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On resonant properties of nuclear internal electronic conversion

Nuclear internal electronic conversion (NIC) is the transfer of nuclear excitation energy ΔE to atomic electron and formally is described by the same Feynman diagram as the elastic scattering of two free charged particles. But these processes differ from each other by the character of particles interaction with electromagnetic (EM) field. In the elastic scattering the interchange of energy ΔE between particles in general does not fix the frequency ϖ of virtual photons and the scattering amplitude depends on intensity $I(\varpi)$ of zero-point quantum fluctuations of EM field and photons in the scattering region in wide frequency range, and not only at the transition frequency $\Delta E=\hbar w_{res}$. In contrast, as it is shown in the present work, because only the discrete nuclear energy levels are taking part in NIC and always their half-life $T1/2>>h/\Delta E$, NIC probability is proportional to the intensity $I(\varpi_{res})$ of the EM field modes near resonant frequency ϖ_{res} only. So, NIC is stimulated by EM field as in the same fashion that the transition with γ-quantum radiation and for instance in γ-laser the NIC stimulation would compete with the γ-radiation stimulation. Such resonant character of NIC leads to the suppression of low energy NIC inside metallic matrix because the matrix can suppress zero-point EM fluctuations at resonant frequency ϖ_{res}. By such way can be explained the observed strong suppression of NIC for nuclear isomers ^{235m}U (ΔE=76 eV), ^{154m}Eu (ΔE=910 eV) and ^{99m}Tc (ΔE=2.17 keV) inside metallic matrixes.

Biography

Vladimir Koltsov has graduated in 1976 from the Sub-Faculty of Nuclear Physics, Faculty of Physics and Mechanics at St. Petersburg Polytechnic Institute, Russia. He works as a Researcher at the Khlopin Radium Institute, St. Petersburg. On the topic of this work, he has published more than 20 articles in reputed journals.

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