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Development of the High Energy Particle instrument for Ions (HEP-ion) on BepiColombo/MMO

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In the past, Mercury has been investigated by Mariner 10 in 1970s. It discovered a dipole-type magnetic field and high-energy particle bursts through three times fly-by. However, due to the limited conditions, the observational results are not sufficient. Recently Messenger explored Mercury through three times fly-by in 2008-2009 and it has detected the substorms, but it has not detected any high-energy particle bursts. In order to reveal the structure and dynamics of the magnetosphere of Mercury, it is crucial to observe plasmas and high energy particles directly. Therefore, the next Mercury exploration, BepiColombo mission is planned to launch in 2014, which is a collaborate project between JAXA and ESA.

Mercury Magnetospheric Orbiter (MMO), one of the two spacecraft of this mission, carries the High Energy Particle instrument for ions (HEP-ion) which has two techniques for high energy particle measurements, namely a Time-of-Flight (TOF) and a Solid-State Detector (SSD). They can measure velocity (v) and energy (E) of incoming ions respectively and the ion mass can be derived from v, E, so the ions are discriminated such as H, He, C-N-O, Na-Mg, K-Ca and Fe. Energy range is required from 30KeV to 1.5MeV.

In order to measure these particles, the characteristics of the TOF unit of HEP-ion have been studied about electrical potential distribution and particle trajectories with numerical simulations. Additionally we calibrate its prototype model in our laboratory by using the high-energy ion beam line which provides 10keV-150keV ion beam of H+, He+, He++, N+. Its performance of a coincidence rate and mass resolution is checked by comparisons with the simulation results. The experiment results of a coincidence rate are consistent with simulations. As for mass resolution, the results of experiments and simulations show good agreement and sufficient mass resolution in the energy range of 55keV to 100keV and we obtain information of mass resolution from 100keV to 1.5MeV with simulations. In this presentation, we report the performance of the TOF unit of HEP-ion.

Keywords: BepiColombo, MMO, HEP-ion, TOF