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Off-line in-gas-laser ionization and spectroscopy (IGLIS) laboratory at KU Leuven

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The in-gas laser ionization and spectroscopy (IGLIS) technique developed at KU Leuven is used at the Leuven isotope separator on line (LISOL) facility to produce short-lived radioactive beams in different regions of the chart of nuclides using light and heavy-ion induced fusion or fission reactions. In this technique, the nuclear reaction products recoiling out of a thin target are thermalized and neutralized in a high pressure noble gas, then resonantly ionized by the laser beams in a two-step process, extracted from the ion source, accelerated and mass separated. In this way isobaric and isotopic selectivity is achieved. High efficiency and selectivity of the ion source [1] allows performing in-gas cell resonance ionization spectroscopy of exotic atoms. Using this method the nuclear magnetic moments of copper [2], silver [3] and actinium [4] isotopes produced in fusion-evaporation reactions have been measured.
As it was shown in recent on-line experiments with actinium isotopes, implementation of resonance laser ionization in the supersonic gas jet allows increasing the spectral resolution by more than one order of magnitude in comparison with in-gas-cell ionization spectroscopy [5]. To obtain the maximum efficiency and the best spectral resolution, properties of the supersonic jet and the laser light have to be correctly chosen [6]. To perform these studies a new off-line IGLIS laboratory, including a new high repetition rate laser system and a dedicated off-line mass separator, has been established under European Research Council (ERC) HELIOS grant [7]. The specifications of the different systems developed for the IGLIS laboratory will be discussed and first results of high-resolution spectroscopy in the supersonic gas jet will be presented. An optimized IGLIS setup to perform laser ionization spectroscopy including high repetition lasers will be installed at the Super Separator Spectrometer (S3), which will be coupled to the superconducting linear accelerator of the SPIRAL2 facility at GANIL [8].

[1] Yu. Kudryavtsev et al., Nucl. Instr. Meth. B 267 (2009) 2908.
[2] T. E. Cocolios et al., PRL 103 (2009) 102501.
[3] R. Ferrer et al., Phys. Lett. B 728 (2014) 191.
[4] C. Granados et al., in preparation.
[5] S. Raeder et al., this conference.
[6] Yu. Kudryavtsev et al., Nucl. Instr. Meth. B 297 (2013) 7.
[7] http://erc.europa.eu/heavy-element-laser-ionization-spectroscopy
[8] R. Ferrer et al., Nucl. Instr. Meth. B 317 (2013) 570.

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