Contribution ID: **18** Type: **Short contribution**

Spectroscopy of low-lying states in neutron-deficient astatine and francium nuclei

Tuesday, 11 November 2014 14:40 (20 minutes)

Recent years have been a particularly active period in the study of neutron-deficient astatine and francium nuclei. For instance new isotopes and new isomers have been reported [1,2,3,4,5], and laser-spectroscopic studies have been performed [6,7]. In this contribution we would like to report on results from in-beam and decay-spectroscopic studies performed in this region using fusion-evaporation reactions with stable heavy-ion beams at the accelerator laboratory of the University of Jyväskylä, Finland (JYFL).

Shape coexistence, associated with the intruder picture, has been studied extensively in the region of neutron-deficient nuclei close to lead. A motivation for the study of particularly astatine and francium nuclei that lie three and respectively five protons above the shell closure, is the question of the prevalence of the intruder picture, as the shell
closure moves further below the Fermi surface. In the odd-Z elements bismuth, astatine and francium, shape coexistence is observed between the 9/2− (πh9/2), 13/2+ (πi13/2) and 1/2+ (πs−1 1/2) states. Of these, the 1/2+ state is generated through the intruder mechanism. In heavier isotopes the spherical 9/2− state remains the ground state, whereas in lighter
isotopes the 1/2+ state becomes the ground state, introducing ground-state deformation. The odd i13/2 proton may also couple to the intruder excitation, resulting in the deformation of the 13/2+ state. Such a coupling will bring the 13/2+ state down in energy and rotational structures observable through in-beam gamma-ray spectroscopy, will be built on this state.

The difficulty in studying excited states in the neutron-deficient astatine and francium nuclei is the low production yield due to the high rate of fission competing against fusion-evaporation at each evaporation step. These challenges are met by the RITU gas-filled recoil separator used in conjunction with the JUROGAM germanium-detector array and the GREAT focal-plane spectrometer located at JYFL. We have observed the 1/2+ state at low excitation energy in the nuclei At-199, At-201, Fr-203 and Fr-205 through novel focal-plane electron spectroscopy, where the implantation detector performed as a calorimeter observing the cascade de-exciting the 1/2+ state to the 9/2− ground state. We have, in addition, for the first time observed the isomeric 13/2+ state in neutron-deficient francium nuclei, namely in Fr-203 and Fr-205. We want to present these results and give an overview on the properties of the ground state and isomeric 1/2+ and 13/2+ states in astatine and francium nuclei.

[1] J. Uusitalo et al., Phys. Rev. C 87, 064304 (2013)
[2] Z. Kalaninov'a et al., Phys. Rev. C 87, 044335 (2013)
[3] U. Jakobsson et al., Phys. Rev. C 85, 014309 (2012) and Phys. Rev. C 87, 054320 (2013)
[4] M. Nyman et al., Phys. Rev. C 88, 054320 (2013)
[5] K. Auranen et al., Phys. Rev. C 90, 024310 (2014)
[6] A. Voss et al., Phys. Rev. Lett. 111, 122501 (2013)
[7] K. T. Flanagan et al., Phys. Rev. Lett., 111, 212501 (2013)

Primary author: Dr JAKOBSSON, Ulrika (KTH)

Presenter: Dr JAKOBSSON, Ulrika (KTH)

Session Classification: SFS-KF

Track Classification: SFS-KF