Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

PCG033-13 Room:101 Time:May 24 11:45-12:00

Effects of upstream IMF direction to the ion escape from Venus

Kei Masunaga[1*], Yoshifumi Futaana[2], Masatoshi[2], Stas Barabash[2], Zhang Tielong[3], Naoki Terada[1], Shoichi Okano[1]

[1]Graduate School of Science, Tohoku Unive, [2]Swedish Institute of Space Physics, [3]Austrian Space Recerch Institute, Graz

The lack of intrinsic magnetic field on Venus results in a direct interaction between its upper atmosphere and the solar wind. This fact causes an ion outflow from Venus to the space. In the past, it has been revealed that the escape processes are controlled by the variable solar wind conditions. It is thought that the escape processes plays an important role for the evolution of Venusian atmosphere.

At present, Venus Express explored plasma environments on Venus. A lot of O+ ions with a speed over escape velocity were observed through the plasma sheet which is identified by a sharp reversal of Bx component (Barabash et al., 2007a). Therefore, the plasma sheet is regarded as the energetic ion outflow channel.

Recently, it is reported that the magnetic field environment on Venus highly depends on the direction of the interplanetary magnetic field (IMF). Usually IMF has a component to the Venus-Sun line (Zhang et al., 2009). In addition, it is also suggested by the global simulation that the IMF direction controls an atmospheric escape flux by the global change of the Venusian plasma environment (Liu et al., 2009)

In this study, we have examined dependence of high energy O+ (>100 eV) observations around Venus on the upstream IMF direction by using velocity distribution functions of plasma and the magnetic field data measured by the ASPERA-4 (Analyzer of Space Plasma and Energetic Atoms) and the magnetometer (MAG) on board Venus Express for a period from June 2006 to December 2008. The orbits are classified into two cases depending on the IMF directions: IMF nearly perpendicular to the Venus-Sun line (the perpendicular case) and IMF nearly parallel to it (the parallel case).

In most orbits for the perpendicular case, x-component of the magnetic field reverses one time per orbit around magnetic poles where the field lines most strongly drapes. The high energy O+ fluxes are also detected near the poles and some of them are observed simultaneously with the Bx reversal mainly in the nightside. In addition, the energy of O+ fluxes increases in proportion to an altitude in the dayside +E hemisphere to which the convection electric field points. On the other hand, in most orbits for the parallel case, the Bx component reverses multiple times per orbit and their spatial distribution is scattered around the terminator and wake region. The high energy O+ fluxes are also detected whole around the post terminator region, and some of them are detected simultaneously with the Bx reversal. In addition, the energy of the fluxes does not show the clear dependence on the altitude compared to the perpendicular case.

Results show that the upstream IMF direction controls the ion acceleration region. For the perpendicular case, the large convection electric field is generated in the dayside region, and the IMF drapes strongly from the terminator and forms a single plasma sheet in the nighside region. O+ ions are picked up into the solar wind due to a large convection electric field in the dayside, and ionospheric O+ ions are scavenged away by a magnetic tension force and/or a kinetic force of the solar wind from the magnetic poles to the wake region. On the other hand for the parallel case, the convection electric field becomes smaller, and the IMF drapes complicatedly, resulting in creating multiple Bx reversals in the nighside region. The multiple Bx reversals indicate that many plasma channels are formed. It is suggested that the ion pickup rate decreases and the ionospheric ions are accelerated by local effects from the multiple plasma channels in the nightside region. These results imply that the IMF direction controls the ion pickup rate and bulk outflow rate.

Keywords: Venus, plasma, Venus Express, VEX