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Atomic Physics Research with Highly Charged Ions and Exotic Nuclei at the Future FAIR Facility

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An overview about the envisioned program of the research collaboration (Stored Particle Atomic Research Collaboration, http://www.gsi.de/sparc) at the future GSI accelerator facility will be given. This program exploits the key features of the future international accelerator that offer a range of new and challenging opportunities for atomic physics and related fields [1]. Particular emphasis will be given to the current R&D activities of SPARC at the ESR storage ring.
In SPARC we plan experiments in two major research areas: collision dynamics in strong electromagnetic fields and fundamental interactions between electrons and heavy nuclei up to bare uranium. In the first area we will use heavy ions up to the relativistic energies for collision studies.
With the extremely short, relativistic enhanced field pulses, the critical field limit (Schwinger limit) for lepton pair production can be surpassed by orders of magnitudes. Com-plementary to the relativistic collision regime, at low ion energies the atomic interactions are dominated by strong
perturbations and quasi-molecular effects. Here even investigations of the super-critical field regime will be possible.
The cooler ring NESR a "second-generation" ESR will have optimized features and novel in-stallations. This unique facility will allow for a broad range of experimental studies ranging from single ion decay spectroscopy to experiments exploiting highest beam intensities for accu-rate x-ray spectroscopy of atomic transitions in the heaviest one- and two-electron ions. These experiments will focus on structure studies of selected highly-charged ion species, a field that is still largely unexplored; with determinations of properties of stable and unstable nuclei by atomic physics techniques on the one hand, and precision tests of quantum electrodynamics (QED) and fundamental interactions in extremely strong electromagnetic fields on the other hand.
Different complementary approaches will be used such as relativistic Doppler boosts of optical or X-UV laser photons to the X-ray regime, or coherent radiation by channelling of relativistic ions, or electron-ion recombination, or electron and photon spectroscopy that will give hitherto unreachable accuracies. These transitions can also be used to laser-cool the relativistic heavy ions to extremely low temperature. Another important scenario for this class of experiments will be the slowing-down, trapping and cooling of particles in the ion trap facility HITRAP. There high-accuracy experiments in the realm of atomic and nuclear physics will be possible [3].

References
[1] SPARC Technical Proposal (2005) http://www.gsi.de/onTEAM/grafik/1068560945/ sparc-technical-proposal_print.pdf
[2] Th. Stˆhlker et al. NIM B: Beam Interactions with Materials and Atoms 261, 234 (2007)
[3] H.-J. Kluge et al., Advances in Quatum Chemistry, 53, 83 (2008)

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