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JYFL Accelerator News

– Accelerator Laboratory, Department of Physics University of Jyväskylä, Finland –

New energy record for ion cocktails with HIISI

A new ECR ion source known as HIISI has been developed in the Accelerator Laboratory. It is the most powerful room-temperature ion source in the world and is a fantastic achievement for our world-class ion source group and the technical staff of the laboratory. HIISI allows for much higher ion beam intensities and energies from our main cyclotron meaning that our facility will be even more attractive to a wider range of users in fundamental research and the aerospace industry.

In the beam test with HIISI and the K130 cyclotron, a beam cocktail of 16.3 MeV/u ions was accelerated to the RADEF irradiation station. The total energy for the heaviest element (^{126}Xe) in the cocktail was 2 GeV, which is a new energy record at JYFL.

Dr. Véronique Ferlet-Cavrois, the Head of the Power Systems and Space Environments Division of the European Space Agency (ESA) says: "These are fantastic results that make RADEF a top-class facility for the space industry in Europe, for the test of new high-tech components which are increasingly used for space applications". Radiation Effects Engineer Cesar Boatella Polo from ESA's Components Space Evaluation and Radiation Effects Section states: "This new beam cocktail will help in testing the new complex devices which require deeper ion penetration".

The solutions found by our excellent ion source group come as a result of basic experimental research and deeper understanding of the various physical processes going on in the ion source plasma. The solutions, experience and technology gained through the HIISI will now be transferred to our international partners, such as at GSI-FAIR in Darmstadt, where a copy of HIISI will be constructed for joint research projects. The development- and construction work of HIISI was been co-financed by the Academy of Finland (FIRI), the European Space Agency and the University of Jyväskylä.

Next Call for Proposals Deadline: March 15, 2019

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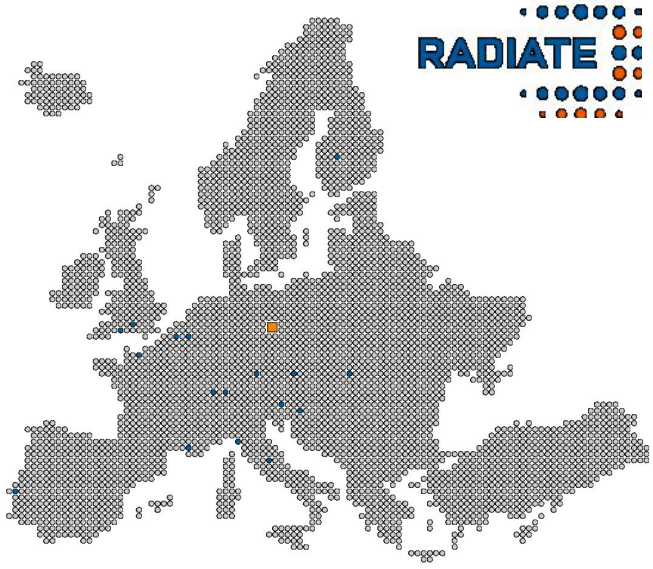
NEWS

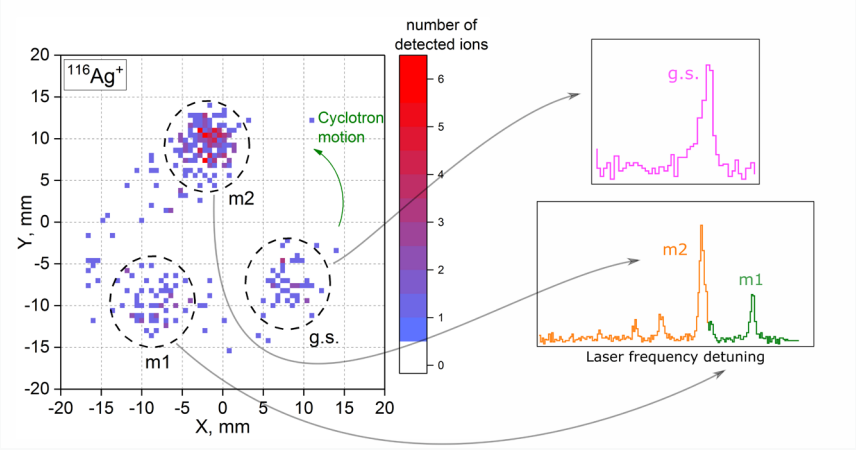


H2020-funding for RADIATE-project

H2020 Integrating Activities funding of 9.9 M€ was granted to the RADIATE (Research And Development with Ion Beams – Advancing Technology in Europe, https://www.ionbeamcenters.eu/) project. The project has 14 partners from public research and 4 SMEs and it runs from 1/2019 until 12/2022. The roles of the Accelerator Laboratory are to provide transnational access (ion beam analysis and helium ion microscopy) and to participate in joint research activities. Along with ENSAR2 this is the second H2020 IA hosted by the laboratory.

Combining mass spectrometry and laser spectroscopy for nuclear structure

For the first time the JYFLTRAP and laser teams have combined their efforts to explore the nuclear structure properties of ground- and isomeric states in neutron-rich silver isotopes. These isotopes have been particularly challenging for mass measurements since they have two or even three long-living states that are often difficult to identify and resolve from each other. The phase-imaging ion cyclotron resonance (PI-ICR) technique was employed and over two measurement campaigns, masses from ^{113}Ag to ^{123}Ag were measured, with several, challenging, low-lying isomeric states independently resolved for the first time. Since the order and the spins of the long-living states have been uncertain for many of the studied isotopes, they were also probed via collinear laser spectroscopy. For these measurements spectroscopy was performed on fast atomic beams, representing the first optical measurements on neutralized radioactive beams at the IGISOL. So far, hyperfine structures were measured for many nuclear states in the mass range $^{113-121}$Ag. The figure shows PI-ICR spectra and partial hyperfine structure measurements performed on ^{116g,m1,m2}Ag. All three states can clearly be identified in both measurements and the assignment of the ordering and spins will be possible.



"Complete" spectroscopy utilizing the power of JYFLTRAP and collinear laser spectroscopy for the measurements of ground and isometric states in ^{116}Ag.

In the future, decay spectroscopy using trap-purified beams of Pd which beta-decay into Ag will be added to this cooking pot of nuclear ingredients. Plans for optical spectroscopy of Pd fission fragments are currently underway, with the first off-line studies already performed on 4 optical transitions in order to probe the spectroscopic efficiency and atomic state population following the charge exchange process.

NEWS

Nuclear Reactions win JINR prize for 2018

Collaboration between JYFL and Dubna on nuclear reaction studies dates back to the early 1990s and the very first beams accelerated by the K130 cyclotron. The Russian-Finnish team conducting research in this field was recently awarded the 2018 JINR prize for "Manifestation of the cluster structure of ^{9}Be nuclei in the mechanism of their interaction". The measurements were performed in Dubna and at JYFL by S. Lukyanov, A. Denikin, V. Maslov, M. Naumenko, Yu. Penionzhkevich, J. Mrazek, W.H. Trzaska. K. Mendibaev, N. Skobelev, and Yu. Sobolev.

Nuclei made of clusters are essential for the study of nuclear matter. In that respect beryllium isotopes hold a special importance as there are reasons to believe that they may contain structures with multiple centres called dimers. The cluster configuration of such nuclei is manifested not only in their structure, but also in the mechanism of interaction with other light nuclei and is largely manifested in the characteristics of individual reaction channels (merging, transfer, inelastic scattering, etc.). The cluster states can be revealed through interaction in the form of exotic systems, such as: multineutrons, ^{5}He, etc.

^{9}Be can be considered as the best example of a nucleon-stable nuclear molecule. It consists of two well-separated α-particles and one valence neutron, which creates a molecular bond of α-particles. In the recent papers [1] we have provided information about the cluster structure of the ^{9}Be nucleus and its effect on the mechanism of the cluster transfer reaction.

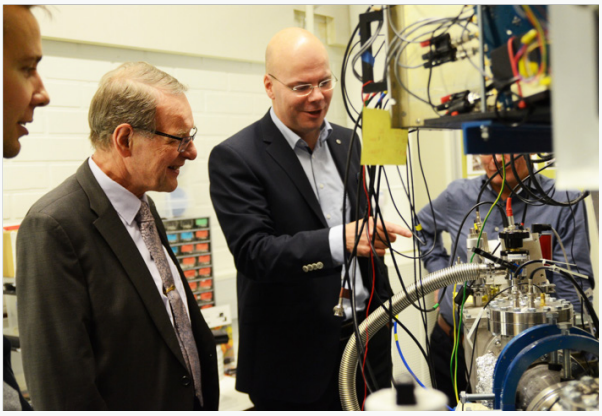
[1] S. Lukyanov, et al, (2018), *Cluster Structure of ^{9}Be by Scattering of Deuterons*, Journal of Physics : Conference Series, 1023. IOP Publishing. doi:10.1088/1742-6596/1023/1/012027Open access and references therein.

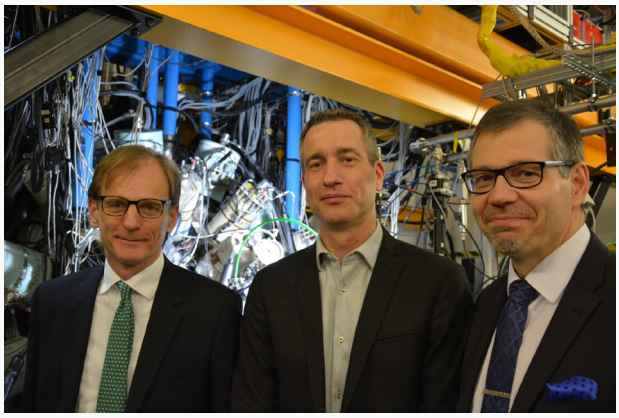
Marie Curie post-doctoral fellow position awarded to Ruben de Groote

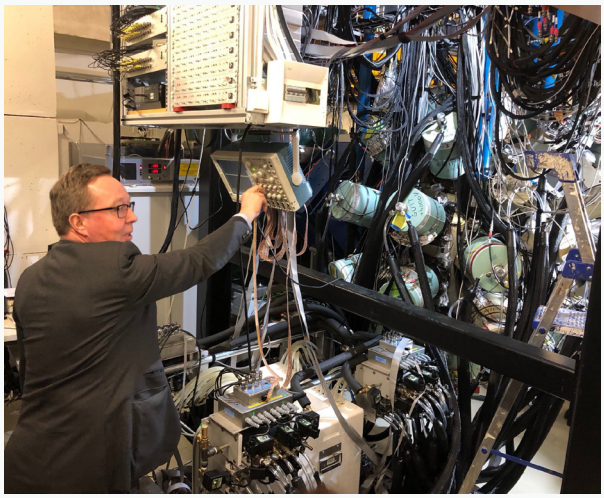
Ruben de Groote was awarded a Marie Curie post-doctoral fellow position to develop new laser resonance ionization methods for optical spectroscopy of radioactive nuclei at the IGISOL facility. Named RAPTOR, short for 'Resonance ionization spectroscopy And Purification Traps for Optimized Spectroscopy', the project will focus in particular on the most challenging atomic systems, whose complexity has so far prevented spectroscopy far from the valley of stability. Achieving this goal requires simultaneous optimization the selectivity of laser ionization schemes for the elements of interest, a refinement of the background-suppression of the Collinear Resonance Ionization Spectroscopy method, and maximal exploitation of the trap-based beam purification methods that have been developed at the IGISOL over the past years. The project will thus combine the existing state-of-the-art capabilities of the laboratory with Rubens experience in high-sensitivity optical spectroscopy of radioactive beams. The RAPTOR project will take place during the coming two years, and should dramatically increase the reach of optical spectroscopy at radioactive ion beam facilities.

NEWS

Distinguished visitors to the Accelerator Laboratory





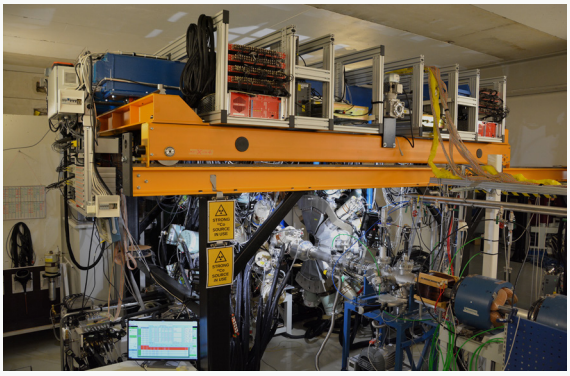


Upper left: Dr. Mikko Laitinen, Dr. Tuomo Suntola and Professor Timo Sajavaara.
Upper right: Ambassador Thomas Dodd, Professor Paul Greenlees and Rector Keijo Hämäläinen.
Left Minister Mika Lintilä and JUROGAM3.

The Accelerator Laboratory has recently hosted several distinguished visitors. The 2018 Millenium Technology Prize (1 M€) was awarded to Dr. Tuomo Suntola for his innovations related to atomic layer deposition. His visit was connected to Commercialization of Breakthrough Technologies -seminar and launch of joint ALD CoCampus effort with JAMK University of Applied Sciences.

H.E. Mr. Thomas Dodd, Ambassador of the United Kingdom to Finland visited to learn of our close collaboration with the U.K. community. We were also visited by Minister of Economic Affairs Mika Lintilä, who got hands-on experience at JUROGAM3.

NEWS



In-beam physics program at MARA set to begin

The JUROGAM 3 Ge-detector array has been commissioned. It allows for back-to-back in-beam gamma-ray spectroscopy experiments employing recoil-decay tagging technique at either RITU or MARA separator. The Ge-detectors are kept cold and biased during transportation between the two caves. Successful commissioning marks a new milestone, in particular for the physics programme focusing on proton dripline and N≈Z nuclei at MARA. Funding for the new infrastructure to support the array came from theAcademy of Finland FIRI program.

Next Call for Proposals – Deadline: March 15, 2019

The next deadline for submission of proposals and letters of intent is March 15, 2019. **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/science/en/physics/research/infrastructures/accelerator-laboratory/access/apply-for-beamtime). You are encouraged to contact anyone in the Contact List at the end of this Newsletter for more information.

From 1st March 2016, the JYFL Accelerator Laboratory is one of the HORIZON2020 ENSAR2-Infrastructures offering a certain amount of supported access to the users from the EU and associated countries. Requests for such support (travel and living expenses during experiments) should be attached to the scientific proposal. All publications resulting from work done at the Accelerator Laboratory should also contain the following acknowledgement:

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