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Nuclear structure and coupling to the atomic shell in the ^{229m}Th isomer

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Abstract

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}Th and promises such a novel and unprecedently precise nuclear clock. The nuclear excited state is the isomer ^{229m}Th with energy of 8.19(12) eV, which can be in principle driven by VUV lasers. As a high-precision oscillator whose frequency is predominantly determined by the strong interaction, the ^{229}Th isomeric transition also offers an increased precision for the determination of fundamental constant variations.

The talk will follow the newest theoretical developments in two directions. First, we will briefly present our macroscopic nuclear structure understanding of the isomer formation at a such low-lying energy [1]. Second, the strong coupling to the atomic shell in the processes of internal conversion and electronic bridge will be discussed. We will focus on electronic bridge in both highly charged ions [2] and in VUV-transparent crystals [3, 4] that can be used to more precisely pin down the isomer energy, and to improve the nuclear clock performance.

References

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