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## Ion-Ion Collisions for Atomic Physics at CRYRING@ESR, GSI/FAIR

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Whereas ion–ion experiments for high-energy physics (like the experiments at CERN) are currently carried out, ion–ion collisions for atomic physics have been performed in the past mainly in the low velocity regime, i.e. typically at center-of-mass energies of a few keV up to a few 100 keV. There, the charge transfer process is by far the dominant electronic process. Investigation of the intermediate velocity regime reached when MeV/u ions interact with keV/u ions is more complicated due to the fact that, there, all the primary electronic processes (electron capture, loss and excitation) reach their optimum probability leading to the maximum of the ion stopping power. To carefully study and measure the absolute cross sections of elementary electronic processes, we have developed an experimental program, named FISIC for Fast Ion Slow Ion collisions, to perform ion-ion collisions with an ultimate control of the number of electrons bounded to the ions. Besides the possibility to reach the pure three-body problem (bare ion on hydrogenic target) as a benchmark, the role of additional electrons –added one by one– should allow quantifying several effects such as the role of electron–electron interactions for instance and this for a large variety of collision systems. This program will be conducted on the CRYRING@ESR facility. CRYRING is an ion storage ring integrated into the GSI/FAIR accelerator complex (Darmstadt, Germany) and the smallest of the storage rings. It can store and cool MeV/u heavy, highly charged ion beams. It features excellent vacuum conditions to achieve ion beam lifetimes of several seconds to minutes for even the highest charge states of ions. The FISIC platform that will provide cleaned keV/u ion beams will be connected to CRYRING. The first experiments are scheduled in 2024-2025. To be more general, France is one of the contributor in the construction of the FAIR accelerator facility. We present here a program that is included in SPARC (Stored Particles Atomic Physics Research Collaboration) belonging to the APPA (Atomic, Plasma Physics and Applications) pillar; one of the four experiment pillars of research at GSI/FAIR.

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