SATURATED ABSORPTION SPECTROSCOPY AND THE CHARACTERIZATION OF FABRY-PEROT INTERFEROMETERS

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Resonance laser ionisation is a selective technique often used for the production of radioactive ion beams at hot cavity as well as gas cell-based facilities. Dedicated pulsed dye- and/or Ti:sapphire laser systems at these facilities provide the laser radiation needed for efficient multi-step ionization schemes. In a variant of this method, in-source resonance ionization spectroscopy (RIS) has become a powerful tool for the study of properties of exotic nuclei via the measurement of hyperfine structure and isotope shift. Although high-resolution RIS studies are hindered by several line broadening mechanisms, nuclear spin, magnetic dipole moments and changes in mean-squared charge radii may be extracted from fluxes of below 1 ion per second.

Despite this success, it remains a challenge to analyse lower resolution RIS spectra which might exhibit fully or partially overlapping hyperfine structures and to reliably assign systematic uncertainties to such measurments. In a previous RIS experiment on stable copper isotopes at the IGISOL facility, University of Jyväskylä, a discrepancy between the measured hyperfine parameters of ^{63}Cu and high-resolution literature data was found and identified as due to an inaccuracy of the wavemeter [1]. Such systematic uncertainties in the wavelength determination were corrected for following the development of a simple plane-parallel scanning Fabry-Perot interferometer (FPI). More recently a semi-hemispherical FPI has been constructed and characterized, with a free spectral range (FSR) suitable for the narrowband ($\sim$1 GHz) pulsed laser used for in-source spectroscopy. A further commercial confocal FPI is in use in connection with the injection-locked Ti:sapphire laser developed for in-gas-jet spectroscopy [2].

In order to precisely determine the FSR, we have developed a Doppler-free saturated absorption spectroscopy setup using Rb as a reference frequency standard. In this contribution, we will present a short overview of the set-up and the results of the measurements of the FSR of both FPIs.

[1] V. Sonnenschein, I. D. Moore, H. Khan, I. Pohjalainen and M. Reponen, Hyperfine Interactions 227:113-123 (2014).
[2] V. Sonnenschein, PhD thesis, University of Jyväskylä (2015).