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In Gas-Jet Isomer Selective Laser Ion Source

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Rare Elements in-Gas Laser Ion Source and Spectroscopy at S^3 (REGLIS³) is the new set-up currently under construction at the SPIRAL2/GANIL facility for the production of high-intensity radioactive ion beams, preselected by the Super Separator Spectrometer (S^3). REGLIS³ will be a source for the production of low-energy, high-quality radioactive ion beams and at the same time a tool for high-precision laser and mass spectroscopic measurements [1], amongst others. It is based on the ‘In-Gas Laser Ionization and Spectroscopy’ (IGLIS) technique, which is currently being developed at KU Leuven in Belgium. In this technique, a radioactive ion beam is thermalized and neutralized in a gas cell. A continuous flow of gas leads the atoms to the gas cell exit, where a de Laval nozzle produces a quasi-parallel supersonic gas jet in which the laser based resonant ionization takes place. The selectively-ionized atoms of interest are then captured in a segmented Radio-Frequency Quadrupole (RFQ) ion guide system, accelerated and mass separated. The low temperature, small velocity spread and low pressure in the jet, enable the different spectroscopic broadening mechanisms to be reduced significantly in comparison to previous in-gas laser ionization spectroscopy results, where the ionization region was placed within the gas cell, rather than in the gas jet [2]. In recent experiments the in-gas-jet technique was tested in on-line conditions at the Leuven Isotope Separator On-Line (LISOL) facility, where traces of the hyperfine splitting (HFS) of ^{214,215}Ac were obtained with a spectral resolution of 5×10^{-7} , improving 25-fold the relative uncertainties of previous results obtained by in-gas-cell experiments. Moreover, the results show that the total ionization efficiency in the gas jet is comparable to that in the gas cell (~0.5 %) and can potentially be improved up to one order of magnitude. With these new results, the selective production of isomer ions can be investigated. In this talk, the new results of in-gas-jet laser spectroscopy technique will be presented and compared to previous results obtained at LISOL by in-gas-cell laser spectroscopy.

References

- [1] R. Ferrer et al., Nuclear Instruments and Methods B317 (2013) 570-581.
- [2] Y. Kudryavtsev et al., Nuclear Instruments and Methods B297 (2013) 7-22.