

PHYSICS DIVISION HEAVY ION DISCUSSION

Nuclear Astrophysics using Storage Rings

RAGANDEEP SINGH SIDHU

University of Edinburgh

HOST: DARIUSZ SEWERYNIAK, PHY DIVISION

Date: Friday, August 25, 2023

Time: 3:30 pm CST

Location: Bldg. 203 /R-150 and Zoom link:

[Join ZoomGovMeeting](#)

Abstract: Storage rings stand as potent instruments for conducting precision experiments involving highly-charged stable and radioactive ions, serving as crucial platforms for nuclear structure and astrophysics studies. Within the domain of nuclear astrophysics research, the storage rings housed at GSI Helmholtz Center in Darmstadt, Germany - namely, the Experimental Storage Ring (ESR) and the CRYRING low-energy storage ring - present unparalleled opportunities. Sophisticated techniques for manipulating ion beams, including bunching, accumulation, and deceleration, play a pivotal role in ensuring the storage of ample ion intensities pertinent to specific energy ranges. This achievement is bolstered by the establishment of ultra-high vacuum conditions, typically in the range of 10^{-11} to 10^{-12} mbar, coupled with effective beam-cooling methodologies.

With enormously rich physics cases, the focus of the talk will be on the most recent highlight results achieved within the FAIR-Phase 0 research program at the ESR and the CRYRING. Firstly, the first-ever direct measurement of the bound-state beta decay of fully-ionized $^{205}\text{Tl}^{81+}$ ions (with no electron) will be reported. After almost three decades of its proposal, the measurement was successfully performed in the ESR, employing the entire accelerator chain at GSI. Secondly, the current status of a new detector system, CRYRING Array for Reaction Measurements (CARME), will be given. CARME was recently installed and commissioned in the CRYRING. This detector system will be used to measure nuclear reactions of interest occurring in novae explosions that control the production of elements ejected into the cosmos and isotopic ratios measured in pre-solar grains found in meteorites.

In the end, the recently performed experiments will be put together in the context of the present research programs at GSI/FAIR, and in a broader, worldwide context, an overview of the new up-coming storage ring projects will be given.