Plasma Acceleration and Aurora above Martian Magnetic Anomalies.

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The ASPERA-3 experiment on ESAs Mars Express have made it possible to study acceleration processes in the nightside/eclipse of Mars. There are strong similarities between accelerated/heated electrons and ions in the deep nightside cavity of Mars and the electron/ion acceleration above Terrestrial discrete aurora. Nearly monoenergetic electrons are observed together with nearly monoenergetic upgoing ions, the classical signature of “inverted V” traversals.
We have analyzed ASPERA-3 data from over 100 Mars Express traversals of the central tail and, using nadir projections, compared with magnetic maps for the crustal magnetization (Brain et al., 2005). We find a close correlation between crustal magnetization regions and the field-aligned acceleration of ions and electrons. The total field-aligned acceleration based on the electron and ion acceleration, is in the kilovolt range. The total downward acceleration should result in intense electron precipitation into the upper atmosphere of Mars. This is therefore evidence for discrete aurora on nightside of Mars. The difference between the Earth´s polar aurora and the Martian aurora is that the latter occur closer to the equator, i.e. where the crustal magnetic field structures are located. Discrete aurora above Mars is expected to form along clefts interfacing crustal magnetization regions, but also along the large scale, halo/oval at the circumference of the largest area of magnetic anomalies at Mars. The precipitating electron flux from the traversals is estimated to be in the range 1 - 50 erg/(cm^2s), i.e. energy fluxes similar to those leading to bright discrete aurora above the Earth.