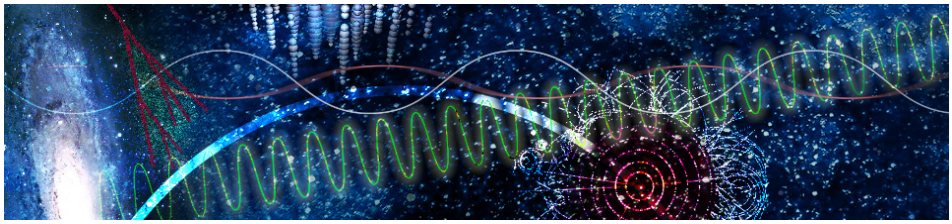

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Towards Precision Physics with Trapped Thorium Ions: TACTICa at a Glance

Thorium isotopes became of high interest in the search for fundamental physics and for testing of the standard model of particle physics because of their unique nuclear and atomic properties [1,2]. In the project Trapping And Cooling of Thorium Ions via Calcium (▨▨▨▨▨▨▨), ion trapping and spectroscopic techniques are developed for a precise determination of nuclear moments, hyperfine intervals, and isotope shifts with different Th isotopes [3]. Two methods are used to produce atomic thorium ions, i. e., laser ablation of macroscopic thorium samples [3] and thin layers of alpha-decaying uranium isotopes which produce thorium daughter nuclei that recoil from the sample with the momentum imparted by the alpha decay [4]. While the former process yields predominantly singly charged ions, the latter also leads to substantially more highly charged ions [4]. Within this project, laser ablated thorium-232 ions were trapped in a linear Paul trap [3], a recoil ion source providing electrostatically decelerated Th ions [4] has been built and commissioned, and an apparatus for systematic studies of the laser-ablation production of atomic and molecular Th ions has been developed. Laser ablation and in-flight reactions are used for the production of molecular thorium ions. Molecules including ThF [5] are of interest in the search for scalar dark matter [6] and could be used as quantum sensors to search for CP violations [7]. For this, further experiments are aimed at investigating the laser ablation behavior of different thorium isotopes in salt-based form and the formation and delivery of different thorium molecules from chemically different Th samples.
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