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Innovations and Opportunities for laser spectroscopy of exotic nuclei in Europe

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High resolution laser spectroscopy is a well-established method for measuring nuclear moments and charge radii of radioactive nuclei. Recent breakthroughs in ion beam bunching with RFQ devices and the in-source application of resonance ionization spectroscopy (RIS) open up the prospect of measuring exotic nuclei. The first ion beam cooler-buncher to be used in this way was installed at the IGISOL facility in the Accelerator Laboratory, Jyvaskya (JYFL). The Birmingham-Manchester-JYFL collaboration has used the improved sensitivity to make measurements of the neutron-rich fission fragments in the zirconium and yttrium isotope chains. The fast release times of the IGISOL ion source has also allowed a number of isomers to be measured both in the yttrium chain and also amongst the recently-measured scandium isotopes. The beam time-structure has allowed the collaboration to demonstrate a collinear-beams resonance ionization spectroscopy technique (CRIS) which has no duty-cycle losses associated with low repetition rate lasers and has the potential of an order of magnitude increase in sensitivity. It has the additional advantage over in-source RIS measurements pursued by the RILIS and FURIOS groups of having much reduced Doppler broadening. A similar cooler-buncher is being built at Europe's premier on-line isotope separator facility, ISOLDE, at CERN. The first on-line experiments are planned for 2006. The benefit this will bring to the laser techniques, coupled with the higher production rates of the volatile exotic nuclei will allow measurements in hitherto unexplored regions of the nuclear landscape. In the longer term, plans are well developed for laser spectroscopy experiments at the future GSI-FAIR facility. The LaSpec collaboration involves more than ten groups from Europe and America who will apply a range of techniques at the facility's low energy beamline.