# Status of CRYRING@ESR and preparations for first experiments

**M Lestinsky[1]*, Z Andelkovic[1], M Bai[1], A Bräuning-Demian[1], V Chetvertkova[1], S Fedotova[1], O Geithner[1], W Geithner[1], O Gorda[1], F Herfurth[1], A Kalinin[1], A Källberg[2], S Litvinov[1], E B Menz[1,3], K Mohr[1], R Sanchez[1], T Stöhlker[1,3,4], G Vorobjev[1] and U Weinrich[1]**

[1]GSI Helmholtzzentrum für Schwerionenforschung GmbH, 64291 Darmstadt, Germany
[2]Fysikum, Stockholm University, SE-106 91 Stockholm, Sweden
[3]Helmholtz-Institut Jena, 07743 Jena, Germany
[4]Institut für Optik und Quantenelektronik, Friedrich Schiller Universität, 07743 Jena, Germany

**Synopsis** CRYRING was moved from Stockholm to Darmstadt, modernized and integrated into the GSI/FAIR beamline topology behind ESR. As CRYRING@ESR, it will receive and store heavy, highly charged ions from all species the present accelerator chain is capable of producing. An extensive research program on low-energy atomic collisions, spectroscopy and nuclear reactions was proposed. The facility is gradually completing commissioning, ion beams from the local injector branch have already been stored and prototype experiments performed. We present the machine status and highlight some planned experiments.

CRYRING@ESR[1] is a low-energy heavy-ion storage ring and the first beam installation realized within the FAIR project. Its full potential will be unleashed, once it receives ion beams from ESR, in all ion species that the GSI accelerator complex is able to produce. The storage of low-energy, heavy, highly charged ions allows for precision spectroscopy of atomic processes and dynamics in strong fields, deriving nuclear parameters like charge radii and nuclear magnetic moments through methods of atomic physics, or probing relevant reactions of nucleosynthesis networks in the Gamow window and many others [2]. Establishing the particle transfer from ESR is presently planned for late 2019.

With its additional ion source and local injector, the facility already runs on its own and provides ion beams e.g. for testing ring subsystems, experimental installations and establishing procedures for data handling and analysis. In the last engineering runs, CRYRING has stably demonstrated storage of ions from the local source, with beam currents close to the space-charge limit and with an ion beam lifetime defined only by residual gas induced loss channels. Moreover, it proved its capability for energy-ramping of the stored ions and for electron cooling, so that well-behaved beams of ions with a narrow beam profile and a sharply defined energy can be delivered to the experimenters' demands. The CRYRING@ESR project is gradually approaching the end of its commissioning period[3] and first experimental installations are ready for beam. Particle detectors for charge exchange reactions have produced beam-induced signal and the new CRYRING laser laboratory has prepared all systems for a prototype beamtime on fluorescence spectroscopy using $Mg^+$ beams from the local injector. The run shall commence already in March 2019. Three first experiment proposals were approved and necessary preparations are tackled in collaboration with partners from HI Jena, U Giessen, U Heidelberg and many others. This contribution shall discuss the present status and future plans for the machine, as well as lay out the immediate and long-term research program.

*E-mail: m.lestinsky@gsi.de

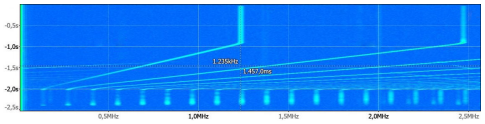

**Figure 1**. CRYRING@ESR Schottky noise spectrum of $H_2^+$ injected at 300 keV/u, accelerated to 24 MeV/u and stored for about one second. The fundamental revolution frequency is seen leftmost with several adjacent higher harmonics.

## References

[1] Lestinsky M *et al* 2012 *GSI Tech Design Rep* CRYRING@ESR: A study group report
[2] Lestinsky M *et al* 2016 *Eur. Phys. J. ST* **225** 797
[3] Herfurth F *et al* 2017 *in proc. Cool'17* THM13