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Laser spectroscopy of triply charged Th-229 toward a nuclear clock

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Abstract

The first-excited nuclear state of Thorium-229 (229mTh) can be excited from the ground state by a vacuum ultraviolet laser. One of its applications is a nuclear clock: an atomic clock based on the nuclear transition between the ground state and 229mTh.
An ion trap is an optimal system for the nuclear clock because the quantum states of the 229Th ion in a trap can be precisely controlled by laser cooling. We developed an ion trap system of triply charged 229Th (229Th3+). The 229Th recoil ions emitted from 233U were cooled by collisions with a helium buffer gas and extracted as a low-energy ion beam by an RF carpet. Since 2% of the recoiled 229Th ions from 233U is 229mTh, laser spectroscopy of trapped 229mTh3+ ions can be performed. Such measurements provide detailed knowledge of this unique nuclear state. In this presentation, we will present details on our experiments of trapping and laser spectroscopy of 229Th3+.