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Recent advances of the S3-Low Energy Branch

The SPIRAL2 facility of GANIL will significantly extend the capability to study short-lived nuclei by producing beams of rare isotopes at unprecedented intensities. 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 as well as super heavy nuclei via fusion-evaporation reactions, with an efficient separation 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 by thermalising and neutralising the nuclei in a gas cell before extraction in a supersonic gas jet. In the jet, resonant laser ionisation can serve as both a selective ion source and a method of spectroscopy.

Resonant laser ionisation spectroscopy in the low density and low temperature environment of the supersonic jet will boost the spectral resolution by an order of magnitude, while maintaining the typical efficiency of in-source laser spectroscopy [2]. The technique allows the precise 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 framework. Combined with the PILGRIM MR-TOF and the SEASON decay station, mass and decay measurements will also be performed. The S3-LEB setup has been commissioned offline in a dedicated laboratory [3, 4], and is now installed at the focal plane of S3, in preparation for online commissioning.

We present the latest results of the offline commissioning of the setup, including a detailed characterisation of the gas jet combined with series of mass measurements using PILGRIM using, e.g., erbium isotopes. The preparation for online experiments at S3 and the first scientific objectives with short-lived nuclei in the coming years will be shown. In addition, we will present the results and perspectives of ongoing related projects, such as FRIENDS3, which aims at improving the extraction speed and neutralisation of the gas cell, and IDEAS3, a tape-based identification station under development.

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