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Solar Forcing and the Comet-like Escape of Ionospheric Plasma from Mars

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New measurements of the ion escape from Mars display a mantle of low-energy ionospheric ions swept from the dayside over the terminator, expanding into the tail in a "comet-like" fashion. The finding is based on data obtained with new energy settings for the ASPERA-3 ion mass analyzer (IMA) as of May 2007. The escape rate of the low-energy ($<$200 eV) heavy ions, $5.2{\cdot}10^{24}$ ($\pm$ $0.5{\cdot}10^{24}$) s^{-1}, is about one order of magnitude higher than that previously reported from Mars Express, a deficiency mainly related with the past IMA energy coverage. In another study we find a strong connection between low-energy ion escape and solar forcing. An order of magnitude changes of the ion outflow is measured on short terms (hours, days), directly connected with changes in the solar wind dynamic pressure and the solar XUV (X-ray and EUV).

A detailed analysis of the ion escape into the tail versus distance from the planet display a gradual energization of low-energy ions by ion pickup-, tail current sheet-, and magnetic field aligned acceleration processes, yet maintaining constant fluency. We therefore conclude that the plasma escape from Mars is comet-like, a gradual removal of dayside ionospheric plasma, further energized by plasma acceleration in the tail. We also conclude that this comet-like outflow is strongly connected with the solar forcing terms (solar wind, XUV), thus also solar cycle dependent.