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Collaborative study of interplanetary hydrogen Lyman alpha emission with the NOZOMI/UVS and SOHO/SWAN

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We have analyzed interplanetary Lyman alpha data obtained by Ultraviolet imaging spectrometer (UVS) on board NOZOMI spacecraft on a Mars transfer orbit. Interplanetary Lyman alpha emissions (121.6 nm) are solar photons backscattered by hydrogen atoms in the interplanetary medium.

The UVS instrument consists of a grating spectrometer (UVS-G) measuring emissions in the FUV and MUV range between 110-310 nm with a resolution of 2-3 nm and a Lyman alpha photometer with hydrogen and deuterium absorption cells (UVS-P) detecting separately hydrogen and deuterium Lyman alpha emissions. UV observations of the emissions of CO, CO+, and CO2+ from the Martian upper atmosphere will allow studies of the ionosphere and its direct interaction with the solar wind. Also, it will allow a better understanding of the escape mechanisms of the H and O atoms and estimates of their escaping fluxes by observations of H and O Corona, crucial for insight into the long-term evolution of the atmosphere of Mars. Moreover, observation of D/H is particularly important to study in the frame of the reconstruction of the history of water on Mars. For these scientific targets, there are many similarities between UVS and Spectroscopy for the Investigation of the Characteristics of the Atmosphere of Mars (SPICAM) to be flown on Mars Express orbiter, which will be launched in 2003. The optical sensor of SPICAM consists of two channels, which are UV spectrometer (118-320 nm) and IR spectrometer (1.0-1.7 _m). The joint research with the two instruments on Mars will provide us with a lot of valuable information.

An important goal of studies of UVS observations on the Mars transfer orbit is the characterization of the interplanetary medium, which is a key issue about solar parameters and the solar system. We have operated UVS three times a week on a routine basis and have an all-sky map of the hydrogen Lyman alpha emission intensity using the one-year data. NOZOMI is a spinning spacecraft, and the Lyman alpha detector scans the all-sky distribution of Lyman alpha radiation during the spinning. UVS has already measured successfully over 2 years, and we can see its time variation. If SPICAM observes the interplanetary Lyman alpha radiation on its transfer orbit, it will be enable us to perform some kind of onboard calibration for the collaboration on Mars.

Here we apply an analysis of data obtained by UVS and the solar wind anisotropies (SWAN) onboard SOHO orbiting around L1 Lagrange point, located 1.5 x 10^6 km from Earth toward the Sun. This instrument is also measuring the interplanetary Lyman alpha background. The SWAN instrument is composed of two identical sensor units positioned on opposites sides of the spacecraft. Each sensor covers the complete hemisphere on its own side by moving a two-mirror periscope mechanism. One full-sky observation is performed in 1 day. It means that SWAN can always cover the region that UVS would observe at the same date. Therefore, we can research the same direction at the different position in the solar system. There are 24 common observation dates in the first half of 2000.

SWAN has a capability to make whole map in one day using the bulk of data recorded three times a week in the photometric mode with good sensitivity. While SWAN is always located at about 1AU, UVS has the advantage of sailing between 1-2 AU from the Sun. The UVS has also an advantage of detecting data from North to South with a single detector. By comparing SWAN and UVS data, we can find out the spatial spread of the interplanetary Lyman alpha emission tomography. In particular, we can find out the position of the region of maximum emission, located in the upwind hemisphere (The interplanetary wind has come from EC [254, 7]), and also its temporal behavior as a function of solar parameters. It significantly depends upon the amount of solar ionization rate and its anisotropies. We should find it by triangulation using SWAN and UVS data.