Solar wind charge exchange and related atomic processes in laboratory

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The soft X-ray emission observed with the ROSAT all-sky survey in the 1990s found an intensity fluctuating in cycles of a few days duration [1]. It was difficult to understand this phenomenon before the mechanism of the soft X-ray emissions from comets has been revealed. In 1996, the ROSAT also observed the soft X-ray emission from the comet C/Hyakutake 1996 B2 approaching to Earth [2]. According to Cravens' suggestion, it has been recognized that the soft X-ray emission stems from charge exchange collisions between the solar wind ions and the neutrals among the comet, and this phenomenon is called ``Solar Wind Charge eXchange" (SWCX) [3]. In analogy to this, it was proposed that the soft X-ray background radiation with fluctuating intensity is due to a charge-excange of the highly charged ions in the solar wind with thin neutral matter within the heliosphere [4].

In order to analyze soft X-ray emission spectra observed with X-ray observatory satellites quantitatively, accurate emission cross sections in collisions of multiply charged ions with neutral atoms are required by astrophysicists. We have a 14.25 GHz electron cyclotron resonance ion source (ECRIS) which can produce various multiply charged ions (for example, bare, H-like, and He-like ions of C, N, and O atoms *etc*.) and beam lines for collision experiments between multiply charged ions and neutral gases with solar wind speed of 300-800 km/s which corresponds to a kinetic energy range of 0.5-3.3 keV/u.

Using this multiply charged ion beam facility, we have been performing the following experiments in this decade:

1) Total charge exchange cross sections:
2) Emission spectra and emission cross sections [5, 6]:
3) Observation of forbidden transitions following charge exchange collisions [7, 8]:
4) Soft X-ray emissions from inner-shell excited Li-like ions [9]:

We will show our recent results on atomic collision experiments with multiply charged ions in the workshop.

References

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