A cryogenic electrostatic ion storage ring at RIKEN

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We have developed a compact cryogenic electrostatic ion storage ring, to explore the properties, especially the cooling process and the collision dynamics of the cold molecular ions in the specific vibrational and rotational states. The cryogenic environment will also provide an extremely high vacuum condition, which offers much longer storage of the ion beam.

The system is composed mainly of two-fold vacuum chambers. All electrodes are placed on a single base stage (1664 mm x 564 mm) made of Chromium Copper (CrCu) alloy. The stage is covered with a stainless steel wagon-headed shaped structure that is cooled by strips of oxygen free copper. The combination assures high thermal conductivity and excellent vacuum property at cryogenic temperatures. This inner vacuum chamber (IVC) is cooled by three sets of GM cryocoolers whose cooling capacity at 4.2 K is 3 W in total, and it is further covered by the outer vacuum chamber (OVC) for thermal isolation.

We have already finished assembling work, and tested performance in vacuum and cooling. The temperature of the IVC reached bellow 5 K. and the pressure in the pumping station attached to the IVC reached in the order of 10^{-11} Torr. Taking account of the conductance between cryogenic and room temperature sections, the pumping speed of the cryogenic chamber wall, and the above-mentioned pressure of the room temperature section, the pressure in the IVC is expected to be better than 10^{-14} Torr.

We prepared an ECR ion source on a 20 kV platform producing atomic ions for testing performance of the storage ring, together with the beam transport and injection system. A neutral beam line for the merging experiment is now under development. The neutral beam is produced by photo-detachment of negative ions produced by a Cs-sputtered ion source. A second harmonic from a Nd:YAG laser is used for photo-detachment.

The first attempt of the ion storage is scheduled in 2013.

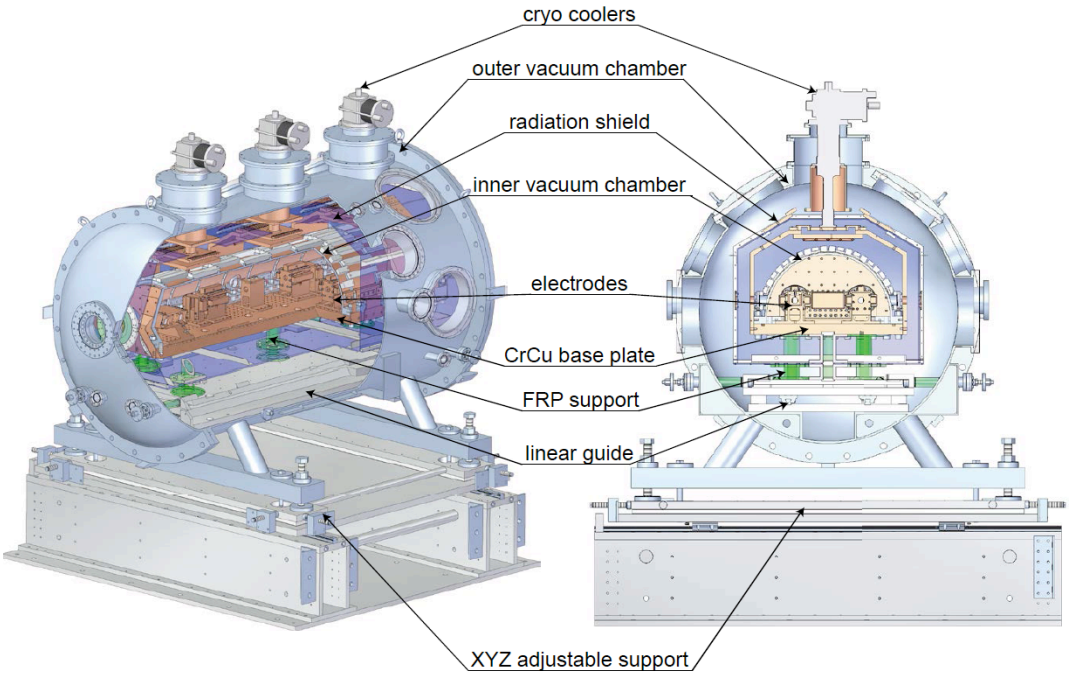

Fig. 1. Schematic view of cryogenic electrostatic ion storage ring at RIKEN