

Plenary Talk

PLV VIII Thu 9:45 HS 1+2

Nuclear laser spectroscopy and the optical nuclear clock —

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Recently, three experiments have obtained resonant laser excitation of a low-energy nuclear transition, from the ground state of Th-229 to its isomeric state at 8.4 eV, using table-top laser systems at a wavelength of 148 nm in the vacuum-ultraviolet. The thorium nuclei have been prepared as dopant ions in VUV-transparent crystals, like calcium fluoride. This opens a new field for experiments that connect nuclear physics with atomic physics, where a nuclear transition occurs

in the energy range that is typical for transitions of atomic valence electrons. Among several possible applications, the development of an optical nuclear clock seems particularly attractive. This clock would offer high accuracy, especially with laser cooled trapped Th-229 ions, high stability, because of the high number of nuclei that can be interrogated in Th-229-doped solids, and high sensitivity in clock-based tests of fundamental principles of physics, involving the strong interaction in addition to electromagnetism. A detailed microscopic picture of why Th-229 possesses these nearly degenerate levels is an open question, but studies of the hyperfine structure of the nuclear and electronic transitions provide information on the relevant nuclear properties like the magnetic moment and the charge distribution.