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BIC versus NEET as the two mechanisms of the nuclear optical resonance

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Making use of the mediating role of the electron shell for mastering nuclear reactions with the help of lasers was proposed as BIC (Bound Internal Conversion). The effective way was offered of accelerating nuclear deexcitation rate by virtue of the non-linear effect of merging two photons on the electron shell. One of the photons comes from the excited nucleus, and the other from the externally applied laser field. If the energy of the both photons matches the atomic energy, the probability increases drastically. For this reason, BIC was also named Resonance Conversion. The Resonance Conversion theory was summed and rounded up specifically, the role of energy conservation was described in detail. Actually, this is internal conversion to an intermediate bound electron state. BIC was experimentally observed and reverse BIC can be applied as an effective tool of nuclear excitation by laser. From such standpoint, one of the most perspective nuclei looks 229Th, where splitting of the ground and excited levels is minimum and makes less than 10 eV. The unique properties of the nuclide allow construction of nuclear frequency standard and nuclear clock, with the minimum error at the level of 10-19 and less. Improvement by a factor of 100 – 1000 of the constraints on the variability of several important fundamental constants also appears possible. Here it works similar to another mechanism of nuclear excitation by laser Nuclear Excitation in Electronic transition (NEET). The way of restoring the energy is the distinguishing feature due to which the both mechanism can be classified. Thus, the name of NEET may be ascribed to a process induced by creation of a hole in the electron shell, which is on the mass shell. In contrast, BIC was intended as a generally off-shell process from the very beginning. The latter mechanism turns out to be much more effective for laser pumping the few-eV isomer of the $^ {229}$Th. We will discuss the prospect of application of BIC and NEET for the two-photon pumping this isomer.

Biography

Feodor F Karpeshin is graduated from the Saint-Petersburg State University. He is Aspirant in Petersburg Nuclear Physics Institute. He worked as a Research Scientist, Professor at the Saint-Petersburg State University, Bonn, Bordeaux, University of Coimbra (Portugal), Weizman Institute of Science, Kharbin Polytechnic Institute and Mendeleev Institute for Metrology (up to present). He stayed as a Visiting Professor at the University of Naples, Aristotle University of Thessalonica, University of Warsaw, Polytechnic University of Zurich, Paul Scherer Institute at Villigen, University of Pisa. He is the Contractor of DTRA, RFFI and other foundations. He is author of 150 science papers in refereed journals. He has monography on *Prompt Fission in Muonic Atoms and Resonance Conversion*, Science, Saint-Petersburg, 2006. His main fields of interests are Electrodynamical Processes in the interdisciplinary field of Atomic, Molecular and Nuclear Physics, dynamics of interaction with strong electromagnetic field, laser-produced plasma. He has theoretical research in close contact with experiment in which the new concept has been developed of resonance enhancement of action of the electromagnetic radiation on the nuclei via resonance internal conversion.

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