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Mars Ion Outflow and Escape – Solar Cycle Dependence

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With 9 years of data from the ASPERA-3 experiment on Mars Express (MEX) it is now feasible to analyze the solar cycle impact on the ion outflow and escape from Mars – from the end of solar cycle 23, through solar minimum 2008, up to the solar maximum of cycle 24. The study is based on average fluxes of low-energy (<300 eV) O+ and O_2+, derived for selected periods when MEX traversed the central tail near the noon-midnight meridian. A time series plot of average O+ and O_2+ fluxes, and solar activity proxies (RI and F10.7) display how the heavy ion outflow from Mars vary with solar activity. We note that the average O+, O_2+ flux increased by a factor of ≈10 from 2008 (solar minimum) to 2013, while RI rose from ≈ 3 to 60, and a normalized F10.7* (F10.7-60) rose from ≈6 – 60, F10.7* suggesting a close correlation with heavy ion outflow.
A correlation analysis between the two solar activity proxies (RI and F10.7*) and the O+ and O_2+ average flux gives correlation coefficients (R2) greater than 0.6, i.e. there is a strong positive correlation between the energization and outflow of ionospheric heavy ions and solar activity.
A preliminary estimate of the total escape rate of heavy ions (O++O_2+) from Mars is ≈1-2·1024 ions/s (2008, solar minimum) and 1-2·1025 ions/s (2013, solar maximum?)