Spectroscopy of proton-drip line and heavy nuclei

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The interplay between single-particle motion, collectivity and pairing in nuclei is seen as a rich tapestry of exotic excitations and coexistence of various structures at low excitation energy. To understand the origin of these structures it is important to extend the systematic spectroscopic studies to nuclei at the extremes of neutron and proton numbers.

Nuclei at the proton drip line and in the region of super-heavy elements can be produced in fusion-evaporation reactions with stable-ion beams and targets. Recently, it has been shown that highest sensitivity and best resolution in spectroscopic studies of these nuclei are obtained in tagging experiments by combining novel in-beam gamma-ray and conversion-electron spectrometer systems with instruments developed for off-beam decay studies. In addition to the gamma-ray, electron- and particle spectrometers, a recoil separator is the key instrument in selecting the very weak reaction channels of interest. The newest developments include a differential-plunger device for lifetime measurements and beta-tagging for studies of N = Z nuclei.

New results obtained in tagging experiments carried out at the JYFL Accelerator Laboratory in Jyväskylä, Finland, will be presented. They include experiments for N = Z nuclei, very neutron deficient nuclei in the Sn and Pb region as well as heavy nuclei close to the Z = 102 nucleus.

Plans to improve sensitivity in such measurements include developments of digital electronics, higher efficiency separators and detector arrays, and higher intensity beams. These developments and expected detection limits will be discussed.