Contribution ID: **40** Type: **Oral Presentation**

The extraction of 229Th3+ from a buffer-gas stopping cell

Thursday, 14 May 2015 09:50 (20 minutes)

Among all known nuclear isotopes, 229Th possesses the lowest nuclear excitation, revealing an energy of just 7.6 eV above the ground state. This low energy is equivalent to a wavelength of the corresponding gamma-ray of about 160 nm, which is set in the VUV region and conceptually allows for the application of laser-spectroscopic methods to the nucleus. The excited state is predicted to be isomeric with a half-life of up to several hours, which would lead to an extremely sharp linewidth, making the isomeric ground-state transition of 229Th an ideal candidate for a nuclear-based frequency standard.

So far, however, the energy of the isomeric state has not been measured precisely enough to allow for a direct optical access to the transition. Further, the direct observation of the isomeric ground-state decay has not been conclusively proven, so that, besides the exact energy, also the half-life and the gamma branching-ratio have to be stated as unknown.

In our approach to directly detect the isomeric ground-state transition, 229Th is populated via a 2 % decay branch in the alpha-decay of 233U. 229(m)Th recoil ions, as produced by a 233U source, are stopped within ultrapure He in a buffergas stopping cell strictly designed to UHV standards. The ions are then extracted with the help of electric guiding fields and a supersonic Laval nozzle. Successively, a sub-mm diameter ion beam is formed by an RFQ guiding structure. Having formed an ion beam allows for a mass-purification of the extracted recoil ions with the help of a customized quadrupole mass separator, designed for high transmission. In this way, possible decays from short-lived daughters in the decay chain are highly suppressed. A search for photons and electrons originating from the isomeric deexcitation is performed behind the QMS. This concept has the advantage that a measurement of the transition can be performed within an environment of ultra-low background, which opens up the way for an unambiguous identification of the isomeric decay.

Obviously, a large combined extraction and mass-purification efficiency of 229Th ions is of major importance for this concept. Measurements were performed to quantify this efficiency. Surprisingly, a large extraction efficiency of 10 % is obtained in the 3+ charge state. This is the first time, that a significant extraction rate in the 3+ charge state could be observed from a buffer-gas stopping cell.

This work was supported by DFG (Th956/3-1).

Primary author: Mr VON DER WENSE, Lars (Ludwig-Maximilians-University Munich)

Co-authors: Mr SEIFERLE, Benedict (Ludwig-Maximilians-University Munich); Dr LAATIAOUI, Mustapha (GSI GmbH, Darmstadt); Dr THIROLF, Peter G. (Ludwig-Maximilians-University Munich)

Presenter: Mr VON DER WENSE, Lars (Ludwig-Maximilians-University Munich)

Session Classification: Session 12