



Energy spectra of backscattered solar wind ENAs

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Abstract

Energy spectra of backscattered energetic neutral atoms (ENAs) from the lunar surface show strong dependence on the solar wind parameter. In this study, using backscattered ENA energy spectra obtained from Chandrayaan-1/SARA instrument we discuss the characteristics of the backscattered ENAs.

1. Introduction

One argument related to the solar wind-Moon interaction is the existence of backscattered ENAs. How can a significant amount of solar wind be backscattered from a regolith surface that has extremely porous structures is yet an open question. Our previous study [1] shows that on average 20% of the solar wind protons are reflected back. The backscattering may be a common feature of the solar wind-regolith interaction. For example, not only the Moon, but also Martian moon Phobos can backscatter the solar wind particles [2].

2. Dataset

In this study, we used the data obtained from SARA/CENA instrument on board Chandrayaan-1. CENA can measure the ENA with energies between 10 eV and 3.2 keV. The intrinsic field of view is $15^\circ \times 160^\circ$ and the time resolution is 4s. During the nominal operation of CENA, the spacecraft was in the circular orbit with altitude of 100-200 km. More than 300 orbit data with enough quality has been used.

To investigate the upstream condition dependence, we used ACE and WIND solar wind parameter. They are shifted in time taking the travel time of the solar wind into account.

3. Results and Discussion

The energy spectra of the backscattered ENAs showed bi-power distribution (Figure 1). The distribution is rather constant below a specific energy (E_0). Above the specific energy, the distribution showed a drop with a power law.

We thus fitted the observed energy spectra by the following analytical function:

$$f_{\text{obs}}(E) = \begin{cases} k_0 E^{r_0} & (0 < E < E_0) \\ k_1 E^{r_1} & (E > E_0) \end{cases}$$

where f is the energy spectra and k_0 , k_1 , r_0 and r_1 is the fitting parameters.

The average parameters are calculated for a standard analytical model the backscattered ENAs. They can also probably used for other regolith-covered bodies like Phobos or Mercury.

We will also discuss dependence of the fitted parameters to the solar wind conditions in order to discuss the characteristics of the backscattered ENAs.

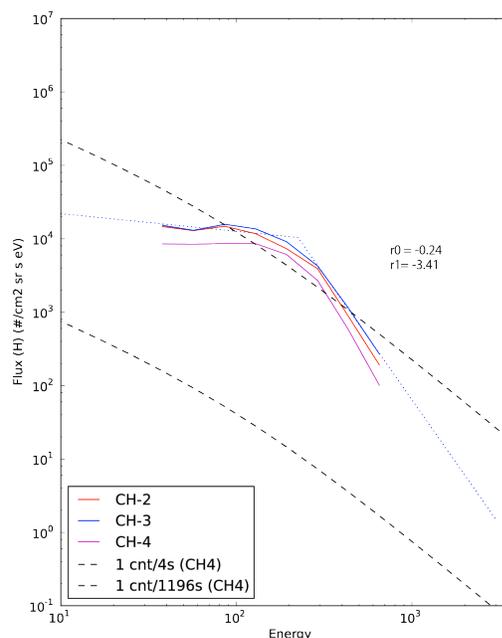


Figure 1. The observed energy spectra of the backscattered ENAs and the results of the fitting. The data was averaged over ~ 20 minutes around the equatorial region. Different color shows different looking directions. Two one-count levels (4 sec and

~20 min) are shown. Fitting for the central channel (CH-3) has been conducted and shown as a dotted line.

References

- [1] Extremely high reflection of solar wind protons as neutral hydrogen atoms from regolith in space, Wieser M., S. Barabash, Y. Futaana, M. Holmström, A. Bhardwaj, R. Sridharan, MB Dhanya, P. Wurz, A. Schaufelberger and K. Asamura, *Planetary and Space Science*, 57, 14-15, 2132-2134, DOI:10.1016/j.pss.2009.09.012, 2009..
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