

"Steps toward a first nuclear frequency standard: improving our knowledge about the ^{229}Th nuclear isomer," by Lars von der Wense (JILA, University of Colorado at Boulder)

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A nuclear optical clock based on a single ^{229}Th ion is expected to achieve a higher accuracy than the best atomic clocks operational today [1]. Although already proposed back in 2003 [2], such a nuclear frequency standard has not yet become reality. The main obstacle that has so far hindered the development of a nuclear clock is an imprecise knowledge of the energy value of a nuclear excited state of the ^{229}Th nucleus, generally known as the ^{229}Th isomer. This metastable nuclear excited state is the one of lowest energy in the whole nuclear landscape and - with an energy of less than 10 eV - offers the potential for nuclear laser spectroscopy, which poses a central requirement for the development of a nuclear clock.

In the past few years significant progress toward the development of a nuclear frequency standard has been made: Starting with a first direct detection of the ^{229}Th isomer in 2016 based on its internal conversion decay channel [3], the isomeric lifetime could be determined in 2017 [4], followed by a first laser-spectroscopic characterization in 2018 [5]. Most recently, a first energy determination based on the isomer's direct detection was successful [6]. This new knowledge is the basis for improved efforts toward the laser-based search of the nuclear transition, which can ultimately lead to the development of a nuclear optical clock [7, 8].

In the presentation I will give an overview over the current status of the nuclear clock development, with a particular focus on the most recent progress. Also the next required steps will be detailed and future perspectives will be given.

References

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