

Energetic Neutral Atom Imaging of Mercury and the Moon, Science and Instrumentation

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Energetic neutral atom (ENA) imaging opens a new window for investigation of the plasma environment of and the plasma - surface interaction at non - atmospheric bodies such as Mercury and the Moon. ENAs originated from the charge - exchange process between singly charged ions and the Mercury exosphere visualize plasma distribution at the planet in the similar way as they do at the Earth. Moreover, ENAs can be used to investigate fast reconfigurations of the magnetosphere, for example substorms, which result in ENA flashes. Ions of the solar wind (at Mercury and the Moon) or accelerated planetary ions (at Mercury) precipitating onto the surface kick off atoms from the outermost layer with energies much greater than the escape energy. These atoms, normally, with energies above 10eV can be used to visualize and study the precipitation region. In the Moon case this technique can provide images of minimagnetospheres, if any, which stand off the solar wind. Furthermore, measurements of the sputtered ENAs reveal the surface composition and contribute to understanding of the sputtering sources to the exosphere. To perform such observations we designed an ENA imaging mass spectrometer to measure ENAs in the energy range 10eV - 3.3keV with the mass resolution to resolve H, O, Na/Mg/Si/Al-group, K/Ca-group, and Fe-group. The pure geometrical factor was optimized to reach 5cm² sr eV/channel for 25eV and 50cm² sr eV/channel for 3300 eV but keep the instrument total mass below 2 kg. The instrument is based on the ENA-to-ion conversion / surface reflection technique. The experiment was selected to fly onboard JAXA - ESA Bepi Colombo MMO satellite and the Indian Chandrayaan-1 mission to the Moon.

Keywords: Planetary magnetospheres; solar wind interaction; energetic neutral atoms; Mercury; the Moon