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A Mysterious Consequence of Moessbauer's Effect

V.N.Strel'tsov strlve@sunhe.jinr.ru

Laboratory of High Energies
Joint Institute for Nuclear Research
Dubna, Moscow Region 141980, RUSSIA

Abstract: The monochromatics of the Moessbauer radiation is ensured by that the totality of nuclei recoiling upon itself. The estimation of the transmission speed of the corresponding interaction from a radiating nucleus to surrounding ones gives a value considerably exceeding the light velocity.
Keywords: Moessbauer's effect, superlight velocities.

Moessbauer's effect (ME) [1] discovered in the middle of the past century is now an important method of research (the Moessbauer spectroscopy). In particular, its use allows one to observe a very subtle effect of quanta frequency shift in Earth's gravitational field [2]. It should be marked that the calculation of this effect served as a decisive argument in favor of the relativistic gravidynamics (the theory of gravivector field) [3].

On the other hand, the ME is an important instrument for the investigation of the very radiation mechanism. Recall that the ME is elastic emission or γ-quanta absorption by atomic nuclei bound in a rigid body (crystal). This is achieved by that the recoil momentum is transmitted not to a individual nucleus but to all the crystal (or its part - "pattern"). The exceptional narrowness of the Moessbauer lines allows one to say about the monochromatics of this radiation. The γ-quanta with energy E_0 of the corresponding nuclear transition and inverse frequency (period) ν^{-1}=T=h/E_0 form it. In order to ensure the radiation monochromatics, the " interaction time" t of the radiating nucleus with a pattern (surrounding nuclei) must be considerably smaller than the time characteristic of radiation presented by T:

$$t \ll T. \tag{1}$$

It is evidently that one can say about the radiation without recoil (since all the pattern takes recoil upon itself). For this, the very duration of radiation can anyhow exceed t.

At the same time, in order that ME may take place the recoil kinetic energy (R) transmitted to the pattern must not exceed the width of the emission line (Γ) since the energy of the radiated γ-quantum is

$$h\nu = h\nu_0 - R. \tag{2}$$

Based on the value of Γ, we estimate the mass of the corresponding pattern (on condition that R=0.1 Γ). For example, for γ-radiation of Fe^{57} with $h\nu_0$=14.4 KeV, we obtain

$$M_1 c^2 = \frac{(h\nu_0)^2}{2(0{,}1\Gamma)} = 2\cdot 10^{13}\,KeV \qquad (3)$$

Whence using the Fe^{57} atom mass $mc^2=5\cdot10^7$ KeV, we get that the number of atoms in the given pattern must be

$$N_1=4\cdot10^6. \qquad (4)$$

Leaned upon the lattice parameters (d), for the linear size of (spherical) pattern we obtain

$$D_1 = \left(\frac{3N}{4\pi}\right)^{1/3} d = 290\,\mathring{A} \qquad (5)$$

For γ-rays of Ag^{107} with the energy $h\nu_0$ =93 KeV we have

$$D_2 = 4\cdot10^5 \mathring{A}. \qquad (5')$$

Knowing the linear pattern sizes and the propagation time of interaction (on condition that t=0,1T), one can estimate the speed of its transmission. It is

$$v_1=2\cdot10^4\ c \quad \text{and} \quad v_2=2\cdot10^7\ c. \qquad (6)$$

These velocities are involuntarily associated with the known hypothetical particles: tachyons. They exceed significantly the top speed of light c, and all the more the sound velocity with which, as we know, elastic waves propagate in a rigid body. To the point, in this case for the propagation time of interaction we respectively get

$$t_1=1.4\cdot10^8\ T_1, \qquad t_2=4\cdot10^{13}\ T_2\ . \qquad (7)$$

As seen, the necessary condition of the radiation monochromatics (1) is considerably violated.

Conclusion. The revealed contradiction calls at least in question the existing representation of the radiation mechanism. And may this phenomenon give us a new surprise as at the beginning of the past century? In any case, the considered problem is worthy of the very great attention.

References

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