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Plasma transport and currents near Mars

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Mars presents a complex and highly variable obstacle to the solar wind, with contributions from the conducting ionosphere (Venus-like), extended exosphere (comet-like), and strong crustal magnetic fields (Earth-like). Study of the global plasma interaction is of special interest at Mars, where it is believed that solar wind stripping of the upper atmosphere has played a major role in altering Martian climate. Since Mars lacks a global dynamo magnetic field, solar wind energy is deposited more directly into the upper atmosphere than on Earth, driving dynamics and chemistry in the upper atmospheric layers. An understanding of plasma transport and current systems near Mars is critical to addressing these topics.

Spacecraft observations reveal evidence for current systems and plasma transport in a number of regions. On the day side, strong current systems above the northern hemisphere lead to 'weathervaning' of the magnetic field away from the subsolar point, and current layers created above crustal magnetic field regions are observed as enhancements in the magnetic field. Near the terminator, measurements of electron angular distributions in some locations indicate day to night transport of photoelectrons along reconnected crustal magnetic field lines. And electron measurements on the night side indicate that auroral-like field-aligned potentials are created near crustal fields that accelerate electrons down into the night side atmosphere, creating patchy night side ionospheres and populating closed crustal field regions with trapped electrons. Using observations from the Mars Global Surveyor spacecraft, we will provide an overview of the phenomena described above and their implications.