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High-resolution laser spectroscopy with the Collinear Resonance Ionisation Spectroscopy (CRIS) experiment at CERN ISOLDE

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The Collinear Resonance Ionisation Spectroscopy (CRIS) experiment at CERN ISOLDE is used for the study of nuclear electromagnetic moments and changes in the mean-square charge radii by means of multi-step, high-resolution, resonance ionisation laser spectroscopy [1]. Thanks to the high selectivity of the technique, it can also be used to separate isobaric beams and even purify isomers with a demonstrated mass resolving power greater than 5.10^6 [2].
The CRIS technique combines the high detection efficiency of resonance ionisation with the high resolution of collinear laser spectroscopy. The use of a decay spectroscopy station [3] enhances the performances of the system by allowing the assignment of different hyperfine components with respect to the characteristic decay patterns of different isomers [2]. Additionally, it can be used to study decay properties of these nuclei in unprecedented clean conditions. Altogether, the CRIS experiment has successfully performed laser spectroscopy on very exotic francium isotopes down to 202Fr with beams of intensities as low as 100 ions / s [4].
A new laser laboratory now completes the CRIS experiment: a 200 Hz Nd:YAG laser system allows spectroscopy with a 5 ms duty cycle to be performed, giving access to the shortest-lived nuclei available at ISOLDE without decay losses; a cw tuneable laser system (dye & Ti:Sa available) with second harmonic generation offers a resolution comparable to collinear fluorescence laser spectroscopy.
In this contribution, the status of the CRIS beam line at ISOLDE, its new laser laboratory, and its recent achievements including high-resolution studies on francium isotopes will be presented.

[1] T.E. Cocolios et al., NIMB 317 (2013) 565
[2] K.M. Lynch et al., PRX 4 (2014) 011055
[3] M.M. Rajabali et al., NIMA 707 (2013) 35
[4] K.T. Flanagan et al., PRL 111 (2013) 222501

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