The solar wind interactions with lunar magnetic anomalies: A case study of the Chang'E-2 plasma data near the Serenitatis antipode

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Introduction: Being the sister satellite of Chang'E-1 which was the first Chinese lunar orbiter (Ouyang et al. 2008), Chang'E-2 was successfully launched on 1 Oct 2010. Up to now, the Chang'E-2 satellite has completed its six months' primary mission phase around the Moon, with various payloads onboard having acquired more than 1.8 terabytes (TB) data. After a total number of 2378 orbits around the Moon, the spacecraft was sent to the L2 Lagrangian point where it arrived on August 30 2011. Among these payloads, the Solar Wind Ion Detector (SWID) is designed to probe the near-Moon space environment, through mapping the phase space distribution of Solar Wind (SW) protons/ions (e.g., Wang et al. 2010, 2011). The measured phase space distributions can then be used to evaluate how the SW properties vary as approaching the lunar surface. This will facilitate the investigation of the SW interactions with the lunar surface.

2. Figures: Below, you will find an example of an included figure. You should use the "Figure_caption" auto-formatting style for the caption.

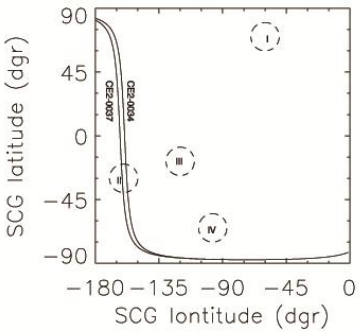

Figure 1: The schematic illustration of the first (CE2-0034) and the last (CE2-0037) Chang'E-2 orbits around the Moon included in this study, in terms of SCG longitude and latitude. Several impact basin antipodes with strong magnetic field intensities (Mitchell et al.2008) are indicated, including the Sikorsky-Rittenhouse antipode (I), the Serenitatis antipode (II), the Crisium antipode (III) and the Humboldtianum antipode (IV).

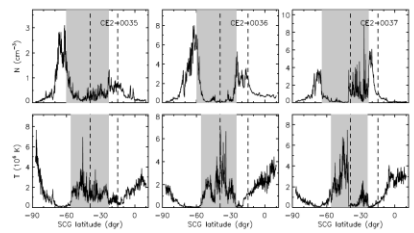

Figure 2: The profiles of proton density (upper panels) and temperature (lower panels) as a function of SCG latitude obtained from several Change'E-2 lunar orbits near the proton cavity. The shadowed regions show apparent decrement in proton density and enhancement in proton temperature. The two dashed lines encompass the extension of the Serenitatis antipode along the spacecraft orbit, according to Table 1 of Mitchell et al. (2008).

3. Tables: Table 1: Information on the 4 Chang'E-2 orbits around the Moon, including the orbit identification number, the UT time of observation, the SCG longitude of orbital crossing at the dayside lunar equator, as well as the closest footprint distance (Dfoot) to the center of the Serenitatis antipode as reported by Mitchell et al. (2008).

ID	UT Time of Obs.	LON	D_{foot} (km)
CE2-0034	22:32-00:30/10-11 Oct 2010	159.3°W	82
CE2-0035	00:30-02:28/11 Oct 2010	160.4°W	53
CE2-0036	02:28-04:26/11 Oct 2010	161.5°W	24
CE2-0037	04:26-06:22/11 Oct 2010	162.6°W	5

4. Summary and Conclusions: The SWID spectrogram data acquired during several Chang'E-2 orbits around the Moon provide an opportunity to investigate the variation of SW protons as approaching the well-known LMA near the Serenitatis antipode. We have identified in the data an interesting region with location and extension in reasonable agreement with the LMA. Such a region is characterized by decrement in proton density and enhancement in proton temperature. In addition, the observed proton energy spectra present a wide angular distribution near the void, in contrast to the strongly anisotropic behavior expected in the upstream SW plasma flow. These results, combined with the LP MAG and ER measurements of the magnetic fields in the same region (Lin et al. 1998, Purucker &

Nicholas 2010), tentatively suggest the presence of a mini-magnetosphere associated with the Serenitatis antipode, which may effectively shield and heat the incident SW protons. The study reported here is analogous to the work of Lue et al. (2011) based on the proton data as well, and is also complementary to the work of Halekas et al. (2008) based on the electron data, as well as the work of Wieser et al. (2010) based on the neutral atom data

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