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RESONANCE MECHANISMS OF NUCLEAR REACTION ENHANCEMENT IN A LASER FIELD

2024 will go down in history as the year of the nuclear clock. Two groups independently performed direct excitation of the 8 eV isomer 229Th with a laser, successively diminishing the uncertainty of its energy by 12 orders of magnitude [1,2]. Now this energy is taken to be 8.355740(3) eV [1]. More than 10 years were spent on developing the technologies. It could have been done much earlier and easier if the resonance properties of the electron shell had been used within the vlines of the papers of 1990-1999. Calculations of the probabilities of triggering the energy of nuclear isomers 235U, 229Th, 125Te, 169Yb, 178m2Hf demonstrated the high efficiency of resonance schemes. The most efficient scheme for excitation of the isomer 229Th with a laser is presented by the Feynman diagram in the figure. The nucleus transfers to the isomeric state as a result of virtual exchange of a photon with a valence electron. The electron gets below the mass surface. It then absorbs a photon from the laser field and passes to the final state 7p. Analysis of this scheme leads to the conclusion [3] that it is 200 times more efficient than those exploited in [1,2].

References

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Section

Energy and materials science (Section 2)

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