

## **LASPEC – Executive Summary**

The competition and balance between nuclear shell and collective effects results in a variety of shapes and sizes within nuclear systems. Thus, their charge distributions display a range of multipole structures. These shapes and structures perturb the atomic levels of ions and atoms at the ppm level and although this is a very small absolute effect it is readily detected and measured by laser spectroscopic methods. These techniques are particularly important for short-lived radioactive nuclides and isotopes with lifetimes as short as a few milliseconds have been investigated.

The nuclear parameters measured by optical techniques are extracted in a manner that is completely free of any nuclear model dependency. Information on bulk and valence properties, in particular the size, shape, spin and moments of the nuclear charge distribution, can be uniquely and reliably determined. By virtue of the sensitivity of laser spectroscopy, the limits at which these determinations can be made are purely defined by the ability to produce singly-ionized or neutral, mono-energetic atoms of the candidate radioisotope.

The Super-Fragment Separator, S-FRS, at FAIR will have a production capability unparalleled in Europe. The device will provide short production and extraction times and will thus be able to deliver exotic nuclear isotopes and isomers well beyond the limits of the known nuclei with high efficiency. The **LASPEC** collaboration, in common with other NUSTAR projects, wish to stop, separate and cool the S-FRS beams. Such cooled exotic ensembles are then immediately available for study by laser spectroscopic techniques.

To perform such measurements, the **LASPEC** community has designed a laser spectroscopic station. It will receive beams from the Low-Energy Beamline (LEB) ion catcher and will be capable of matching, in its spectroscopic capabilities, the universal production of the S-FRS. To exploit the many opportunities in isotope and isomer production offered by the S-FRS, the **LASPEC** collaboration has drawn its members from all European nuclear laser groups and has combined a range of skills and specialized spectroscopic techniques. With a careful design it has been possible to absorb these techniques into one compact but fully, and multi-functional laser spectroscopy station.

The station is shown in Figure 1 and its full description, function and costing is detailed in the Technical Design Report.

