JYFL Accelerator News

Accelerator Laboratory, Department of Physics
University of Jyväskylä, Finland

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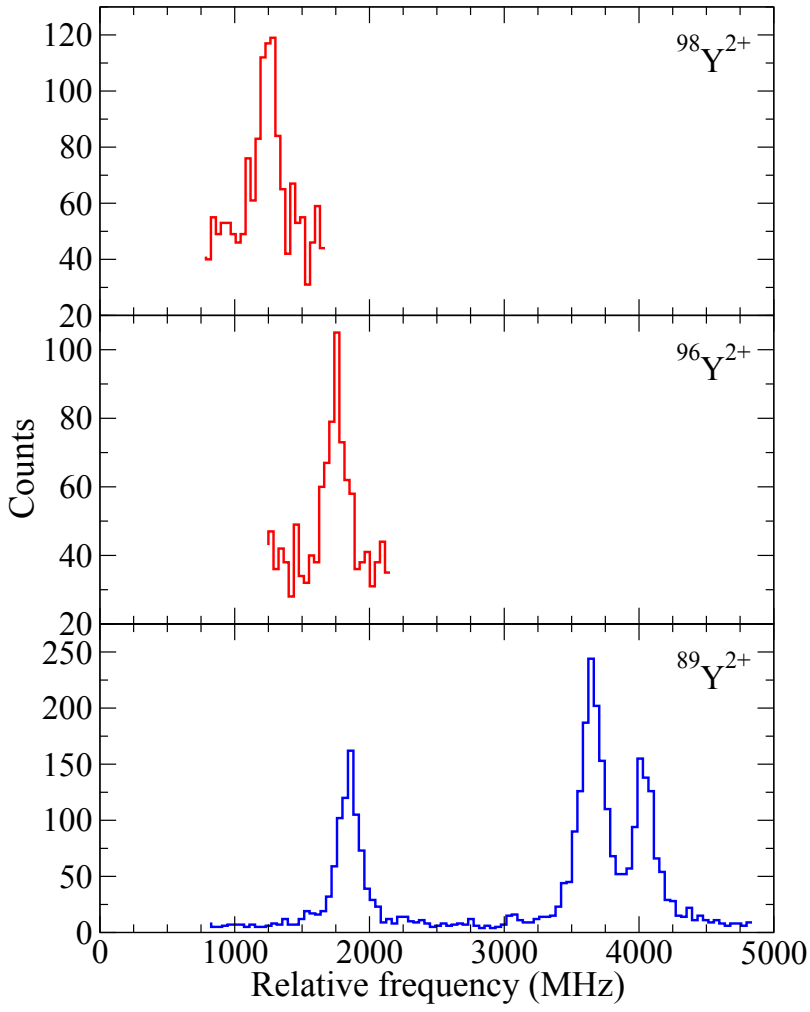
Next Call for Proposals
Deadline: September 15, 2017

First collinear spectroscopy of doubly-charged isotopes

An extensive chain of nuclear radii in yttrium isotopes have previously been measured at the IGISOL facility, spanning the A∼100 region and studying changes in deformation and shape coexistence. An important calibration of these has now been found by performing the first collinear laser spectroscopy of doubly-charged ions. These are produced from the IGISOL at around 10% of the singly-charged yield.

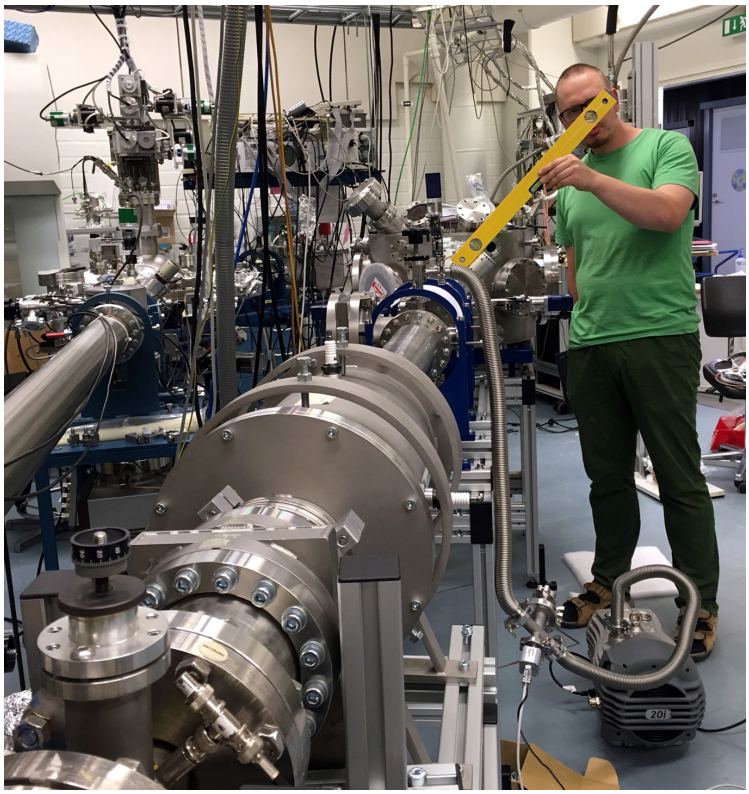
Mean-square charge radii are extracted from optical isotope shifts without model dependence. Only two constants need to be determined for the studied atomic transition, usually from existing charge radii data. However, for elements with only one naturally occurring isotope, challenging MCDF calculations are required but are greatly eased for simple atomic configurations, such as those in the doubly-charged yttrium ion.

Critical to this work was the availability of stable beams from the new offline source located on the second floor of the facility. This has recently been constructed to allow optimisation and developmental work without interventions being required in the IGISOL target area. A re-measurement of only the ^{96}Y and ^{98}Y fission products was sufficient to re-calibrate all previous data, with a vital frequency reference from simultaneously available beams of stable ^{89}Y. Unlike singly-charged ions, these were found not to be produced via plasma discharge from a foil, but could be "switched-in" on request from the new offline source.



Photon counts as a function of laser frequency for doubly-charged ions of $^{96,98}Y^{2+}$ produced in fission, with a stable reference of $^{89}Y^{2+}$ produced from the new offline source.

News from the Pelletron group



Marko Käyhkö checking the alignment of the new beamline's beam profile monitor.

New beamline for the Pelletron

The installation of a new beamline at the Pelletron is almost completed. The beamline has a large multipurpose chamber for ion beam irradiations and RBS and PIXE measurements. After the chamber is a unique setup for performing high resolution PIXE measurements (TES-PIXE) using external beams. The new beamline enables better possibilities for both scientific and industrial collaborations.

Training school of ion beam techniques for ALD community

On 5-8 November the group organizes in collaboration with HERALD COST action a *Training school on ion beam techniques to study ALD films* in Jyväskylä. The event brings 15 participants and 3-4 external lecturers to the Accelerator Laboratory. First there will be an introduction to different ion beam analysis techniques, especially in the analysis of thin films followed by a hands-on experience in the art of time-of-flight elastic recoil detection analysis (TOF-ERDA), Rutherford backscattering spectrometry (RBS) and helium ion microscopy (HIM). To apply and for more information, please check http://www.european-ald.net/events/training-school-ion-beam-techniques-study-ald-films

Jyväskylä joins PicoFIB network

The accelerator based materials research group has been invited to join the PicoFIB network coordinated by the University of Sheffield and partnered by Universities of Southampton and Newcastle, University College of London, Trinity College Dublin and Helmholtz-Zentrum Dresden-Rossendorf. The PicoFIB network brings together international researchers in the field of gas ion patterning and microscopy. Obviously, helium ion microscopy (HIM) is one of the main technologies within the network. The network runs from 2017 to 2020 and it provides support for knowledge exchange, technical training and research visits.

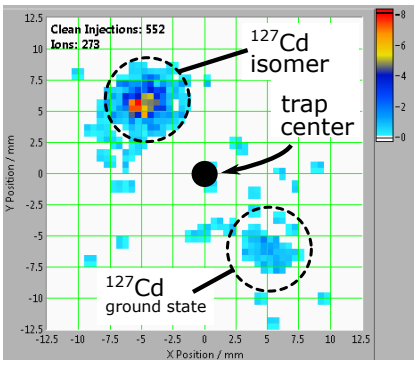
NANOIS Academy project starts in September

September 2017 marks the beginning of a new four-year project supported by the Academy of Finland, NANOIS - Novel nanostructure morphologies by ion beam shaping. The consortium is between the Departments of Physics in Jyväskylä and Helsinki. In the project new types of photonically active structures will be created by means of high-energy heavy-ion irradiations of carefully fabricated nanostructures. The project is coordinated by the group of accelerator based materials physics and the consortium PI is Prof. Timo Sajavaara.

A new phase-dependent isomeric cleaning method demonstrated at JYFLTRAP

A new phase-dependent cleaning method with a Penning trap has been developed and employed for the first time at JYFLTRAP. Two states of radioactive ^{127}Cd could be easily separated using this technique (see Figure). The two states, representing a ground- and isomeric state, have an energy difference of about 280 keV, which in JYFLTRAP's 7 T magnetic field corresponds to about 2 Hz cyclotron frequency difference. In the new cleaning method, one of the states is pulled to the trap center using a specific excitation scheme while the other state ends up further from the trap center. This was now done to provide clean ^{127}Cd to the TASISpec post-trap decay spectroscopy setup. The new method can be used to separate states with much smaller energy differences than possible with the previously available techniques. For example, with about 600 ms evolution time, it would be possible to separate states with 28 keV energy difference to 90 degrees. Ultimately, decay losses and ion spot distortions will set the limits.

The phase-dependent mass measurement technique was also commissioned with offline ions produced from a new surface ion source. Preliminary measurements indicate that this technique is capable of reaching the 10^{-10}-level of precision, which is about a factor of ten improvement over the previous (time-of-flight) technique.



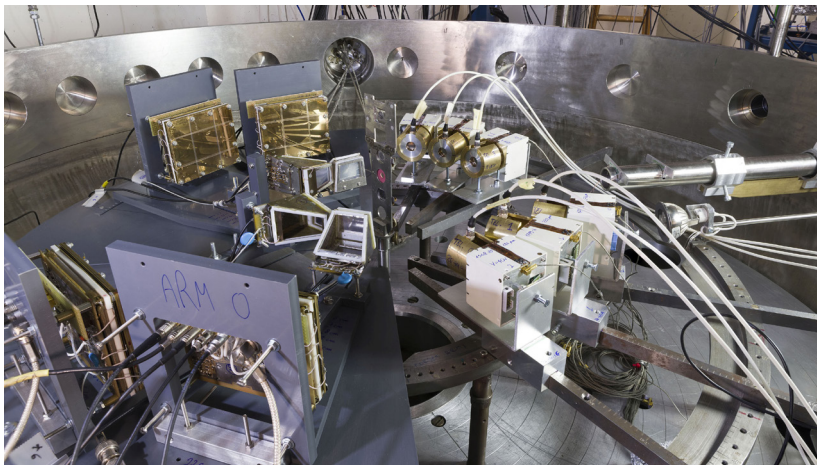
The two states of ^{127}Cd after 250 ms phase evolution time. Due to the 2 Hz cyclotron frequency difference, the two states are separated by about 180 degrees after this excitation. The method also allows extraction of production ratios of different states.

Commissioning of HIISI has been started

Commissioning of HIISI 18 GHz ECR ion source was started in summer 2017. After a couple of days of testing an intensity of 175 μA was reached for O^{7+} ion beam at a microwave power of 600 W and using 10 kV extraction voltage. The intensity already exceeded the typical performance of the JYFL 14 GHz ECRIS. Commissioning will be continued in September after the completion of the gas feeding system.

Successful measurements at LSC

The team of NRO127 experiment celebrating the end of the run.



Detector configuration inside of the LSC. The target holder is in the middle. The beam enters the chamber through a long collimator visible on the right. Also visible are 4 position-sensitive TOF arms based on MCP detectors and 6 dE-E telescopes. This setup was used for NRO127.

This summer the Nuclear Reaction group has conducted a series of successful experiments using the Large Scattering Chamber (LSC). Three major measurements were carried out in a short succession. First the Dubna team, with Sergey Lukyanov as the spokesperson, studied ^{5}He cluster transfer via scattering of deuterium from a Be target (NRO125). The collected data are of high quality and good statistics thanks, to a great extent, to the perfect operation of the K130 cyclotron and committed work of the operators.

With less than 2 days to modify, align, and tune the setup in the LSC, the first experiment was followed by the study of the ^{11}Be(^{3}He,d)^{12}C reaction (NRO126). This was part of the comprehensive Rainbow Scattering study in collaboration with the Kurchatov Institute, Dubna, Skobeltsyn Institute at MSU, Radium Institute, Universidad Autonoma del Estado de Mexico, MEPhI, and Kazakhstan. The aim of the latest experiment was to determine the properties of ^{12}C states at high excitation energies. The spokesperson of the experiment is Alla Demyanova. The measurement required improved energy resolution of the beam. This is a special feature that has been developed by Pauli Heikkinen and his team to extend the use of the K130 cyclotron.

The third of this summer's experiments was NRO127: the study of the ternary decay channel included by shell effects via the reactions ^{40}Ar + ^{208}Pb and ^{40}Ar+^{205}Tl. The measurements will continue for the reactions ^{34}S+^{208}Pb and ^{37}Cl+^{205}Tl. This is the work of the JYFL-Napoli-Dubna collaboration. The spokespersons are Emanuele Vardaci and Eduard Kozulin.

Next Call for Proposals
Deadline: September 15, 2017

The next deadline for submission of proposals and letters of intent is September 15, 2017. **Proposals should include an abstract/summary**. A justification of the beam time requested, based on cross-sections, detector efficiencies, etc. should be given. If a proposal is the continuation of an existing experimental program at the JYFL Accelerator Laboratory, a summary of the status of the project should be included. Proposals and letters of intent should be sent (preferably as a postscript or pdf file) to the Program Advisory Committee secretary Mikael Sandzelius (address: see below) and include the Proposal Summary Sheet which is available from the JYFL WWW-pages (https://www.jyu.fi/fysiikka/en/research/accelerator/index_html/beamtime.html). You are encouraged to contact anyone in the Contact List at the end of this Newsletter for more information.

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