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Perspectives for nuclear moment measurements using laser spectroscopy at S3

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The SPIRAL2 facility of GANIL will extend the capability of studying short-lived nuclei by producing beams of rare radioactive isotopes with the highest intensities achieved so far. The SPIRAL2-LINAC coupled with the Super Separator Spectrometer (S3) recoil separator will facilitate the production of neutron-deficient nuclei close to the proton dripline and super heavy nuclei via fusion-evaporation reactions, and separate them from the intense background contamination [1]. At the focal plane of S3, the Low Energy Branch (S3-LEB) will enable low-energy nuclear physics experiments (laser spectroscopy, mass spectrometry and decay spectroscopy) by stopping the nuclei in a gas cell, then neutralising and extracting them in a supersonic jet. In the jet, resonant laser ionisation can take place, which will act as both a selective ion source and a method of spectroscopy.

Resonant laser ionisation spectroscopy in the low density and temperature of the supersonic jet will boost the spectral resolution by an order of magnitude, while maintaining the efficiency typical of in-source laser spectroscopy [2], allowing the investigation of isotope shifts and hyperfine structures at the extremes of the nuclear chart. This will give access to ground-state properties such as spins, charge radii and electromagnetic moments in a nuclear-model-independent manner. The S3-LEB setup has been commissioned offline and is currently being installed at the focal plane of S3, in preparation for online commissioning [3, 4].

This contribution will present the results of the offline commissioning of the setup and its current status. The focus will then be on the online commissioning plan, and the perspectives for nuclear moment measurements, based on the existing Letters of Intent which mainly deal with the N=Z 100Sn region and the (super)heavy region.

[1] F. Déchery et al., Nucl. Instrum. Meth. B 376, 125-130 (2016)
[2] R. Ferrer et al., Nat. Comm. 8, 14520 (2017)
[3] J. Romans, et al., Nucl. Instrum. Meth. B 536, 72 (2023)
[4] A. Ajayakumar, et al., Nucl. Instrum. Meth. B 539, 102 (2023)

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