Challenge to reveal Solar Wind Charge Exchange mechanism with TES X-ray microcalorimeter and TMU-ECRIS

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In X-ray astronomy, it is still a question how diffuse soft X-ray emission occasionally shows term variations in a few days. A possibility has been proposed that the emission is caused by charge exchange process between the solar wind ion and the interplanetary neutral matter. However, it is difficult to identify that this emission is truly generated by charge exchange process with the spectral resolution of current X-ray astronomy satellites. Our group is developing an experiment to reveal the mechanism of Solar Wind Charge eXchange (SWCX) occurring in space. We employ high resolution X-ray spectrometer, namely TES (Transition Edge Sensor) X-ray micro-calorimeters, and ECRIS (Electron Cyclotron Resonance Ion Source).

The TES X-ray microcalorimeter is a state of art X-ray spectrometer, which offers high energy resolution ($E/\Delta E \sim 2000$ around 6 keV) and high quantum efficiency (~ 1) at the same time. TES calorimeters are operated at an extremely low temperature (~ 100 mK). For this, we are developing a double stage ADR (Adiabatic Demagnetization Refrigerator) which uses two ADR steps in series (Fig 1 Left) [1]. We achieved a holding time of about two hours at 100 mK, and plan to introduce TES calorimeter into this system very soon.

The charge exchange collisions of multiply charged light ions, such as oxygen, with neutral atoms have been experimentally produced using the ECRIS in TMU. We carried out a preliminary experiment using a windowless Si(Li) detector to examine the ECRIS performance [2]. When our TES calorimeter is combined with the TMU-ECRIS, we can obtain high-resolution X-ray spectrum and look into the detailed charge exchange process. This will help us understand the properties of the SWCX with the earth atmosphere. I present brief description of the experimental system and TES microcalorimeter, with a report on the recent progress.

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Reference

1 K.Shinozaki *et al.* 2009, SPIE, 7011E. 110S
2 H.Tanuma *et al.* those proceedings.

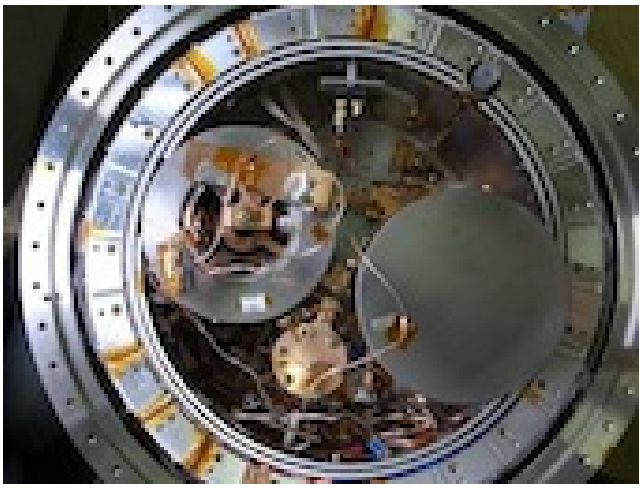

Fig. 1: Left:double stage ADR. Right: Ion collision facility with TMU-ECRIS