High-resolution resonance ionization spectroscopy of actinides in a Supersonic Gas Jet

R. Ferrer, P. Chhetri, A. Claessens, A. de Roubin, F. Ivandikov, Yu. Kudryavtsev, S. Pineda, P. Van Den Bergh, P. Van Duppen and the JetRIS@GSI and S3-LEB@GANIL collaborations

Instituut voor Kern- en Stralingsfysica, KU Leuven, Leuven, Belgium

Resonance ionization and spectroscopy are widely used techniques at radioactive ion beam facilities to produce pure beams of exotic nuclei and to measure isotope shifts, electromagnetic moments and spins of these nuclei. In such measurements on the heaviest elements, however, it is difficult to combine a high efficiency with a high spectral resolution. A significant improvement in the spectral resolution by more than one order of magnitude was demonstrated without loss in efficiency by performing laser ionization spectroscopy of actinium isotopes in a supersonic gas jet [1]. This novel spectroscopic method [2] is thus suited for studies of the ground- and isomeric-state properties of the hardly accessible actinide elements with an unprecedented spectral resolution and a high efficiency using JetRIS [3] behind SHIP (GSI) and S3-LEB [4] behind S3 (GANIL).

Offline characterization studies at KU Leuven have been carried out to optimize the performance of the technique, dealing with the fluid dynamics and the formation of supersonic jets produced by different gas-cell exit nozzles [5] as well as with the characterization of narrow bandwidth and high-power lasers for accurate and efficient spectroscopy studies in the gas jet. Moreover, studies to demonstrate the existence of the nuclear-clock isomer in the singly-charged ^{229}Th ion by means of in-gas-jet laser spectroscopy measurements are ongoing [6] that complement current and future measurements on this isomer performed at ISOLDE (CERN).

In my talk I will summarize the main results of the preparatory studies to apply the in-gas-jet laser spectroscopy method on the actinide elements at GSI and GANIL, and will show the most recent results obtained with these setups as well as the results of our studies of ^{229}Th^{+} obtained at KU Leuven.

References:

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