Geophysical Research Abstracts
Vol. 16, EGU2014-4546-1, 2014
EGU General Assembly 2014

Plasma signatures in large Martian magnetic flux ropes: MARSIS/ASPERA-3 observations

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Cylindrical structures of highly twisted magnetic field (flux ropes) have been observed at Mars, using measurements by the MAG-ER magnetometer-electron reflectometer onboard Mars Global Surveyor (MGS) and by the MARSIS radar sounder onboard Mars Express (MEX). Signatures of flux ropes are spikes of magnetic field strength and magnetic field rotations. Both small scale flux ropes (diameters of a few tens of km) and large scale flux ropes (diameters of around 100 km) have been found at Mars. We look at times of presumed flux ropes on the dayside of Mars, detected in the local magnetic field strength given by MARSIS. The signatures in MARSIS are magnetic field strength increases (peak strength reaches several tens to hundred nT) for several minutes (size of hundreds of km along the spacecraft track), found outside but near crustal magnetic field regions. Although we cannot determine the presence of a magnetic field rotation because of the lack of a magnetometer onboard MEX, we assume that these magnetic field increases are large flux ropes. There are indeed large flux ropes with similar characteristics which were established by the magnetometer data from MGS, and thought to form by stretching and reconnection of crustal magnetic field by the solar wind. On the other hand, MEX possesses in situ ion measurements, unlike MGS. We will use the ion and electron data from the ASPERA-3 particle instrument onboard MEX in order to characterize the plasma (ionospheric only or mixing with shocked plasma?) inside the flux ropes, which will give hints on their origin.