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The magnetic field structure of the Martian MPB from MAVEN data

Gabriela Boscoboinik (1), Cesar Bertucci (2), Christian Mazelle (3), Daniel Gomez (2), David Mitchell (4), Jasper Halekas (5), and Jared Espley (6)

(1) Departamento de Física, Facultad de Ciencias Exactas y Naturales, Universidad de Buenos Aires, Ciudad de Buenos Aires, Argentina (gboscoboinik@gmail.com), (2) Instituto de Astronomía y Física del Espacio, Ciudad Universitaria, Buenos Aires, Argentina, (3) Institut de Recherche en Astrophysique et Planétologie, Toulouse, France, (4) Space Sciences Laboratory, University of California, Berkeley, USA, (5) Department of Physics and Astronomy, University of Iowa, Iowa City, Iowa, USA, (6) Solar System Exploration Division, Planetary Magnetospheres Laboratory, NASA Goddard Space Flight Center, Greenbelt, USA

The study of the current systems within the magnetosphere of Mars is essential to understand the energy and momentum transfer processes that lead to atmospheric escape. Since 2014 the Mars Atmosphere and Volatile EvolutioN (MAVEN) spacecraft has been in elliptical orbit around Mars characterizing its atmosphere and plasma environment.
In the present work we analyze data from the magnetometer (MAG), and solar wind particle instruments (SWIA and SWEA) to identify the Martian magnetic pileup boundary (MPB) and to characterize its magnetic morphology. More specifically, we used the minimum variance analysis of the magnetic field (MVAB) to derive the boundary's normal vector, its thickness and the associated current density. We find that within the MPB the minimum variance direction of the magnetic field is well defined, and it is approximately normal to the surface of the discontinuity derived from the existing conic section fits. This analysis also reveals that the MPB behaves either as a rotational or a tangential discontinuity in the magnetohydrodynamical sense.
As reported in previous works, the thickness of the discontinuity in the normal direction is of the order of the solar wind proton inertial length and not the gyroradius, suggesting that the role of Hall effects near the MPB is important. We then studied the relative importance of the Hall electric field with respect to the convective electric field within the generalized Ohm's Law.