MS 7: Ion Storage Rings

Time: Wednesday 11:00–12:15 Location: PH/HS2

MS 7.1 Wed 11:00 PH/HS2

The Cryogenic Storage Ring CSR — •Robert von Hahn[1], Arno Becker[1], Klaus Blaum[1], Christian Breitenfeldt[1], Aodh O'Connor[1], Sebastian George[1], Jürgen Göck[1], Manfred Grieser[1], Florian Grussie[1], Philipp Herwig[1], Claude Krantz[1], Holger Kreckel[1], Christian Meyer[1], Olda Novotny[1,2], Roland Repnow[1], Claus-Dieter Schröter[1], Kaija Spruck[3], Stephen Vogel[1], and Andreas Wolf[1] — [1]Max-Planck-Institut für Kernphysik, Heidelberg, Germany — [2]Columbia Astrophysics Laboratory, Columbia University, New York, USA — [3]Institut für Atom- und Molekülphysik, Justus-Liebig-Universität Giessen, Germany

At the CSR, a cryogenic electrostatic storage ring, first experiments studying low-energy ion reactions with atoms, photons or electrons are upcoming in near future. At beam energies of 20 keV to 300 keV per charge unit and 35 m circumference the CSR is designed to allow experiments in a cryogenic environment providing conditions of extremely low vacuum (1 x 10E-13 mbar) and temperature (10K). Moreover, phase space cooling by electrons is under construction to be installed as the next step.

In spring 2014 a 50 keV Ar+-beam could be successfully stored in the CSR still operating at room temperature. Additionally beam diagnostics as well as particle detectors for neutral and charged fragments have been successfully tested.

Presently preparations are finalized for the first complete cryogenic cool down of the CSR, in order to start first exploratory experiments with stored atomic and molecular anions and cations in spring 2015.

MS 7.2 Wed 11:15 PH/HS2

The low-energy electron cooler for the Cryogenic Storage Ring — •Stephen Vogel, Klaus Blaum, Claude Krantz, Svenja Lohmann, and Andreas Wolf — Max-Planck-Institut für Kernphysik, 69117 Heidelberg, Germany

The Cryogenic Storage Ring (CSR) at the Max Planck Institute for Nuclear Physics in Heidelberg, Germany, is being commissioned. CSR will be an ideal tool for preparing and studying cold atomic and molecular ions using ion beams of $20 - 300$ keV kinetic energy (per ion charge unit). As a first important upgrade CSR will be equipped with an electron cooler. The latter is designed for cooling beams with a charge-to-mass ratio q/m of 1 to 1/160 e/amu. This corresponds to an electron beam energy range of 1 to 163 eV. The beam will be produced by a cryogenic photocathode and electron temperatures in the co-moving frame reach down to 10 K. The cooler can also be used as an electron target by detuning the electrons' kinetic energy. The cooler is currently under construction and first tests on the already finished warm beam line parts are ongoing. The current status of the CSR electron cooler will be presented.

MS 7.3 Wed 11:30 PH/HS2

Large-area detectors for position and energy resolving detection of neutral molecular fragments at CSR — •L. Gamer[1], D. Schulz[1], A. Fleischmann[1], L. Gastaldo[1], S. Kempf[1], C. Krantz[2], O. Novotny[3], A. Wolf[2], and C. Enss[1] — [1]Heidelberg Univ. — [2]MPI-K Heidelberg — [3]Columbia Astrophysics Laboratory

We present a detector with a circular detection area of 10 cm^2 based on metallic magnetic calorimeters that is suited for position and energy sensitive measurements of neutral particle hits from fragmentation of molecular ion beams at the Cryogenic Storage Ring at MPI-K. It consists of 16 large area particle absorbers, arranged like the 16 slices of a pizza of radius 36 mm, where the temperature of each is monitored by a paramagnetic temperature sensor positioned along the outer absorber edges. Due to the finite thermal diffusivity in the absorbers, the signal rise-time is a measure of the radial event position while the integrated signal amplitude is proportional to the particle energy. We show very successful prove-of-principle experiments of this detector using x-ray photons. We discuss measurements where fragments of 150 keV molecules where stopped in massive gold absorbers showing that the production of lattice defects can cause a major contribution to linewidth in this energy and mass range. As an outlook we move on to a 4096 pixels detector covering a detection area of 20 cm^2. It consists of 1024 temperature sensors that are read out by only 32 SQUID channels. Each temperature sensor is coupled to 4 absorbers using different thermal links, thus allowing to locate the event position within a set of absorbers again by measuring the rise-time of the detector signal.

MS 7.4 Wed 11:45 PH/HS2

Neutral-atom molecular-ion merged beams experiments at the cryogenic storage ring — •Aodh O Connor, Manfred Grieser, Florian Grussie, and Holger Kreckel — Max-Planck-Institut für Kernphysik, Heidelberg

Gas phase interstellar chemistry is dominated by reactions between neutrals and ions. Thus far, there remain large uncertainties on many reaction rate coefficients, which determine formation pathways. Experimental determination of ion-neutral reaction rates relevant to cosmic chemistry have been inhibited by technical challenges. The greatest obstructions are: generation of a well-defined, pure, ground-term neutral beam, and preparation of molecular ion beams with sufficiently low internal energies. To address these challenges, we have developed a beamline capable of producing atomic beams of hydrogen, deuterium, carbon and oxygen. The neutrals are created by photodetachment from a parent anionic beam using a direct diode laser. The neutral beams are coupled to the Cryogenic Storage Ring (CSR) at the Max Planck Institute for Nuclear Physics. They are merged with a cold, stored molecular ion beam in one of the straight sections of the CSR. The co-propagating beams can be matched in velocity, allowing center-of-mass collisional energies as low as a few meV. Measurement of beam fluxes, velocities, and overlap length will permit absolute determination of the reaction thermal rate coefficients.

MS 7.5 Wed 12:00 PH/HS2

Development of a Transversely Sensitive Resonant Schottky Pickup for the CR@FAIR — •Xiangcheng Chen[1,2], Shahab Sanjari[1], Jeremi Piotrowski[2,3], Peter Hülsmann[1], Yuri Litvinov[1,4], Fritz Nolden[1], Markus Steck[1], and Thomas Stöhlker[1,5] — [1]GSI, Darmstadt — [2]Uni. HD, Heidelberg — [3]AGH Univeristy of Science and Technology, Krakow, Poland — [4]MPI-K, Heidelberg — [5]HIJ, Jena

The prospective FAIR facility will offer unprecedented opportunities to extend atomic and nuclear physics research programs with its high-energy and high-intensity heavy ion beams. For instance, the Collector Ring (CR) will be best suitable for addressing mass and lifetime measurements of rare isotopes when it is operating in the isochronous ion-optical mode. However due to the large acceptance of the CR the non-isochronicity effect still exists, which limits the measurement precision. The determination of particle positions in addition to their revolution frequencies is required to enhance the mass resolving power. In this contribution, we present a novel design of a transversely sensitive resonant Schottky pickup for the CR. It is an elliptical pillbox-cavity with an off-centred beam pipe, and works in the monopolar eigenmode. Based on the simulations and offline tests, its feasibility of coping with different beam parameters of the CR is also discussed.