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TUNING THE NEET PROBABILITY

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Of great interest are nuclides, in which there are excited state with extremely low energies, within the scale of e few eV or keV: 201Hg, 189Os, 237Np, 235U, 229Th and other nuclides. Such levels are isomeric owing to small their energies. They effectively mix up with close atomic levels, forming resonances in the optical domain [1]. This gives the chance to operate with the lifetimes of these isomers in a resonant field of laser radiation. One can exploit various proper schemes of NEET –Nuclear excitation by Electron Transition for the purpose of producing the isomers through optical pumping, and measuring their precise energy [2]. Unlike the atomic spectra, the nuclear lines are stable against influence of external fields and environment. They possess rather narrow widths. These advantages do their use attractive in many aspects, including creation of reference points of frequency in the optical range. This gives basis for development new nuclear technologies, founded on application of lasers for mastering nuclear processes. From such standpoint, one of the most perspective looks 229Th, in which nucleus the splitting of the basic and excited levels is minimum and makes less than 10 эВ. There are projects of creation of an atomic clock on this transition with an uncertainty within 10-21.
However, there is a problem induced by extremely small probability of NEET. In all the considered cases, it is ˜10-8 and smaller. This makes extremely difficult the optical pumping of the isomer. We offer the way of enhancing this probability radically, up to values of the order of unity, by scanning the resonance defect with a laser, as proposed in Ref. [3] for inducing the isomer depletion.

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