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The study of nuclear structure far from stability at the IGISOL-4 facility

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Since the successful commissioning of the new IGISOL-4 facility, Jyväskylä, in 2012-2013 [1], the past year has seen a move towards full operation and first experiments have been performed. The gradual evolution of the ion guide method for a universal production of both volatile and non-volatile elements has been driven by the pursuit of physics research on both sides of the valley of beta stability. The on-going development of new ion manipulation techniques as well as new production methods at the IGISOL-4 facility has been driven by the needs of the evolving scientific programme.

This contribution will provide an overview of the current experimental programme, highlighting some of the important experiments performed in 2014-2015. Our decay spectroscopy programme has been initiated in earnest in collaboration with scientists from York, Aarhus and Madrid. A cubic array of Double-Sided Silicon Strip Detectors was used to search for the elusive second excited 2+ state in 12C – a key contribution to our understanding of the triple-alpha process. Using the purification capabilities of JYFLTRAP a number of trap-assisted spectroscopy experiments have been performed in combination with novel experimental equipment. This includes the new segmented total absorption spectrometer (DTAS), designed for NUSTAR, FAIR. DTAS was used in the study of beta decays relevant for the prediction of reactor neutrino spectra. The BELEN-48 4π neutron counter has been used to study the beta-delayed neutron emission of neutron-rich nuclei which play a role in the safe control of nuclear power plants as well as of interest to the astrophysical r-process path.

The laser spectroscopy programme has commenced with optical studies of bunched beams of doubly-charged ions. A new ultra-low energy electrostatic ConeTrap device has been installed to complement the laser station, which has been shown to successfully store cooled ions on millisecond timescales. Resonance ionization of Pu isotopes obtained from the Mainz TRIGA reactor, in collaboration with Mainz and Leuven, initiates a programme towards optical spectroscopy of heavy elements, with the first collinear laser spectroscopy of Pu+ ions expected in 2015.

I will also briefly look towards the future with exciting new developments designed to keep the IGISOL facility at the forefront of nuclear and atomic structure research. This includes the status of the neutron converter project, designed to provide a high neutron flux for fission and thus the production of the most neutron-rich fragments. A new Multi-Reflection Time-of-Flight Mass Spectrometer (MR-TOF-MS) is planned which will be used both at IGISOL and the future low-energy branch of the MARA recoil separator. Finally, new opportunities are planned in collaboration with the University College London, for the first cold atom experiment at IGISOL.

[1] I.D. Moore et al., Nucl. Instrum and Meth. In Phys. Res. B 317 (2013) 208.

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