



## **Strong Seasonal Variation of Martian Pick-up Ions and Reflected Ions**

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Mars Express (MEX) has operated for more than 10 years in the environment of Mars, providing solar wind ion observations by the Analyzer of Space Plasmas and Energetic Atoms (ASPERA-3) experiment's ion mass analyzer (IMA). In the region just outside the bow shock of Mars, IMA frequently observes ring-like distributed ions that include both pick-up ions of exospheric origin and reflected solar wind by the bow shock (Yamauchi et al., 2012). Although there are some restrictions imposed when using the IMA measurements, the length and quality of the IMA data is sufficient to statistically diagnose the seasonal and solar cycle variation. According to this long-term observation, the observation probability of the ring-like distributed ions outside the bow shock with certain intensity strongly depends on the season, i.e. the flux of these ions varies by nearly one order of magnitude every two years. A careful examination reveals that the variation of pick-up ions is locked to the distance from the Sun rather than the tilt angle of the rotation axis. This indicates that the planetary scale variation of solar UV has a drastic effect on the formation of the pick-up ions. Solar cycle effects are not distinguishable partly because they are masked by the seasonal effects and partly because MEX and IMA are optimum for such observations due to the instrumental limitations (FOV and energy range) and the lack of the magnetometer experiment on the Mars Express spacecraft