

2026 Helmholtz – OCPC – Programme

for the involvement of postdocs in bilateral collaboration projects

PART A

Title of the project:

Precision Atomic Physics with Highly Charged Ions at the SPARC/FAIR Storage Rings

Helmholtz Centre and/or institute:

GSI Helmholtz Centre for Heavy Ion Research

Project leader:

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Department: (at the Helmholtz centre or Institute)

SPARC – Stored Particle Atomic Physics Research Collaboration / APPA

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Description of the project (max. 1 page):

The Stored Particle Atomic Physics Research Collaboration (SPARC) is one of the four experimental collaborations within the Atomic, Plasma Physics and Applied Sciences (APPA) pillar of the Facility for Antiproton and Ion Research (FAIR) at GSI Darmstadt (fair-center.eu/user/experiments/appa/sparc). With more than 700 scientists from 30 countries, SPARC pursues a world-unique research programme using cooled and stored beams of highly charged heavy ions at the FAIR storage rings (HESR, CRYRING@ESR) and trapping facilities (HITRAP), as well as at the existing ESR and CRYRING in FAIR Phase-0.

The central physics goals of SPARC are the precision tests of Quantum Electrodynamics (QED) in the regime of extreme electromagnetic fields (e.g. up to 10^{16} V/cm for bare uranium U^{91+}), the investigation of relativistic collision dynamics, studies at the interface between nuclear and atomic physics (including nuclear excitation by electron capture), and the development of novel atomic physics techniques for the determination of nuclear properties. Experiments exploit state-of-the-art instrumentation including high-resolution micro-calorimeters, Compton polarimeters, crystal spectrometers for hard X-rays, and electron and ion spectrometers.

The selected postdoctoral candidate will be integrated into the SPARC group at GSI/Helmholtz Institute Jena and will contribute to one or more of the following research directions, to be adjusted according to the candidate's expertise: (i) precision X-ray spectroscopy of highly charged heavy ions at CRYRING@ESR or the HITRAP facility for QED tests and bound-state g-factor measurements; (ii) laser spectroscopy of stored relativistic ions for nuclear structure and isotope shift studies; (iii) development and commissioning of novel detector systems (e.g. micro-calorimeters, polarimeters) for use at FAIR; and/or (iv) preparation of SPARC physics experiments for Early Science operation at FAIR. The candidate will join the SPARC Collaboration and present results at international conferences. The specific project focus can be tailored once the candidate has been selected. Further details on the SPARC programme are available at fair-center.eu.

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

SPARC has active and growing collaborations with Chinese institutions, most notably the Institute of Modern Physics (IMP) of the Chinese Academy of Sciences in Lanzhou — home of the CSR and future HIAF storage ring facilities — and Peking University (Beijing). Collaborative activities span precision atomic physics experiments at GSI/FAIR and at the CSR in Lanzhou, as well as joint detector development and theory efforts. The OCPC postdoctoral programme offers an excellent opportunity to deepen these collaborations and to establish new partnerships with Chinese groups working on atomic physics with highly charged ions, particularly in view of the complementary physics programme planned at HIAF. Candidates from any Chinese institution with interest in precision atomic physics, storage ring experiments, or detector development are warmly encouraged to apply.

Required qualification of the postdoc:

- PhD in Atomic Physics, Nuclear Physics, or Experimental Physics
- Experience with precision spectroscopy experiments and/or particle/ion detectors
- Knowledge of highly charged ions and storage ring physics is a strong advantage
- Good programming skills (C++, Python, or equivalent); experience with data analysis tools (ROOT or similar)
- Additional skills in detector development, X-ray spectroscopy, or laser physics are beneficial
- Language requirement: fluent English (speaking and writing)