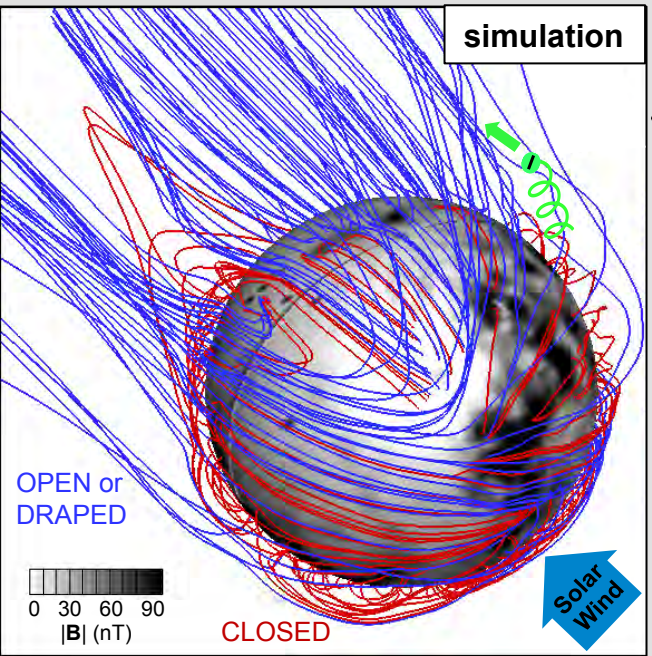
First 3-D Map of Mars Magnetic Topology

Mars' intense crustal magnetic sources give rise to complex magnetic fields. These fields either form closed loops (miniature magnetospheres) or connect with the interplanetary magnetic field to form cusps, as in the Earth's polar regions.

The first 3-D map of Mars magnetic topology has been determined from MAVEN SWEA/MAG data. Below 300 km altitude, closed magnetic loops dominate over the entire planet (lower right) – surprisingly, even over the weakly magnetized northern hemisphere. At higher altitudes, closed loops give way to open and draped field lines, except over the strongest crustal magnetic sources (upper right). Magnetic topology is important for energy transport in Mars' upper atmosphere and ion loss to space.



Magnetic field lines from an MHD simulation. Closed loops are red; open or draped lines are blue. Electrons (green) spiral along field lines. The grayscale indicates the intensity of crustal magnetic sources at 105 km altitude.

Occurrence rate of closed field lines on the dayside in four altitude ranges. Topology is inferred from MAVEN SWEA electron data, inferring the plasma source region(s) sampled by field lines. Contours indicate crustal magnetic field intensity.

Xu et al. [2017], *JGR MAVEN Special Issue*