Int. Workshop “Shapes and Dynamics of Atomic Nuclei: Contemporary Aspects”
ed. Nikolay Minkov, Heron Press, Sofia 2021

Perspectives towards the ^{229m}Th Nuclear Clock

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Abstract

Due to its low excitation energy of about 8.19(12) eV, the elusive ^{229m}Th isomer is so far the only candidate to realize an ultra-precise nuclear clock, potentially able to surpass the performance of the best present atomic clocks. Moreover, a nuclear clock promises a variety of intriguing applications [5], from time-dependent metrology of fundamental constants and search for dark matter to relativistic geodesy. Recently, drastic progress could be achieved in characterizing the thorium isomer, from its (internal conversion) decay [1], the lifetime of the neutral isomer [2], the hyperfine structure of the isomer [3] to finally a considerably improved determination of the isomeric excitation energy [4].
On the basis of the recent achievements the talk will outline the strategy and ongoing activities towards the realization of world’s first optical nuclear clock. Short-term goals are a first measurement of the ionic lifetime of ^{229m}Th in a cryogenic Paul trap and the development of a VUV laser system to achieve a first optical excitation of the nuclear isomer with laser spectroscopic precision. These activities are embedded in the ERC Synergy Grant Project ThoriumNuclearClock, which will also be introduced [6].

References

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