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IMF direction controls which Martian crustal magnetic field cusps are open or closed to the solar wind.

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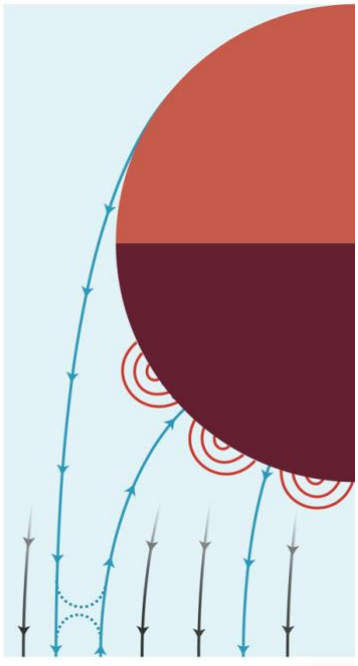
Abstract

The Martian magnetic field environment is complex. Locked into the planet's surface are crustal magnetic fields, remaining from a time when Mars possessed a global magnetic dynamo. As the interplanetary magnetic field (IMF) encounters the planet, it interacts with these crustal fields, producing a dynamic topological system. This in turn constrains the motion of charged particles, channelling both the inflow of energetic electrons and the outflow of ionospheric particles through regions of vertically oriented field referred to as magnetic "cusps". These cusp regions are host to a range of energetic processes including field-aligned currents and aurora, and may be the source of substantial quantities of ion escape at Mars.

Here we present an analysis of variability in crustal cusps, using electron pitch angle distributions and energy spectra measured by MAVEN to study how cusp topology varies with the direction of the incoming IMF [1] [2]. We find that changes in upstream IMF direction control which cusps preferentially open to the solar wind, with a dependence on the radial direction of the cusp magnetic field.

We attribute this affect to reconnection occurring throughout they Martian magnetotail, and use our results to show that open cusp fields on the nightside of Mars frequently reconnect with other open fields, producing large-scale closed loops that have been previously observed connecting the dayside and nightside of the planet [3]. A simplified diagram is included to the right.



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