



2023 Helmholtz – OCPC – Programme for the involvement of postdocs in bilateral collaboration projects

PART A

Title of the project:

Advancing Precision Atomic and Nuclear Science: Novel Schottky Detector Systems and Data Acquisition for Heavy Ion Storage Rings

Helmholtz Centre and/or institute:

GSI Helmholtz Center Darmstadt

Project leader:

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Department: (at the Helmholtz centre or Institute)

Atomic, Quantum & Fundamental Physics division (AP)

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Description of the project (max. 1 page):

In close collaboration with scientists from all over the world - and in particular within the frame of the [SPARC collaboration](#) - the groups in GSI's Atomic, Quantum & Fundamental Physics division (AP) exploit the possibilities of the present [GSI](#)- and future [FAIR](#)-accelerator complex. This combination of a linear accelerator (UNILAC), heavy-ion synchrotron (SIS), fragment separator (FRS), and both storage rings [ESR](#) and [CRYRING@ESR](#), makes it possible to accelerate, store, and cool slow to relativistic ion beams of every element from hydrogen to uranium. Stable or radioactive isotopes are being investigated. The main interest is focused upon the very highly charged heavy ions.

The use of non-destructive Schottky detectors facilitates precise determination of the mass and lifetime of exotic nuclear species and their isomeric states within heavy ion storage rings. The ability to measure with few or even single ions has been consistently achieved in the past through



the employment of these detectors. Recent designs aim to enhance measurement precision by incorporating the measurement of particle position in a dispersive section of heavy-ion storage rings.

This project involves the design and realisation of novel Schottky detector systems for the GSI and FAIR storage rings. These steps include simulations, construction, off-line and on-line testing and characterisation of the detectors, for which existing code has to be adapted and improved.

The project will also involve the investigation and building of broadband and narrowband data acquisition hardware based on software defined radio for use with such detectors. Existing systems will be used, whereas novel systems will be investigated, adapted and tested with such detectors. Prototype acquisition systems will be built and tested with ion beams and thoroughly characterised.

The candidate will also take active part in the upcoming beam times and experiments.

Potential project Outcomes/milestones

- Longitudinal and transversal Schottky detector systems for ESR
- Longitudinal Schottky detector system for the CRYRING@ESR
- Realisation of novel broadband and narrow band time capture data acquisition systems
- Active participation in experimental program

Description of existing or sought Chinese collaboration partner institute (max. half page):

GSI, and in particular the Atomic Physics Department, has a long-standing collaboration with the Institute of Modern Physics (IMP) in Lanzhou. Numerous publications testify to the fruitful cooperation in recent years. We have also benefited from the Helmholtz OCPC programme: at least 3 postdocs have been actively involved in research at GSI's atomic physics department in the past. While others have returned to their home country, we are happy, that one of the postdocs will still be with us until the end of 2023.

Required qualification of the postdoc:

Skills:

- PhD in physics or related major
- Basics of accelerator physics
- Basics of RF and microwave
- Basics of data acquisition systems / software defined radio
- Very good command of Python programming language and Linux operating system
- Experiences with accelerator based experiments, specifically storage rings are welcome
- Good command of spoken and written English