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Emittance measurement of ion beam current in selectively heating low Z ions on electron cyclotron resonance ion source in mixing low Z gases

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We have been studying efficient production of multicharged ions in electron cyclotron resonance (ECR) ion source (ECRIS) based on experimental facts and theoretical considerations. We are conducting experiments in mixing low Z gases, which is widely known empirically as a method for efficient production of multicharged ions. Furthermore, low-frequency electromagnetic waves have been introduced to the experiment to enhance effect of the low Z gas mixing.
Specifically, we conduct experiments in which Ar and He gases are introduced into Xe operation gases and then selectively heat low Z ions (Ar+ and He+) by ion cyclotron resonance (ICR) to actively promote the cooling effect of multicharged Xe ions. Experiments of ICR selectively heating are conducted by using electromagnetic waves with frequencies of 40kHz for Ar and 400kHz for He.
Multicharged Xe ion beam currents extracted from ECRIS are increased by introducing low-frequency electromagnetic waves. When He was introduced, the multicharged Xe ion currents increased significantly compared to Ar case. Next, the emittance of each ion beam was measured in both of Xe/Ar and Xe/He cases. Since the effect of the magnetic field strength on emittance in our ECRIS is considered to be comparable to ion temperature's one, we conduct under constant magnetic field strength. We confirmed the effect of ICR selectively heating He+ and Ar+ from rms emittance values derived from multislit method and corresponding primary profiles of beam current. Rms emittances of ion species heated by ICR is tending to be higher than those without ICR. Therefore, low Z ions are heated by introducing low-frequency electromagnetic waves. We consider these results cause the increase of multicharged Xe ion beam currents due to enhance ion cooling effect. We conduct the same measurements for multicharged Xe ions in progress. We also obtain the corresponding plasma parameters. In this report, we describe the details of these experimental results.

Primary author: IDE, Akinobu (The University of Osaka)

Co-authors: FUJIMURA, Yushi (The University of Osaka); TOKUNO, Shinji (The University of Osaka); INOUE, Daichi (The University of Osaka); ASAJI, Toyohisa (The University of Shiga Prefecture); MURAMATSU, Masayuki (QST); KITAGAWA, Atsushi (National Institutes for Quantum Science and Technology (QST)); KATO, Yushi (The University of Osaka)

Presenter: IDE, Akinobu (The University of Osaka)

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