Excitation Mechanisms for the 229-Th Nuclear Clock Transition

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Incredibly precise nuclear clocks may soon outperform and replace the present atomic clocks that define the global time standard. The only known nuclear transition in the range of vacuum-ultraviolet (VUV) lasers occurs in 229-Thorium and promises such a novel and unprecedently precise nuclear clock. The nuclear excited level is a metastable state with an energy of 8.19(12) eV, allowing driving with VUV lasers. As a high-precision oscillator whose frequency is predominantly determined by the strong interaction, the 229-Thorium transition also offers an increased precision for the determination of fundamental constant variations.

The talk will discuss two nuclear excitation mechanisms which use optical or x-ray lasers to drive the nuclear transition. First, the electronic bridge mechanism will be discussed, in combination with optical fields, either in highly charged ions [1] or in Th-doped VUV transparent crystals [2]. Second, recent theoretical results for x-ray pumping of the nuclear isomer via the second excited state at 29 keV using coherent population transfer techniques will be presented [3].

References

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