrations, which yield radiation due to the physical essence of the bond. Thus we have considered the nucleus as the hadron oscillator and used for its frequency calculation the known Yukawa potential [5]:

$$U(r) = -B\exp(-kr)/r \qquad (1)$$

where $U$ is the potential; $r$ is the distance between nucleons; $B$, $k$ are the field and space constant correspondingly. In the region $r>r_0$ the potential sharply reduces and a direct action of hadron field on the great distance from the nucleus is negligible. But nevertheless the hadron interaction can provide the remote influence due to the above-mentioned oscillations. The connection between the force and potential is given by the known expression $F = -dU(r)/dr$ . Using this expression we obtain the resulting formula for the hadron force $F_H$:

$$F_H(r) = -B\exp(-kr)(1+kr)/r^2 \qquad (2)$$

The calculation will be produced for the helium nucleus, shown on the fig.1. This nucleus has rather simple structure and at the same time the helium is a component of the Sun matter, which produces the hadron radiation.

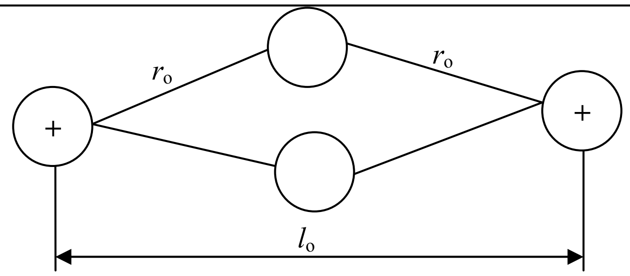


**Fig.1.** The model of the helium nucleus, including the two connected pairs of neutrons o and protons ⊕. The $l_o$ and $r_o$ are the equilibribrium distances.

The equilibrium distance $l_o$ is the nucleus size, which can be valued by the known formula [5]:

$$l_o = 1{,}2A^{1/3} \cdot 10^{-13} cm \qquad (3)$$

where $A$ is the mass number. For helium $A$=4 and thus we obtain: $l_o = 1{,}91 \cdot 10^{-13} cm$ . It can be seen on the fig.1, that the $r_o$ quantity takes the value $0{,}95 \cdot 10^{-13} cm$ .

### 3. The frequency calculation

It is obvious that such a structure has a set of frequencies. The certain frequency ω can be valued by the known expression [6]:

$$\omega = (G/m)^{1/2} \qquad (4)$$

where $m$ is mass (this case, the nucleon one), $G$ is the rigidity coefficient, which can be obtained by the known formula $F=Gx$ where $x=r-r_o$ is the distance near the equilibrium point [6].

The function $F_H(r)$ can be approximated near the equilibrium point by the following expression:

$$F_H(x) = (dF_H(r)/dr)_{r_o} x = G_H x \qquad (5)$$

Substituting (2) in (5) we obtain:

$$G_H = B(a^2 + 2a + 2)\exp(-a)/r_o^3 \qquad (6)$$

where $a = kr_o$. Substituting (6) in (4) and using the values $m = 1{,}67 \cdot 10^{-24} g$ , $a = 1$ [5] we obtain:

$$\omega = 1{,}05 \cdot 10^{12} \cdot \left| B/r_o^3 \right|^{1/2} \qquad (7)$$

This expression was used for the preliminary estimation of the hadron radiation frequency. The usage of the approximate values $B/r_o = 100$ *Mev*, $r_o = 10^{-13} cm$ yielded the following result: $\omega = 1{,}33 \cdot 10^{23}$ radian/sec, what corresponds to $2{,}1 \cdot 10^{22}$ *Hz* [4]. The precise frequency calculation will be produced with the use of the nucleons disposition, presented on the fig.1.

#### *3.1. The neutron vibration*

This vibration mode is produced under the constant distance between protons, which is $l_o$ on the fig.1. We consider the hadron bond as the nuclear analogy of the covalent one and thus the $r_o$ is an equilibrium distance. Hence, under the neutron vibration the two forces (5) simultaneously act as the restoring force $F_R$. Thus, $F_R = 2F_H$ and for this mode the expression (4) takes the following form:

$$\omega_1 = \left| 2G_H/m \right|^{1/2} = 1{,}48 \cdot 10^{12} \left| B/r_o^3 \right|^{1/2} \qquad (8)$$

For this mode $2G_H = G_1$ is the resulting rigidity coefficient. For helium nucleus $B/r_o$=7 Mev

[5], the $r_o$ value was calculated above and thus we obtain: $\omega_1 = 5,2 \cdot 10^{22}$ $radian/\sec$, what corresponds to $8,3 \cdot 10^{21}$ $Hz$.

*3.2. The proton vibration*

The calculation of the proton vibration frequency can be produced with the use of the Coulomb repulsion force $F_C$, decribed by the known formula:

$$F_C(l) = q^2 / l^2 \qquad (9)$$

where $q$ is proton charge, l is the distance between protons. In the equilibrium state the repulsion force $F_C(l)$ is compensated by the two hadron forces $F_H(r)$, i. e. $F_C(l_o) = 2F_H(r_o)$. Thus, the equilibrium condition is given by the following expression, obtained by the use of the (9) and (2) ones:

$$q^2 / l_o^2 = 2B \exp(-a)(1+a) / r_o^2 \qquad (10)$$

It occurs that the Yukawa potential parameter $B$ can be valued by the known table magnitude. Under $a$=1, $l_o$=2$r_o$ we obtain: $B$=0,17$q^2$. Substituting this value in (6) under $a$=1 we obtain:

$$G_H = 0,31 q^2 / r_o^3 \qquad (11)$$

This expression provides the consideration of the proton vibrations, which depend on the two forces: hadron and Coulomb. The function (9) can be approximated near the equilibrium point by the following expression:

$$F_C(x) = (dF_C(l)/dl)_{l_o} x = G_C x \qquad (12)$$

where $x=l-l_o$. Substituting (9) in (12) we obtain:

$$G_C = -2q^2 / l_o^3 \qquad (13)$$

It can be seen on the fig.1, that there are the two modes of the proton vibrations: **external** and **inside**. Under the **external** vibration the two hadron forces (5) play the role of the restoring force, which is weakened by the Coulomb force (12). Thus for this mode the restoring force $F_R(x) = 2F_H(x) - F_C(x)$. Substituting (5) and (12) in this expression and using the (11) and (13) we obtain the resulting rigidity coefficient $G_2$ for the proton external vibration:

$$G_2 = 2G_H - G_C = 0,37 q^2 / r_o^3 \qquad (14)$$

Substituting (14) in (4) we obtain the expression for the external proton vibration frequency $\omega_2$:

$$\omega_2 = (0,37 q^2 / m r_o^3)^{1/2} \qquad (15)$$

Using the table values $q = 4,8 \cdot 10^{-10}$ $CGSE$, $m = 1,67 \cdot 10^{-24} g$ and the calculated value $r_o = 0,95 \cdot 10^{-13} cm$, we obtain: $\omega_2 = 7,8 \cdot 10^{21} radian/\sec$, what corresponds to $1,24 \cdot 10^{21} Hz$.

The obtained $\omega_2$ value is in the good agreement with the $\omega_1$ one despite the different ways of the parameters evaluation. For the (8) expression we used the experimental $B/r_o$ value [5], whereas the (15) one includes the parameter B evaluation, obtained by the (10) equality. The frequencies values agreement proves the used approach reliability.

Under the **inside** proton vibration the Coulomb force $F_C(x)$ acts as a restoring force together with the $2F_H(x)$. Thus for this mode the rigidity coefficient $G_3$ takes the following form:

$$G_3 = 2G_H + C_C = 0,87 q^2 / r_o^3 \qquad (16)$$

Substituting (16) in (4) we obtain the expression for the inside proton vibration frequency $\omega_3$:

$$\omega_3 = (0,87 q^2 / m r_o^3)^{1/2} \qquad (17)$$

Using the mentioned parameters values, we obtain: $\omega_3 = 1,2 \cdot 10^{22}$ $radian/\sec$, what corresponds to $\omega_3 = 1,9 \cdot 10^{21}$ $Hz$.

The $\omega_3$ value also is in the good agreement with the $\omega_1$ one.

## 4. Discussion

The principal achievement of this work is the agreement between the two ways of the frequency value estimation, exactly to say, the estimation of the Yukawa potential parameters. The first way is the usage of the experimental value of the nucleon bond energy for the helium nucleus: the expression (8) was valued by such a way. The second way was rather different, it was used the equilibrium condition (10) and the rigidity coefficient (6) takes the (11) form. The neutron and proton vibrations frequencies were calculated by the first and second ways, correspondingly, and the obtained values are in good agreement.

We have to note that the possibility of the nuclear energy photons generation was considered in 1964 by Feynman in connection to the Yukawa potential [7]. And only in 1996 this assumption was proved by the theory, which futher development is produced in this work.

The following step in this direction is the estimation of the Planck constant quantity for the hadron radiation, generated at the expense of the thermal energy. The nucleus receives the thermal energy by encounter and thus namely the proton inside vibration is the most probable among the others modes. The thermal quantum energy $E$ is usually valued by the known expression $E = kT$ , where $k$ is Boltsman constant, $T$ is temperature. It is assumed that for the Earth centre the approximate value $T$=6000 $^{o}$K has place and thus for $E$ we can take the value 0,52 eV. This quantity can be used for the estimation of the Planck constant value for hadron radiation $\hbar_H$, using the known expression in respect to this radiation: $E = \hbar_H \cdot \omega$ . Using the calculated frequencies average value $\omega = 10^{21}$ radian/sec, we obtain the following approximation: $\hbar_H = 5{,}2 \cdot 10^{-22}$ eV· sec, what is less than the usual electromagnetic value by the seven orders of magnitude.

The hadron radiation stimulates the different chemical reactions [3], for example, the reaction

$$H_2O \rightarrow H^+ + OH^-$$

takes the energy 5,2 eV, what is ten times greater than the hadron quantum energy. It is obvious that the hadron radiation action on an atom or molecule is produced via the hadron quanta accumulation by the mentioned objects. The radioactivity stimulation by the hadron radiation is produced via the resonance absorption of hadron quantum, which serves as the trigger action for the nucleus destruction, perceived till now as the “spontaneous radioactivity” [4].

The obtained set of frequencies shows the solar hadron radiation spectrum so as the helium nucleus is a component of the solar matter. What refers to the planet radiation, one has to note that according to the geophysical assumption the high temperature Earth core includes such chemical elements as ferrum and cobalt, which nuclei have 56 and 59 nucleons, correspondingly. Thus these nuclei have more complex spectrum of hadron radiation whereas the obtained helium values can be used as an approximation for this spectrum estimation.

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## Детальное рассмотрение процесса генерирования адронного излучения путем вибрации нуклонов


Адронное излучение генерируется крупными космическими телами наряду с электромагнитным излучением. В первом приближении генерирование данного излучения рассматривается как следствие вибрации нуклонов вдоль адронной связи. Разработана усовершенствованная теория, показанная на примере ядра гелия. Полученные значения частоты излучения непосредственно относятся к солнечному адронному излучению и могут быть использованы в качестве приблизительной оценки для аналогичного планетарного излучения.


*Ключевые слова:* ядерная физика, ядерная энергетика, планетарное и солнечное неэлектромагнитное излучение.