

Physics with Highly Charged Ions

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The future international accelerator Facility for Antiproton and Ion Research (FAIR) encompasses 4 scientific pillars containing, at this time, 14 approved technical proposals worked out by more than 2000 scientists from all over the world. They offer a wide range of new and challenging opportunities for atomic physics research in the realm of highly-charged heavy ions and exotic nuclei. As one of the backbones of the Atomic, Plasma Physics and Applications (APPA) pillar, the Stored Particle Atomic Physics Research Collaboration (SPARC) has organized tasks and activities in various working groups for which we will present a concise survey on their current status.

The new project is promising the highest intensities for relativistic beams of stable and unstable heavy nuclei, combined with the strongest available electromagnetic fields, for a broad range of experiments. This will then allow the extension of atomic-physics research across virtually the full range of atomic matter, i.e. concerning the accessible ionic charge states as well as beam energies. For atomic physics (AP), one of the major research fields served by FAIR, the scientific program and the R&D projects at the current ESR and the future NESR storage rings will concentrate on two central research areas: correlated electron dynamics including production of electron-positron pairs in strong ultra-short electromagnetic fields and fundamental interactions between electrons and heavy nuclei – in particular the interactions described by Quantum Electrodynamics, QED. It is further considered to use atomic physics techniques to determine properties of stable and unstable nuclei and to perform tests of predictions of fundamental theories besides QED.

In order to reach the desired physics objectives, a large number of diverse experimental installations will be available, each equipped with novel and sophisticated instrumentation. Within the SPARC collaboration the atomic physics community has formed twelve experimental and one theoretical working groups to advance the development and construction of the project.

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