SOUTHWEST RESEARCH INSTITUTE

Impacts of Solar Wind Magnetic Holes Associated with Reconnecting Current Sheets on Earth's Bow Shock

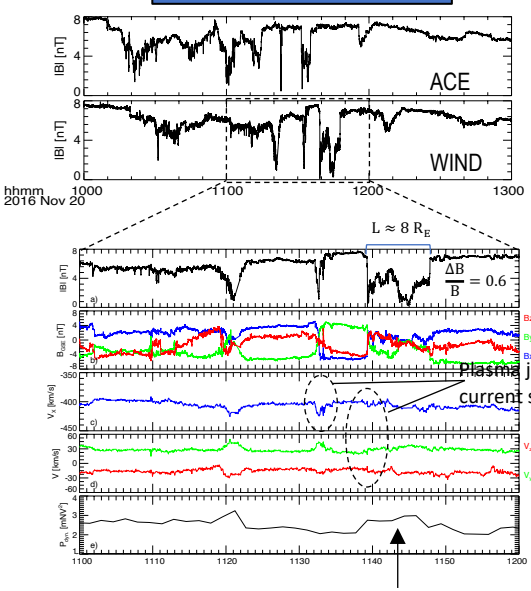
Hadi Madanian

Questions/suggestions: hmadanian@swri.edu

Background

- Magnetic holes (MHs) or magnetic decreases or depressions in the solar wind are reductions in the interplanetary magnetic field strength in an otherwise unperturbed solar wind flow (Stevens $ Kasper, 2007).
- Rotational MHs are associated with current sheets in the solar wind, some of which are consistent with reconnection events and show plasma jets across the current sheet.
- While the magnetic pressure is reduced inside these structures, the plasma pressure typically shows an increase through enhanced density and/or temperature.
- The dynamic pressure of these transient structures is higher than the ambient solar wind plasma, which can cause significant disturbances as they interact with other plasma boundaries.

Observations at L1

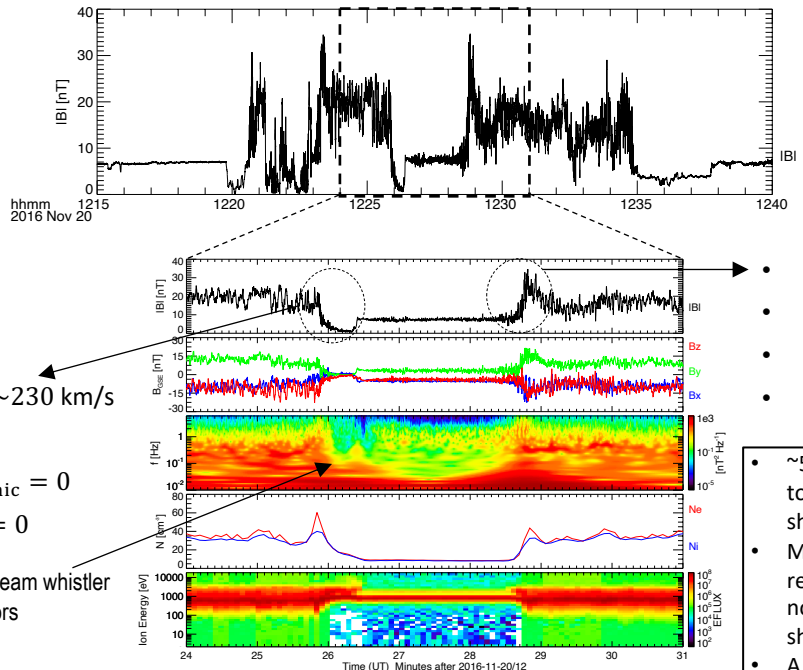


- V_{shock}~230 km/s
- $\beta = \infty$
- $M_{Alfvénic} = 0$
- $M_{fms} = 0$

No upstream whistler precursors

- Increase in the dynamic pressure
- Magnetic holes dynamically evolve as they travel in the solar wind flow.

MMS observations at the bow shock



- V_{shock}~245 km/s
- $\beta = 3.0$
- $M_{Alfvénic} = 5.9$
- $M_{fms} = 4.0$

- ~50 minutes transit time to the nose of the bow shock.
- MMS was near the flank region and observed nonstationary bow shock.
- A type of "foot-less" shock crossings.

Conclusions

Impacts on the bow shock:

- The high dynamic pressure inside the structure pushes the entire bow shock inward.
- The shock speed appears to be close to the solar wind speed along the shock normal.
- Receding shock still reflects ions, but no whistler emission.
- Reflected ions are constrained to the extent of the MH, by their gyroradius.

Stevens & Kasper, 2007, doi: 10.1029/2006JA012116