DEVELOPMENT OF AN ACTINIDE ION SOURCE BY IN-GAS-CELL LASER RESONANCE IONISATION AT THE IGISOL FACILITY

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High resolution optical spectroscopy for measuring nuclear ground and isomeric state properties has thus far been limited in the heavy actinide element region. Therefore, a program of research towards obtaining such information is currently ongoing at the IGISOL facility of the University of Jyväskylä. Access to actinide nuclei can be realised through laser ionisation of bulk (ng) samples of material produced in nuclear reactors. Via this method the first measurement of several long-lived isotopes of plutonium has been performed at the collinear laser spectroscopy facility [1, 2] and in the near future, measurements on thorium isotopes will commence, including thorium-229, related to the search for the elusive low-energy isomeric state.

In order to provide ion beams of actinide elements, a new gas cell has been constructed taking into account the high purity and fast extraction requirements for in-gas-cell laser ionisation. Resonance laser ionisation has been successfully performed on isotopes of plutonium [3] and thorium evaporated from tantalum filaments via electro-thermal heating inside the gas cell. Characterisation of the gas cell has been done by studying the chemical and dynamic processes. In this presentation the characterisation of the gas cell as well as the laser ionisation studies of both elements will be presented.

[1] B. Cheal, D. H. Forest, Hyperfine Interact. 223, 223-230 (2014).
[2] A. Voss, et .al., High-Resolution Laser Spectroscopy of Long-Lived Plutonium Isotopes, submitted to Phys. Rev. A (2017).
[3] I. Pohjalainen, et. al., Nucl. Instr. Meth. B 376, 233-239 (2016).