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THEORETICAL ASPECTS OF POWER OPTICAL RADIATION OF BIOLOGICAL OBJECTS

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Theoretical study of the interaction of photons with electrons optical radiation irradiated structures based on the laws of quantum biophysics

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The impact of the use of electromagnetic energy, including light emission, the irradiation of biological objects depends on understanding the mechanism of interaction of energy from perceiving structures irradiated object.

The purpose of research - to investigate the mechanism of optical energy radiation on biological body irradiated.

Materials and methods of research. The study used tenets and laws of quantum mechanics and theoretical biophysics.

Results. According to the laws of quantum physics interaction of electromagnetic fields with structures (electrons, atoms or molecules irradiated body) adopted to describe the quanta of energy. Energy quantum is inversely proportional to its wavelength distribution λ. The wave nature of propagation of electromagnetic radiation in space, usually represented as a differential equation superposition of plane waves.

In the classical theory of Maxwell interaction of matter (electrons) with radiation described by

$$H' = \frac{1}{c}\int (A \cdot j) d^3x \tag{1}$$

A - the vector potential of the radiation field, and j - density electronic excitation of molecules of substances which operates the field.

$$A = \sum_{k\lambda} \sqrt{\frac{2\pi c\hbar}{kV}}\, u_k^{(\lambda)} (b_{k\lambda} e^{ik\cdot r} + b_{k\lambda}^{\dagger} e^{-ik\cdot r}) \qquad (2)$$

where ukλ - unit vector field, and - amplitude perpendicular plane waves, and the index of λ corresponding to two transverse polarization states of a photon

In the energy density of the final states of the scale of the laws of the Schrödinger probability of excitation of electrons is completely determined by the energy of photons absorbed by them:

$$\rho_f = \frac{k^2 dk d\Omega_k V}{(2\pi)^3 \hbar c dk} = \frac{V}{8\pi^3 \hbar c} k^2 d\Omega_k \qquad (3)$$

where dΩ_k - spatial unit solid angle at which the photon is falling; V - volume of the interaction of photons with electrons.

The final expression for determining the probability of radiative excitation of molecules of the body photons of electromagnetic field has the form

$$P_{k,\lambda} = \frac{e^2}{\hbar c} \frac{4\pi^2 \nu^3}{c^2} d\Omega_k |\langle f | u_k^{(\lambda)} \cdot r | i \rangle|^2 \qquad (4)$$

The matrix element appearing in the expression can be written as the product

$$\langle f | u_k^{(\lambda)} \cdot r | i \rangle = (u_k^{(\lambda)} \cdot r_{if}) \qquad (5)$$

The conclusions

Analysis of the expression (5) shows that the left side of the equation is a characteristic electromagnetic field and determines the direction of polarization of departure and the emitted photon, and the right of internal parameters can be determined irradiated atom. That data support the possibility of mathematical calculations to justify the likelihood of occurrence photophysical reactions excitation of atoms or molecules of matter irradiated optical radiation based on consideration of the spectral composition of radiation and molecular structure irradiated body. What is shown in a further theoretical studies.