AOGS 2005

Low Energy Neutral Atoms Imaging of the Moon: Potential contribution of LENA imaging to the lunar science

YOSIHFUMI FUTAANA[1], STAS BARABASH[1], MATS HOLMSTRÖM[1,2] and ANIL BHARDWAJ[3,4]

[1] *Swedish Institute of Space Physics, Box 812, 98128, Kiruna, Sweden*
[2] *Currently at NASA Goddard Space Flight Center, Greenbelt, MD 20771, USA*
[3] *Space Physics Laboratory, Vikram Sarabhai Space Centre, Trivandrum 695022, India*
[4] *Currently at NASA Marshall Space Flight Center, NSSTC/XD12, Huntsville, AL 35805, USA*

Since the Moon possesses neither global magnetic field nor atmosphere, the solar wind can directly precipitate on its surface causing atomic sputtering. The fluxes of the sputtered atoms are expected to be on the order of 10^4 (for Fe, Na, Ca, Si, Al or Mg) to 10^5 cm^{-2} sr^{-1} s^{-1} (for O) in the energy range 10-100 eV, which is detectable by a realistic low energetic neutral atoms (LENA) sensor. Imaging the sputtered LENAs with sufficiently high mass resolution reveals the moon surface composition and the solar wind surface interaction pattern.

We will discuss the feasibility of LENA imaging around the Moon and its potential contributions to lunar science. The relative yield of different elements reflects the surface composition, then images of the LENA flux can be converted to the surface composition maps. As was established by Lunar Prospector (Lin et al., 1998) the lunar surface magnetic anomalies can stand off the solar wind locally. The solar wind flux cannot reach the surface in these areas and hence the LENA flux disappears. Our calculation shows that the depletion can be seen clearly, and we can then image the global distribution of strong magnetic anomalies.

The solar wind is a supersonic flow and has a finite thermal velocity, it can also reach areas not accessible by solar photons such as permanently shadowed craters and areas beyond the limb. We have calculated the expected sputtered LENA fluxes from the dark side of the moon from two different aspects. We first treated the solar wind flow into the shadowed region parallel to the magnetic field as caused by the ambipolar diffusion. We then considered the finite-gyroradius effect of individual solar wind protons by using the particle concept. The calculations revealed that the sputtered LENAs can be imaged and will provide valuable information on the unlit region.