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Present and Planned Experiments with the FRS and Super-FRS

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A projectile fragment beam, separated in flight has an inevitable large emittance due to their stochastic creation processes and the atomic interactions in the production target, degrader and detector materials. Therefore, high-resolution spectrometer experiments require the use of dedicated ion-optical operation modes, or methods which reduce the phase space by cooling and energy bunching. Recent momentum and mass measurements with the fragment separator FRS have demonstrated the success of these efforts and will be reported in this contribution. The measurements described are pilot experiments which will be continued with the super-conducting fragment separator Super-FRS at FAIR.

The physics program with the Super-FRS as a high-resolution ion-optical system will be pre-sented in this contribution as well. The maximum kinetic energies of the uranium projectiles will be 500 MeV/u higher compared to the present facility. This requirement sets a clear pri-ority and opportunity to the heaviest, fully ionized projectile fragments in the planned exper-iments and assures that the Super-FRS will be unique worldwide. The search of new isotopes and the measurements of their properties will be a central activity as they are now at the FRS. The Super-FRS can be operated in dispersive, achromatic or dispersion-matched ion-optical modes which can be applied for high-resolution momentum measurements in combination with secondary reaction studies. Basic atomic collision studies will be performed to contribute to the basic knowledge of heavy-ion interaction with matter and to enable an efficient separa-tion performance in the enlarged energy domain. The energy range corresponding to up to 20 Tm opens up new fields for studies of hyper-nuclei, delta-resonances in exotic nuclei and spectroscopy of atoms characterized by bound mesons. Rare decay modes like multiple-proton or neutron emission and the investigation of the role of the nuclear tensor force are also research topics covered with the Super-FRS. The in-flight radioactivity measurements in the picosecond range, pioneered at the FRS, will be extended with the proposed program.

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