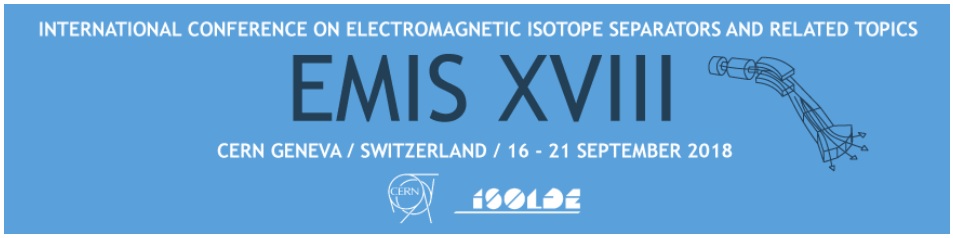

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Resonance ionization schemes for high resolution and high efficiency study of exotic nuclei at the CRIS experiment

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Laser spectroscopy of exotic isotopes requires a technique that combines high spectral resolution with high efficiency. At the Collinear Resonance Ionization Spectroscopy (CRIS) ISOLDE [1], significant effort has been invested in improving both aspects. These developments resulted in e.g. linewidths of 20 MHz in radioactive Francium [2], and in the successful high-resolution measurements on beams with yields as low as 20 pps [3]. This contribution presents an in-depth study on how to achieve high-resolution and high-efficiency RIS on radioactive ion beams. These developments will pave the way for current and future experiments on radioactive beams, with many different groups exploring ways to achieve high resolution RIS [4,5].

Resonance ionization scheme developments have been performed for a number of elements ($_{19}$K, $_{29}$Cu, $_{31}$Ga, $_{49}$In, $_{50}$Sn, $_{87}$Fr, $_{88}$Ra). The significance of these studies lies in achieving high resolution without introducing efficiency losses and line shape distortion in the observed hyperfine spectra. Interesting and unexpected effects have been identified related to the role of laser powers, temporal laser pulse lengths and relative firing delay of pulsed lasers. In particular, the use of "chopped"continuous light [2,6] as the first excitation step has been investigated in comparison with the use of an injection-locked laser [3,7]. The complementarity of these two approaches is such that both will continue to see use at CRIS.

In this contribution, the laser systems installed at CRIS will be presented, along with experimental results, demonstrating the advantages and opportunities that come with having such a versatile laser system, and the necessity of a solid understanding of the interaction of lasers and atoms for high resolution resonance ionization laser spectroscopy.

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