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Investigation of the optical transition of the ^{229}Th nucleus in a solid-state environment[1] WADE RELLERGERT, SCOTT SULLIVAN, UCLA, DAVID DEMILLE, Yale, RICHARD GRECO, MARKUS HEHLEN, JUSTIN TORGERSON, LANL, SAED MIRZADEH, ORNL, ERIC HUDSON, UCLA —
We describe a novel approach to directly measure the energy of the narrow, low-lying isomeric state in ^{229}Th. Since nuclear transitions are far less sensitive to environmental conditions than atomic transitions, we argue that the ^{229}Th optical nuclear transition may be driven inside a host crystal with a high transition Q. This technique might also allow for the construction of a solid-state optical frequency reference that surpasses the precision of current optical clocks, as well as improved limits on the variability of fundamental constants. Based on analysis of the crystal lattice environment, we argue that a precision of $3 * 10^{-17} < \Delta f/f < 1 * 10^{-15}$ after 1 s of photon collection may be achieved with a systematic-limited accuracy of Δf/f $\sim 2 * 10^{-16}$. Improvement by a factor of 10^2 to 10^3 of the constraints on the variability of several important fundamental constants also appears possible. We report on recent results aimed at directly measuring fluorescence from the transition.

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