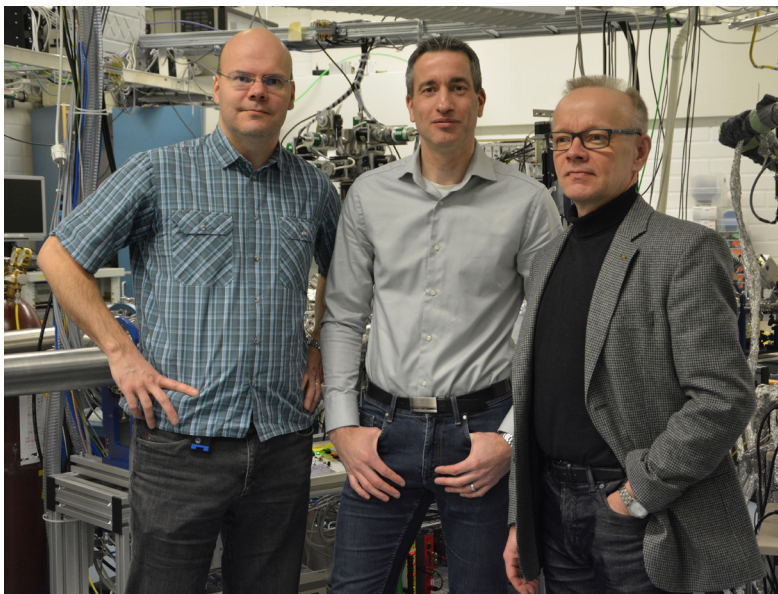


## New roles for Accelerator Laboratory Professors

The turn of the year brought many changes of personnel in leadership roles throughout the University. In our own Department, the Head of Department, Jukka Maalampi, stepped down ahead of his retirement in late 2018 and was replaced by Markku Kataja. Markku had been acting as Deputy Head of Department along with Ari Jokinen. At the Faculty level, the former Dean Henrik Kunttu moved to a position as Vice-Rector of the University (Research) and was replaced by Mikko Mönkkönen. Ari Jokinen was selected as Vice-Dean of the Faculty (Research) and thus stepped down from his roles as Head of the Accelerator Laboratory and Deputy Head of Department. As a consequence, Timo Sajavaara, leader of the Accelerator-Based Materials Physics group, was selected as Deputy Head of Department responsible for Research and Infrastructure. Paul Greenlees, leader of the Nuclear Spectroscopy group, will take over from Ari Jokinen as Head of the Accelerator Laboratory.

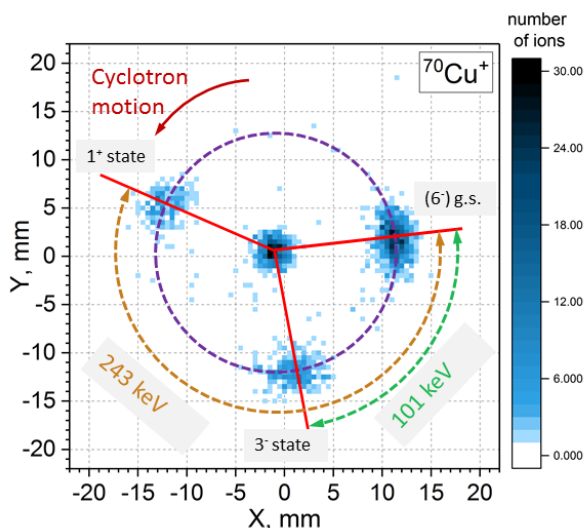


From left to right: Timo Sajavaara, Paul Greenlees and Ari Jokinen.

## Nuclei close to $^{78}\text{Ni}$ explored at JYFLTRAP

A successful experiment on neutron-rich Fe, Co, Ni, Cu and Zn isotopes was run at IGISOL in November. The ions of interest were produced with 35 MeV protons on a natural uranium target. Three ground-state masses and two isomeric states were measured for the first time. During the experiment, the phase-imaging ion cyclotron resonance (PI-ICR) technique was used to efficiently detect long-living isomeric states in the studied nuclei. To illustrate the power of the new PI-ICR technique, the three long-living states in  $^{70}\text{Cu}$  could be easily resolved using 100 ms phase accumulation time (see Figure). To reach similar resolving power with the conventional time-of-flight ion cyclotron resonance (TOF-ICR) technique would require at least ten times longer excitation time!

The measured masses are relevant not only for understanding nuclear structure in the vicinity of  $^{78}\text{Ni}$  but also for electron capture and nucleosynthesis during the



The  $(6^-)$  ground state,  $(3^-)$  state at 101 keV and  $1^+$  state at 243 keV in  $^{70}\text{Cu}$ , resolved using the PI-ICR technique at JYFLTRAP.

core collapse phase in supernovae. The experiment was done together with French researchers from GANIL and CENBG. This French-Finnish collaboration has been supported by the Institut Français de Finlande, the Embassy of France in Finland, the French Ministry of Education, Higher Education and Research and the

Finnish Society of Science and Letters. The recently accepted PICS scientific cooperation program "MITICAN" will further strengthen the collaborations related to core-collapse supernovae as well as for the fundamental interactions studied in the MORA project.

## Status of the new heavy ion source (HIISI)

The construction of HIISI and its beam line was completed in spring 2017. The first beam from HIISI was extracted in May 2017 and the first mass analyzed beams of O, Ar and Xe in October 2017. The results of the first two weeks of commissioning are shown in Table 1. The intensities are compared to those extracted from the JYFL 14 GHz ECRIS demonstrating the superiority of HIISI.

An important objective of HIISI is to increase the energy of high-energy beam cocktails from 9.3 MeV/u to above 15 MeV/u for radiation effects testing of electronics with the K130 cyclotron. In the present 9.3 MeV/u cocktail the highest energy is obtained with the  $\text{Xe}^{35+}$  ion beam. In order to meet the requirement ( $\geq 15$  MeV/u) the charge state of at least 43+ has to be produced in the case of xenon. In addition, the intensity on the radiation target has to reach the value of  $10^6$  ions/s. These requirements are far beyond the performance of the JYFL 14 GHz ECRIS

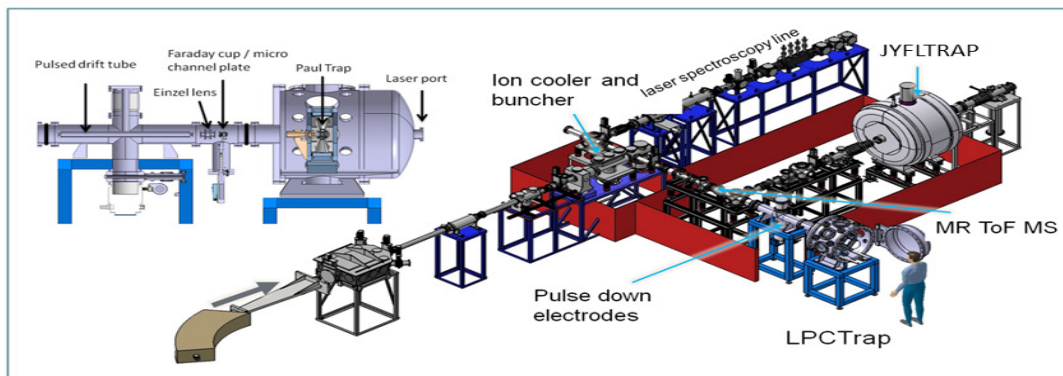
Table 1: Comparison of ion beam intensities of the JYFL 14 GHz ECRIS and HIISI.

Ion source/ion	O7+	Ar12+	Ar13+	Ar14+
JYFL 14 GHz ECRIS	222 $\mu\text{A}$	103 $\mu\text{A}$	51 $\mu\text{A}$	49 $\mu\text{A}$
HIISI 18 GHz	560 $\mu\text{A}$	462 $\mu\text{A}$	312 $\mu\text{A}$	182 $\mu\text{A}$

and have been met so far only by the superconducting ECR ion sources. The ultimate goal ( $\text{Xe}^{43+}$ ) will be pursued via an intermediate step (12.5 MeV/u) requiring the  $\text{Xe}^{40+}$  ion beam. The performance testing of HIISI for electronic-radiation-testing program was conducted during the last quarter of 2017. The first test was performed by producing highly charged xenon plasma and by measuring the intensity of  $^{131}\text{Xe}^{35+}$  ion beam (9.3 MeV/u) on the RADEF station. After a short tuning procedure of HIISI the ion beam intensity of 50 nA was measured before the RADEF station

corresponding to  $>10^8$  ions/s on the radiation target. This greatly exceeds the maximum intensity needed for radiation testing and intensity available from the JYFL 14 GHz ECRIS ( $\approx$  factor of 100 more). The HIISI beam cocktail testing was continued in December 2017 by accelerating the  $^{131}\text{Xe}^{40+}$  ion beam. This ion is included in the 12.5 MeV/u beam cocktail. After a short tuning of HIISI the intensity of 2 nA was measured indicating that approximately  $4 \times 10^6$  ions/s is available for the radiation effect testing. Consequently, the intermediate milestone has successfully been met.

## MORA - solving the open question of matter - antimatter asymmetry in the Universe



Planned location of the MORA trapping experiment at the IGISOL facility. On the upper left: pulsed drift tube, einzel lens and beam diagnostics used for the injection of radioactive nuclei into the trap, the latter based on the LPCTrap design.

Precision experiments of nuclear beta decay provide a means to search for signatures of physics beyond the Standard Model. These signatures may arise through violations of symmetries in nature, for example a measurement of a specific correlation parameter in beta decay would infer an asymmetry in time (T), which through the known Charge-Parity-Time (CPT) symmetry must therefore break

Charge-Parity (CP) - a violation of which is proposed to explain the matter-antimatter asymmetry in the Universe.

MORA (Matter's Origin from the RadioActivity of trapped and polarized isotopes) is aimed at a measure of T asymmetry in the beta decay of  $^{23}\text{Mg}$ . The project, led by French researchers, has been supported by 600 k€ of funding from the Region Normandie. The first phase

of the experiment will be performed over the coming years at the IGISOL facility, and will exploit state-of-the-art techniques of laser polarization and ion trapping, combined with nuclear beta detection, to make a first measurement. A final phase of the experiment will be performed after 2022 at the DESIR facility, SPIRAL-2 accelerator complex, in France.

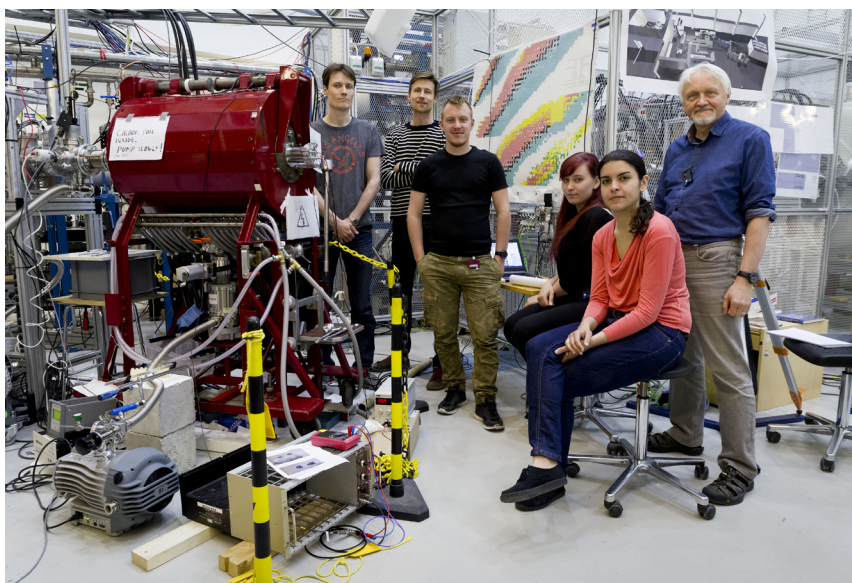


## Prestigious ERC Consolidator Grant to Dr. Anu Kankainen



Academy Research Fellow Anu Kankainen has been awarded a prestigious ERC Consolidator Grant in 2017 for her project MAIDEN “Masses, Isomers and Decay studies for Elemental Nucleosynthesis”. This significant research funding of 2 MEUR will substantially strengthen the research at IGISOL. The five-year project will start in June 2018.

## Recommissioning of an electron spectrometer for the beta decay of $^{20}\text{F}$



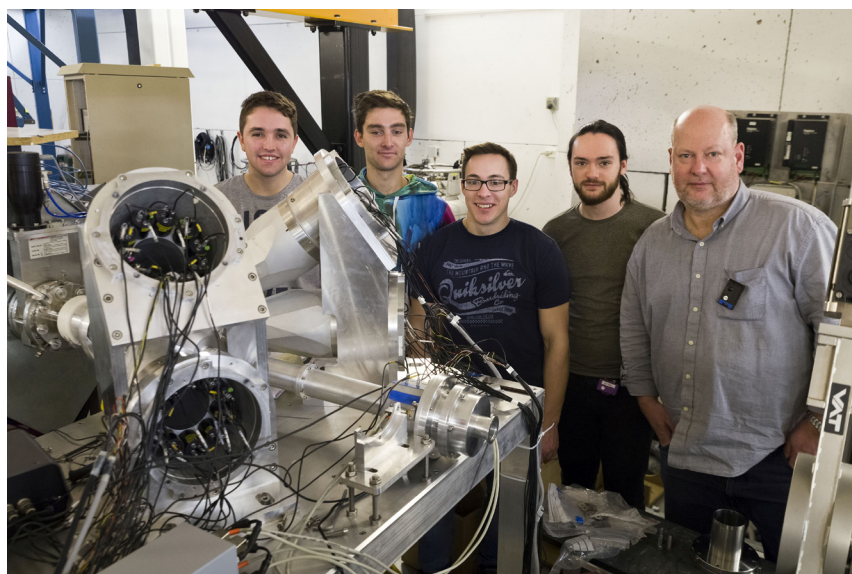
*The refurbished intermediate focus spectrometer at IGISOL in preparation for studying the beta decay of  $^{20}\text{F}$ . From left to right: Sami Rinta-Antila, Oliver Kirsebom, Michael Munch, Marjut Hukkanen, Laetitia Canete and Wladyslaw Trzaska.*

Knowledge of the electron-capture rate on  $^{20}\text{Ne}$  is critical for understanding the final evolution of stars in the mass range between 8 and 10 solar masses. Of crucial input to stellar models would be an experimental measurement of the second-forbidden, non-unique,  $0^+ \rightarrow 2^+$  transition between the ground states of  $^{20}\text{Ne}$  and  $^{20}\text{F}$ . The transition strength may be determined from the branching ratio of the inverse transition in the  $\beta$  decay of  $^{20}\text{F}$ , for which the experimental upper limit is  $\sim 10^{-5}$ . In

collaboration with Aarhus University, Denmark, and with the Nuclear Reactions group, an intermediate-focus spectrometer has been refurbished and installed at IGISOL, capable of focusing electrons up to 8 MeV. Following a commissioning and yield test in 2017, the experiment was run in early 2018 with analysis of the data underway. The figure shows the spectrometer installed on the spectroscopy beam line at IGISOL with some of the team involved.

## Three-foil Plunger for Exotic Nuclei commissioned

Young physicists from the University of Manchester have worked hard in order to get the latest addition to the Accelerator Laboratory infrastructure working. The brand new Three-foil Plunger for Exotic Nuclei (TPEN) was tested in beam in February 2018, as it uses two degrader/stopper foils instead of the standard one. This method would pave way for the lifetime measurements in more exotic nuclei in JYFL-ACCLAB. In the commissioning experiment, the lifetimes in  $^{156}\text{Dy}$  were measured using TPEN.



*From left to right: Jacob Heery, Stuart Szwec (JYFL Postdoc), Michael Giles, Liam Barber and Andrew Smith.*

## Next Call for Proposals

### Deadline: March 15, 2018

The next deadline for submission of proposals and letters of intent is March 15, 2018. **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](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.

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:

*This work has been supported by the EU HORIZON2020 programme "Infrastructures", project number: 654002 (ENSAR2) and by the Academy of Finland under the Finnish Centre of Excellence Programme 2012-2017 (Nuclear and Accelerator Based Physics Research at JYFL).*

## New webpages at the University of Jyväskylä

The University of Jyväskylä recently renewed its website. Related to this, all accelerator facility webpages have been updated. The core information about the accelerator facility and related infrastructure, access and beamtime schedule can be

found from the usual address [www.jyu.fi/accelerator](http://www.jyu.fi/accelerator). The research groups, their research interests and people are described under <https://www.jyu.fi/science/en/physics/research/nuclear-and-accelerator-based-physics>.

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