ID de Contribution: **10** Type: **Oral Presentation**

Optimization of in-gas jet laser spectroscopy for S3-LEB

mercredi 27 septembre 2023 09:45 (20 minutes)

The Super Separator Spectrometer-Low Energy Branch (S^3-LEB) is a low-energy radioactive ion beam experiment under commissioning as part of the GANIL-SPIRAL2 facility [1-3]. It will be used for the production and study of exotic nuclei by in-gas laser ionization and spectroscopy (IGLIS), decay spectroscopy, and mass spectrometry.
Development work has been ongoing at the S^3-LEB setup [2-5]. It uses in-gas-jet laser ionization, to resonantly ionize the neutralized atoms, and ion guides to send them to the Piège à Ions Linéaire du GANIL pour la Résolution des Isobares et la mesure de Masse (PILGRIM), a Multi-Reflection Time Of Flight Mass Spectrometer (MR-TOF-MS), or to a decay spectroscopy study station, SEASON. A buffer gas cell with 400 ms extraction time is now coupled to the ion transport ensemble and a de-Laval nozzle of Mach number M ~ 8 (developed at KU Leuven) has been installed at the gas cell aperture, which can create a hypersonic jet of narrow velocity distribution in a reduced collision environment. The hypersonic jet environment reduces the Doppler and pressure broadening by at least an order of magnitude compared to the gas cell [6,7]. Laser spectroscopy with suitable atomic transition schemes at S3-LEB thus offers improved spectral resolution (≤ 300 MHz) while maintaining high efficiency. It is an efficient technique giving access to isotope shifts and hyperfine constants measurements and thus to nuclear structure such as nuclear spin, moments and difference in nuclear charge radii for the exotic nuclei.
Here, we present ongoing technical developments including development of a continuous wave Ti:sapphire laser system for high resolution laser spectroscopy. The results from the offline commissioning of S3-LEB with first in-gas-jet high-resolution laser spectroscopy results of erbium will be presented. Measurements of the isotope shifts and hyperfine constants in the hypersonic gas jet will be presented and compared with literature and measurements in an Atomic Beam Unit (ABU)[8]. Characterization of the pressure-broadening effects in the gas cell will be reported. Additionally, the first optimization of the overall transport efficiency for the setup with laser-produced ions will be presented.
References:
[1] Grand Accélérateur National d'Ions Lourds, URL: https://www.ganil-spiral2.eu/en/
[2] F. Déchery., et al., Eur. Phys. J. A 51, 66 (2015)
[3] F. Déchery., et.al., NIMS B, 376125 (2016)
[4] J. Romans., et al., Atoms, 10, 21 (2022)
[5] J. Romans., et.al., NIM B, 536, 102 (2023)
[6] R. Ferrer., et.al., NIMS B, 317570 (2013)
[7] R. Ferrer., et.al., Nat. Comm. 8, 14520 (2017)
[8] A.Ajayakumar., et.al.,NIM B, 539, (2023)

Auteur principal: AJAYAKUMAR, Anjali (GANIL)

Orateur: AJAYAKUMAR, Anjali (GANIL)

Classification de Session: Spectroscopy of heavy and superheavy elements

Classification de thématique: Instrumentation and Technical developments