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Electronic Bridge schemes in ^{229}Th doped LiCAF

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The thorium isotope ^{229}Th has attracted a lot of interest over the past few decades. This is related to its extremely low-lying first excited state at $\sim$ 8 eV and long radiative lifetime of a few 10^3 s [1]. This makes ^{229}Th an ideal candidate for a nuclear clock with outstanding properties promising a variety of applications [2].

Large band gap crystals such as CaF_2 or $LiCaAlF_6$ (LiCAF) hosting ^{229}Th have been proposed for the operation of a solid-state nuclear clock.
Among others, these crystals are transparent at the wavelength of the clock transition and a large number of nuclei can be interrogated at the same time [3]. However, DFT simulations of such environments indicate that doping of ^{229}Th leads to the formation of localized electronic states in the band gap, so-called defect states [4]. These states can be used for effective nuclear excitation via the Electronic Bridge mechanism, as we could show in the case of Th-doped CaF_2 crystals [4,5].

Here, we investigate theoretically different laser-assisted Electronic Bridge schemes for ^{229}Th doped LiCAF crystals and present the corresponding excitation rates. Similar to CaF_2 crystals, these schemes can provide, depending on the energetic position of the defect states, orders of magnitude stronger nuclear excitation/deexcitation compared to direct photoexcitation with current laser technology. The results are discussed in conjuncture with the design of a solid-state nuclear clock.
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