

Energetic Neutral Atom Imaging for Lunar science: Interactions between space plasma, exosphere, and surface

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More than 99% of all known matters in the Universe is in the plasma state. The behavior of the plasma is therefore a key for understanding how the Universe works. On top of the traditional in-situ measurements of charged particles, energetic neutral atom (ENA) imaging has opened a new channel for space plasma investigations in this two decades. ENA is produced when an ion receives an electron from neighboring matters. Due to its neutrality the ENA do not feel any electromagnetic forces, and therefore, the ENA imaging is possible. We can extract the plasma characteristics from obtained ENA images.

ENA imaging has been utilized first to plasma physics missions, but were applied to lunar and planetary missions. Low energy (~1 keV) ENA instruments deployed at a Moon orbit (by Chandrayaan-1) provided basic physics on the solar wind - Moon surface interaction. For example, a global map of the solar wind proton flux was produced from the orbiter data. The flux is highly dependent on the existence of the magnetic anomaly, distributed globally over the lunar surface. The solar wind proton flux pattern at the surface exhibits a high similarity to the global map of the hydroxyl distribution, independently characterized by the infrared spectroscopy. This coincidence indicates that the solar wind proton is a major source of the surface hydration.

In this talk, we review science outcomes achieved by ENA imaging at the Moon. We further describe a future lunar mission to investigate the origin of the lunar water and its transport, equipped with the ENA imaging technique.

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