

Department “SPARC Detectors” in the FAIR@GSI Project*

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In the last decades, accelerator-based atomic physics has advanced into hitherto unexplored areas of research, encompassing high energies, high atomic charge states and strong electromagnetic fields. Here, the heavy-ion storage rings play an indispensable role. A worldwide unique research program is being pursued at the experimental storage ring ESR of GSI by conducting precision spectroscopy of relativistic few-electron ions and interaction studies of relativistic ions with atoms, electrons and photons. The atomic physics groups at GSI and HIJ have gained an unparalleled expertise in this field which ensures that the unprecedented possibilities of the future Facility for Antiproton and Ion Research (FAIR) [1] – concerning energy, intensity and experimental tools – can optimally be exploited to provide access to the fundamental facets of relativistic atomic physics and neighbouring fields. Realisation of this rich research program is the main aim of a large international collaboration, the SPARC Collaboration [2].

The envisioned experiments were initially foreseen in several areas of the FAIR complex: in a dedicated APPA multi-purpose cave, at the SIS-100/SIS-300 synchrotrons, at the FLAIR facility and at the New Experimental Storage Ring NESR. However, the SPARC research program was dramatically reduced by the Modularised Start Version (MSV) [3] of FAIR, where the construction of the central facilities for the SPARC experiments, the NESR and the connected FLAIR facility have been moved to later modules. Therefore, intense investigations of various possibilities to rescue the SPARC science at FAIR by using the facilities available within the MSV have been conducted in the last two years.

One of the solutions is to explore the unique opportunity offered by the High Energy Storage Ring (HESR) [4], which was primarily designed for experiments with stored and cooled antiprotons. However, it turned out to be a well-suited facility which can accommodate a range of SPARC experiments with high-energy stored heavy-ion beams [5, 6]. In particular, the HESR can store cooled beams at energies of up to 5 GeV/u and can thus enable unique atomic physics experiments which are not feasible at any other place in the world. Furthermore, installation of the CRYRING – the storage ring which was operated until very recently at the University of Stockholm – at the present ESR facility will open up the possibility of precision experiments with cooled highly-charged heavy ions at low energies already in the MSV of FAIR [7].

A dedicated department within the FAIR@GSI Project, SPARC Detectors, has been organised, the primary task

of which is to accomplish working packages assigned by the SPARC collaboration as the GSI contribution to the SPARC experiments at FAIR. These are the integration of the overall SPARC setup including the necessary infrastructure in the HESR and – if required by the collaboration – the construction of SPARC instrumentation, like internal targets, spectrometers, particle detectors, etc.

References

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