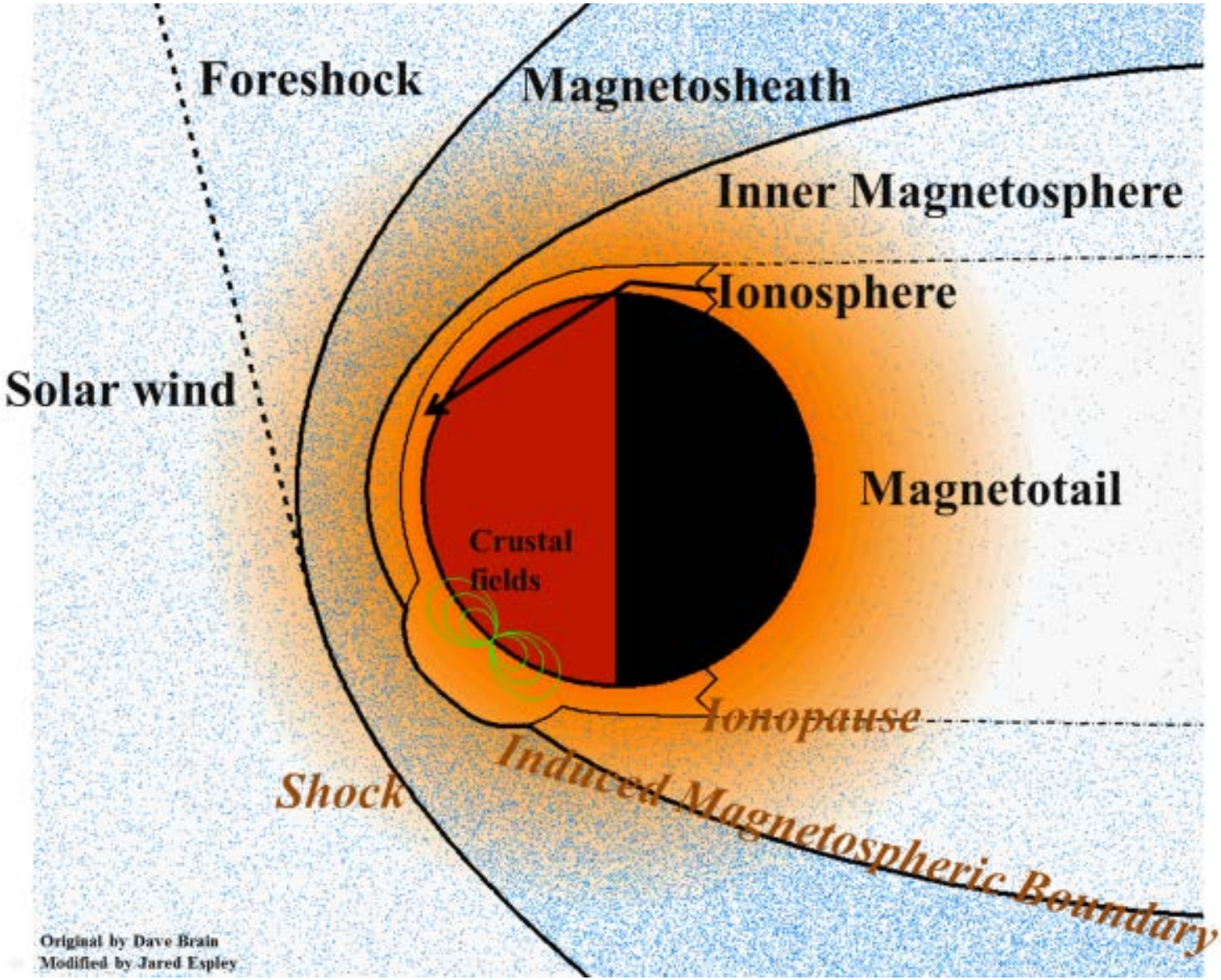
The Complex Martian Magnetosphere: Recent Insights Based on MAVEN Magnetometer Observations

Jared Espley, Gina DiBraccio, Jacob Gruesbeck, Yasir Soobiah, Alex Shane, Glyn Collinson, Chris Fowler, Jack Connerney

Summary

- Bow shock has asymmetrical 3D structure
- Magnetotail is twisted due to reconnection with crustal fields
- The martian magnetosphere is a hybrid obstacle to the solar wind:
  - Induced, ionospheric obstacle (“induced magnetosphere”)
  - Instrinsic, crustal magnetic fields (“many mini-magnetospheres”)

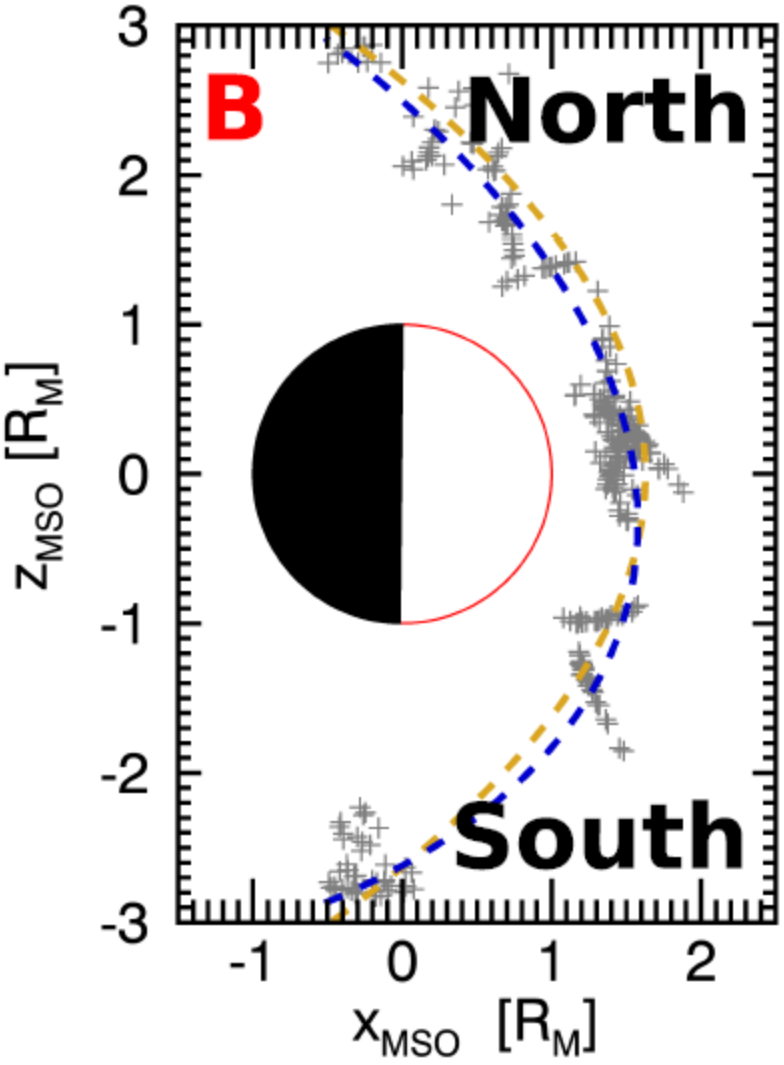
Martian magnetosphere

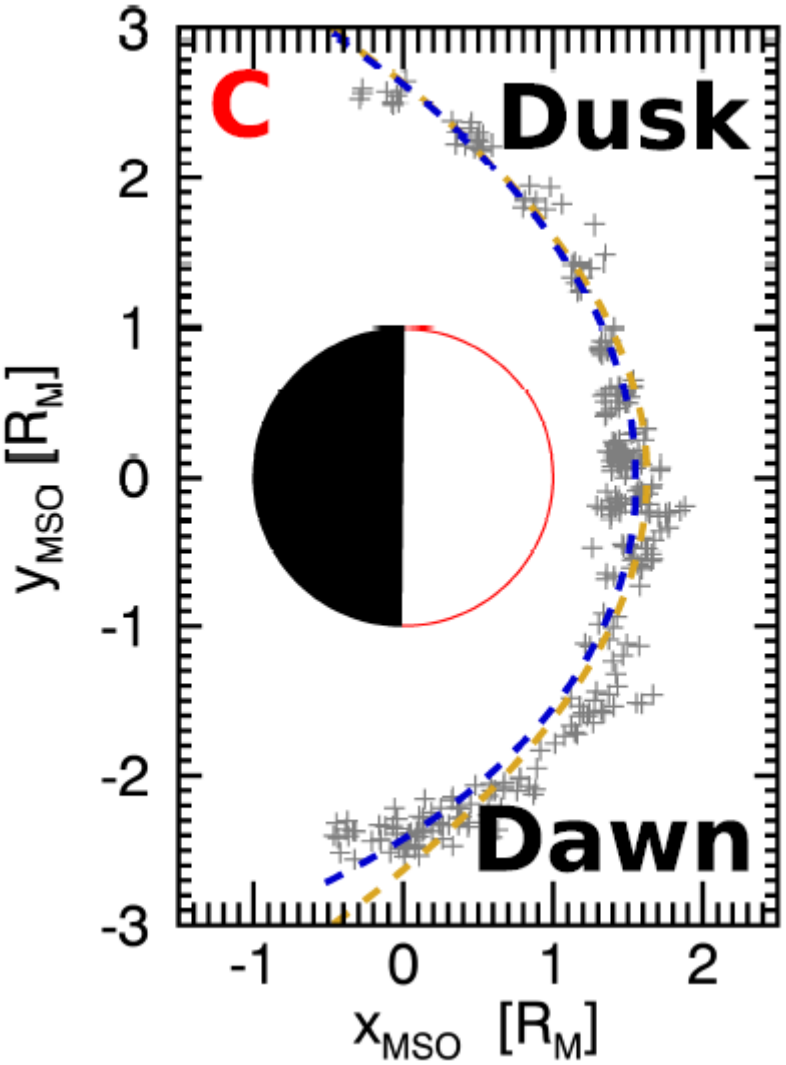


Espley [2018]

Asymmetrical 3D bow shock

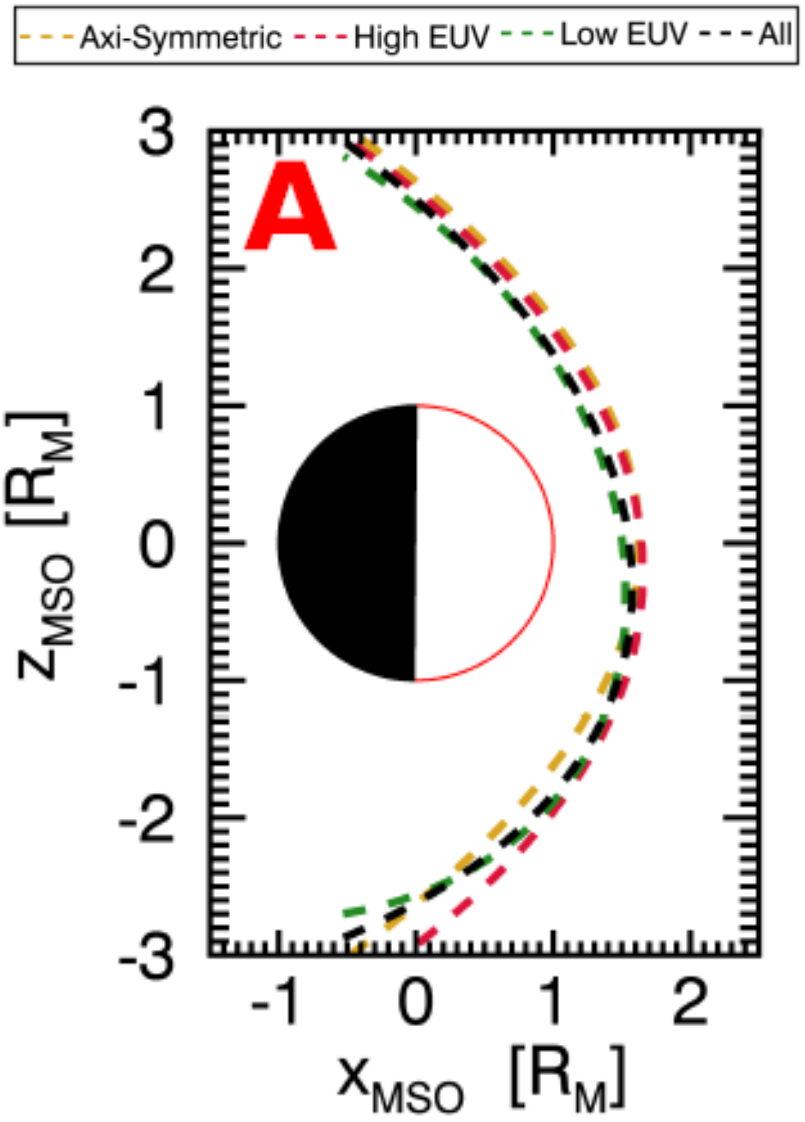
Axisymmetric Model ---- Fully 3D model ----

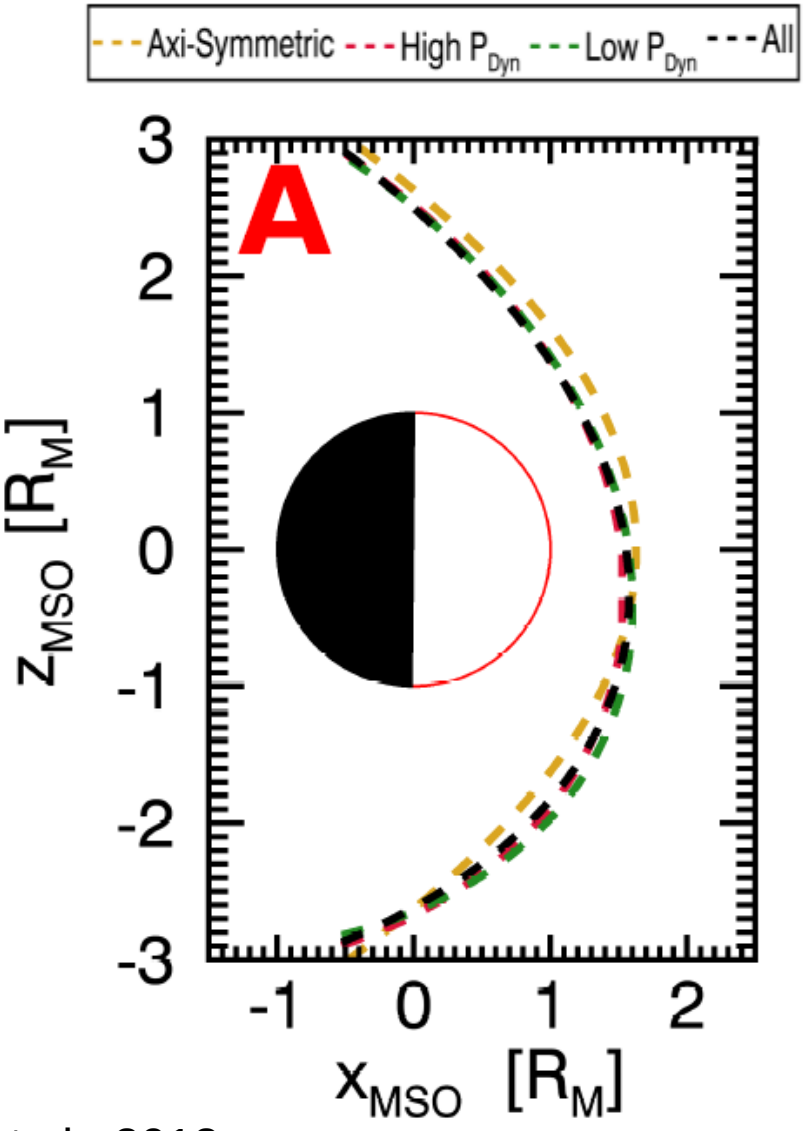




Gruesbeck et al., 2018

3D Bow shock influences

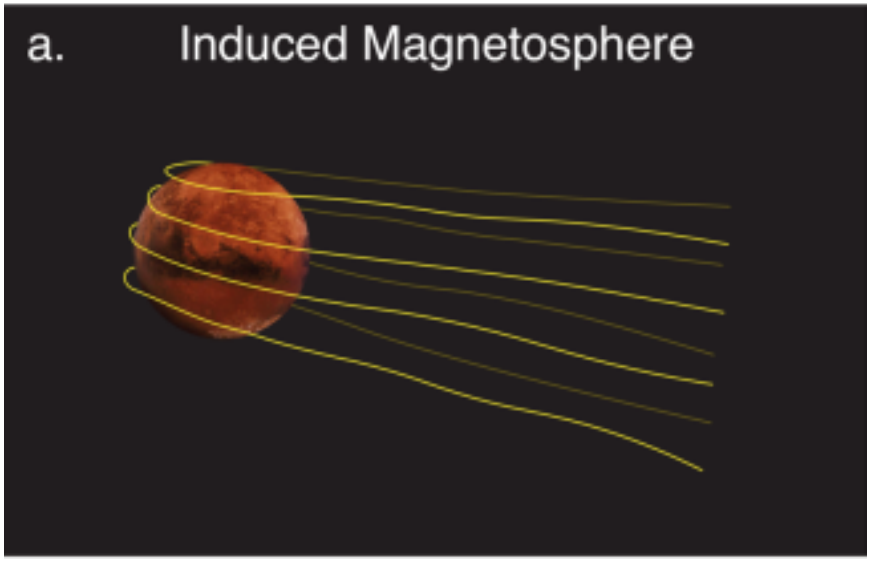


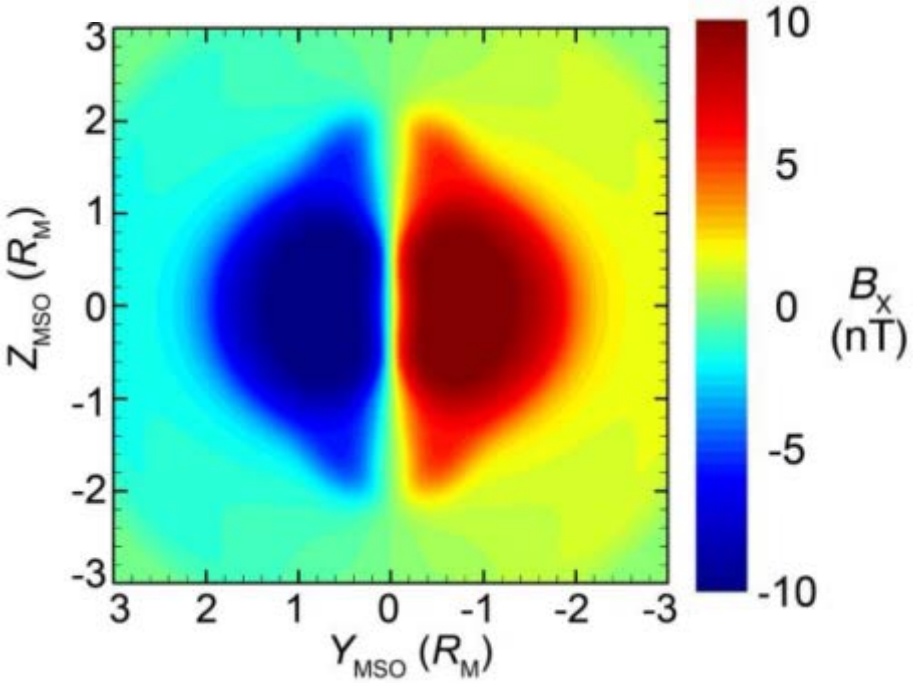


Gruesbeck et al., 2018

Expected Magnetotail Configuration

- IMF is typically predominantly in the x-y plane

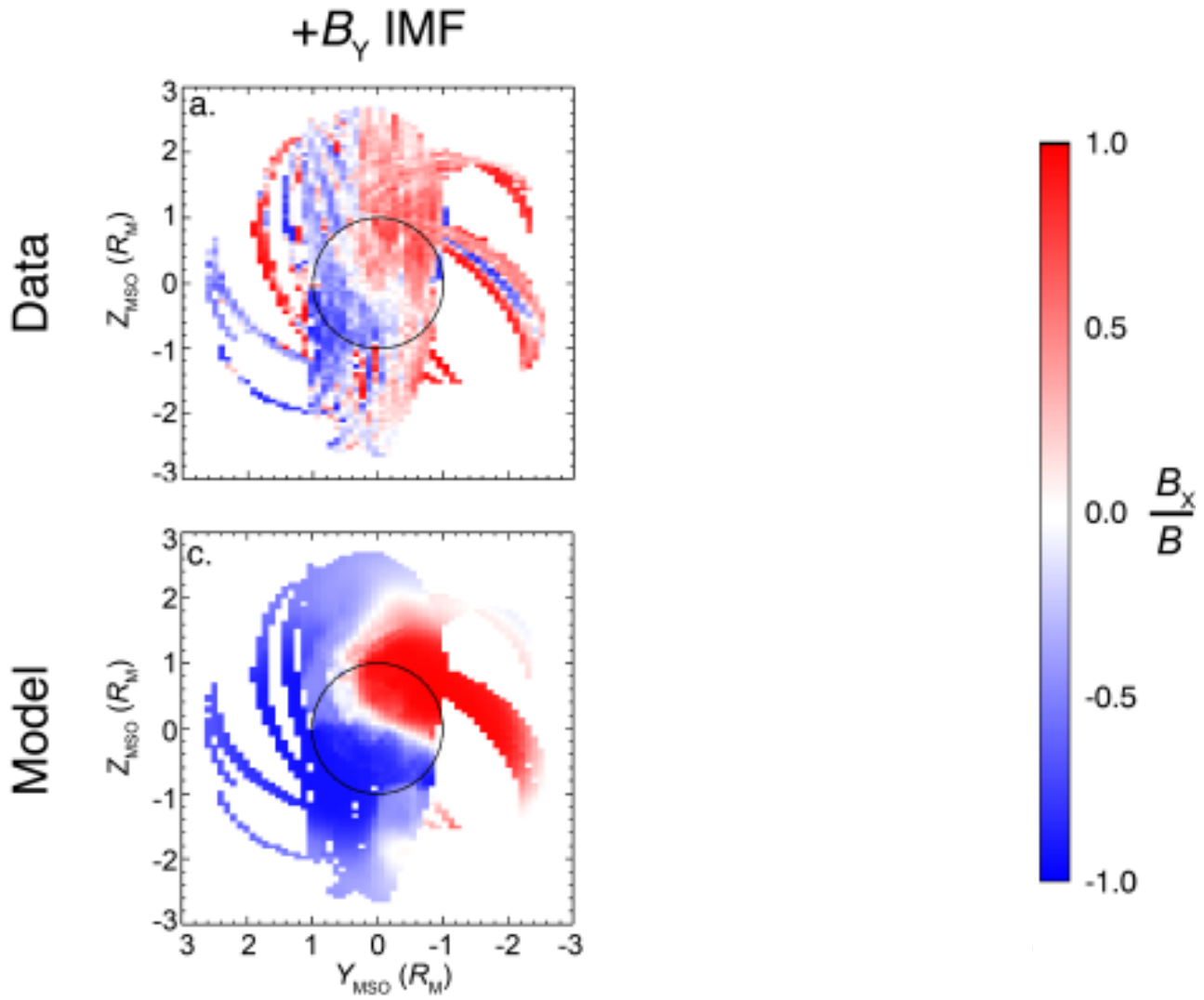




Theory

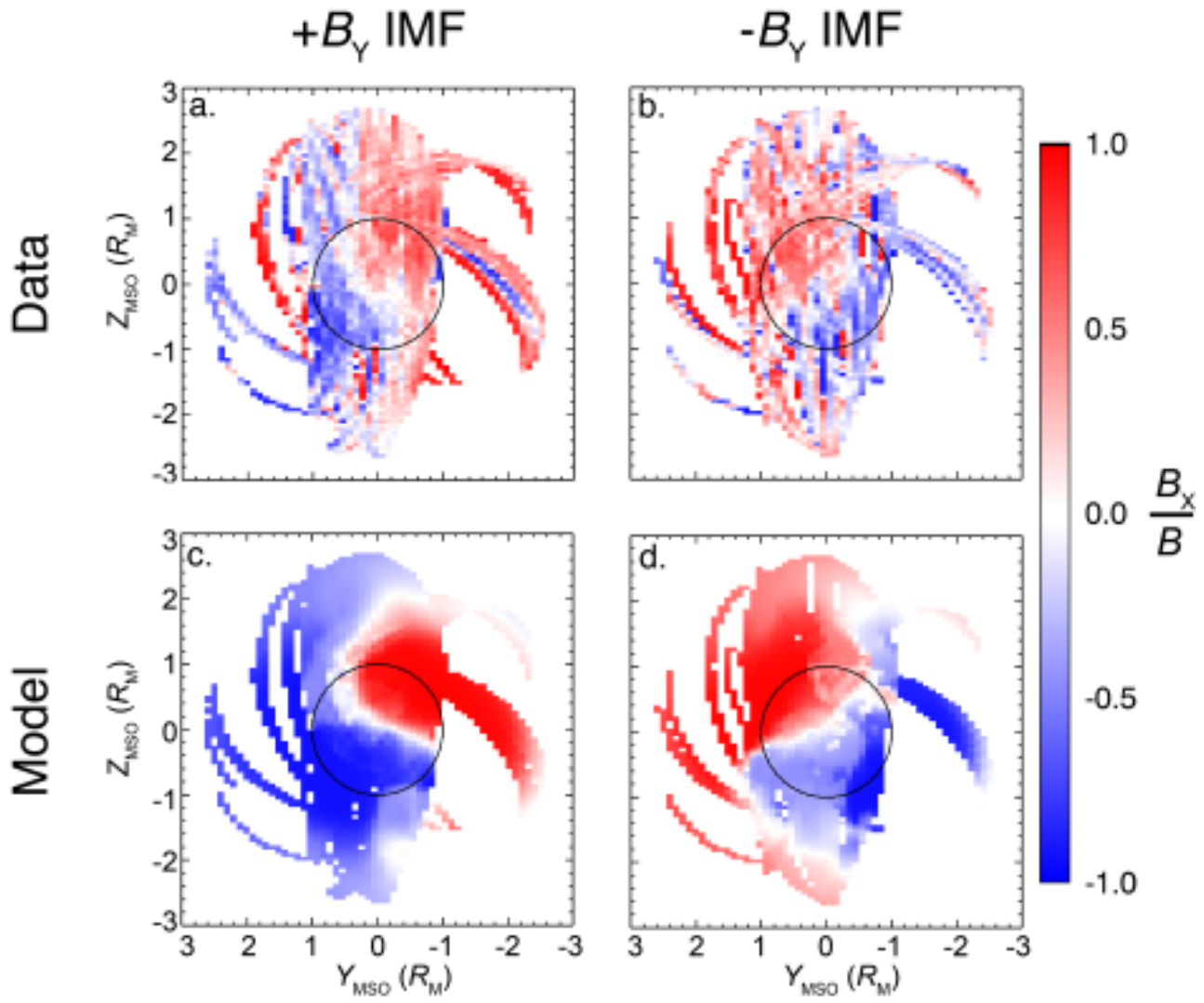
DiBraccio et al., 2018

Actual Magnetotail Configuration



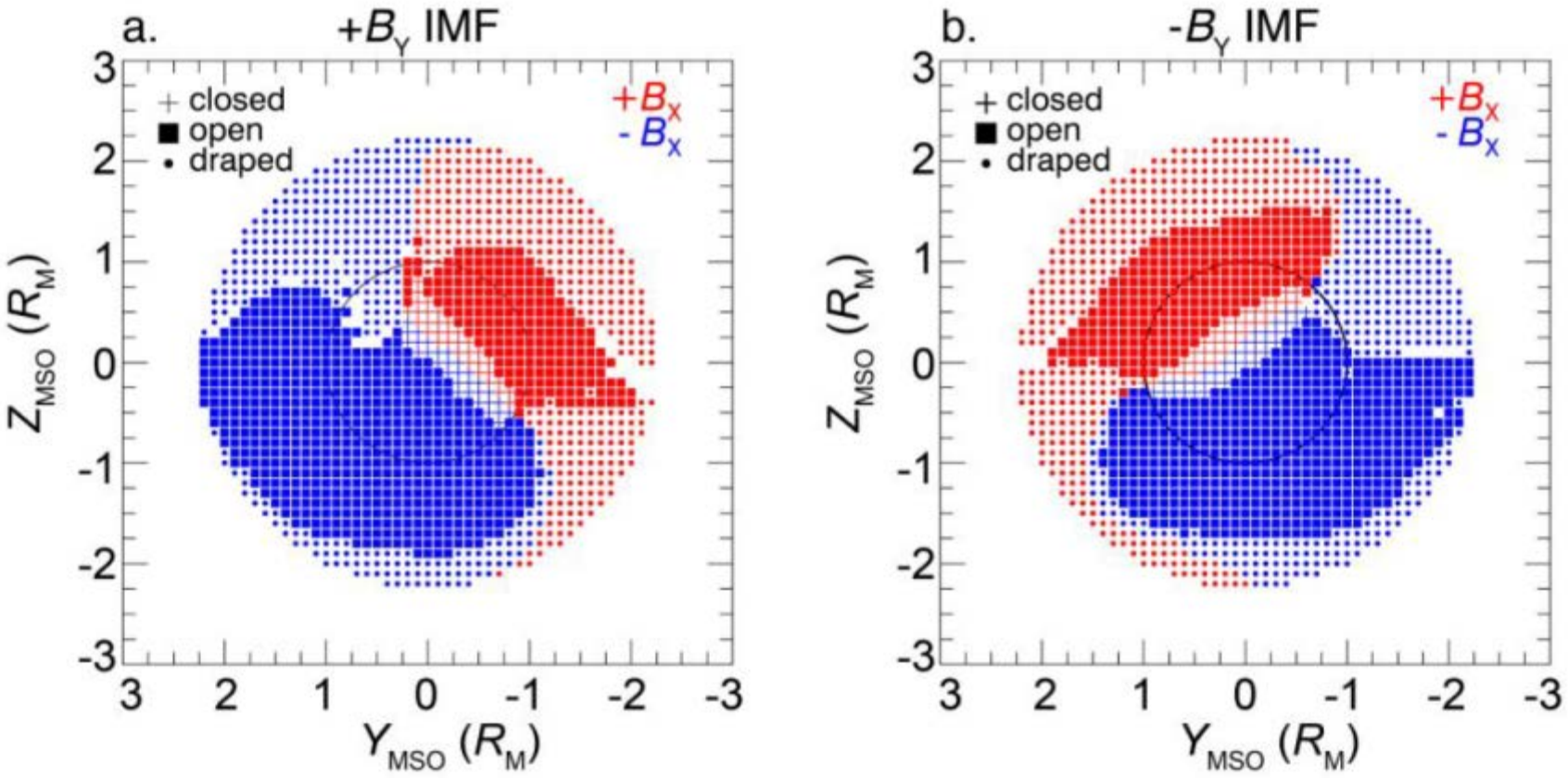
DiBraccio et al., 2018

Actual Magnetotail Configuration



DiBraccio et al., 2018

Open field lines are the twisted ones



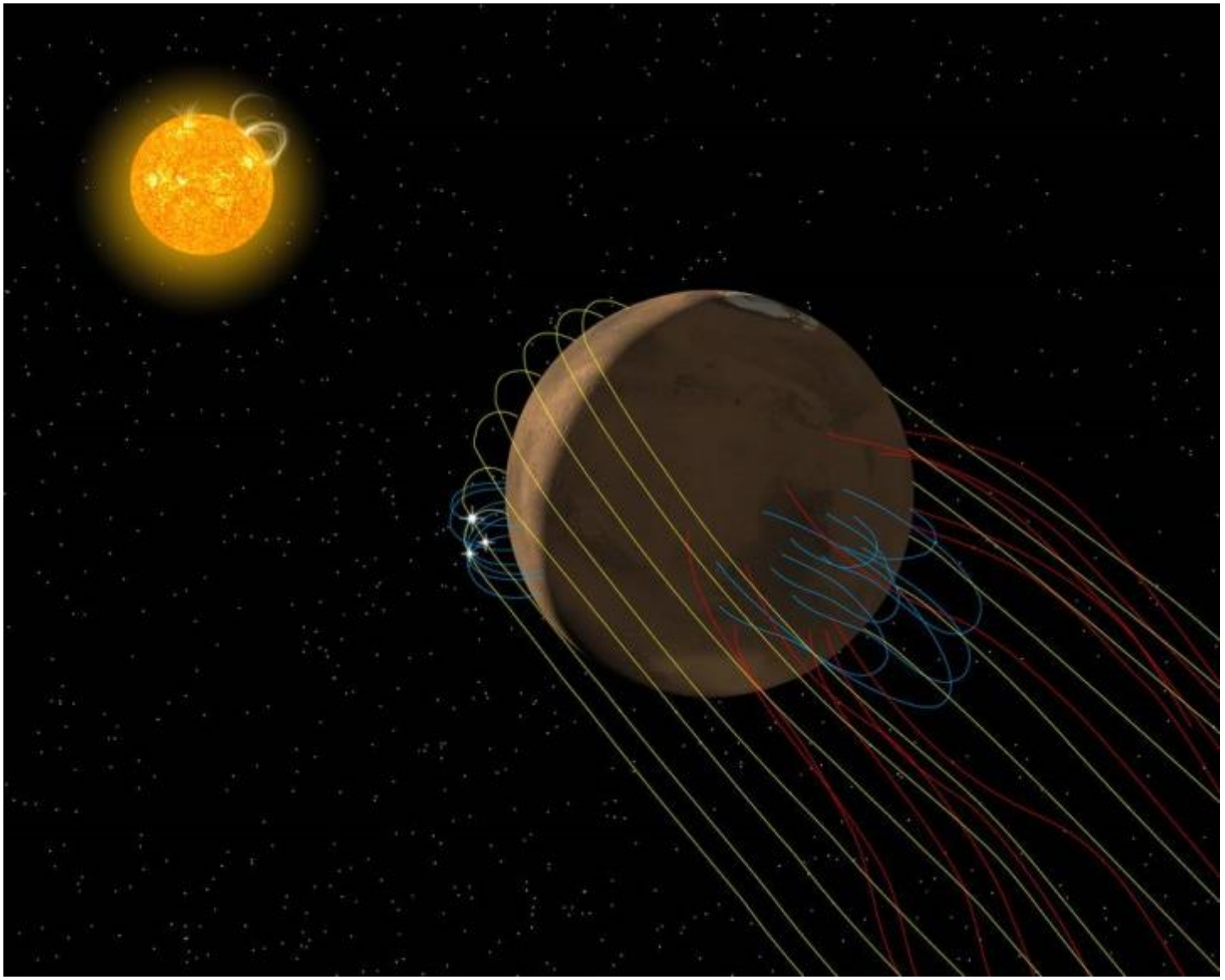
Open = 1 end connected to “planet”

Closed = Both ends connected to planet

Draped = Both ends connected to solar wind

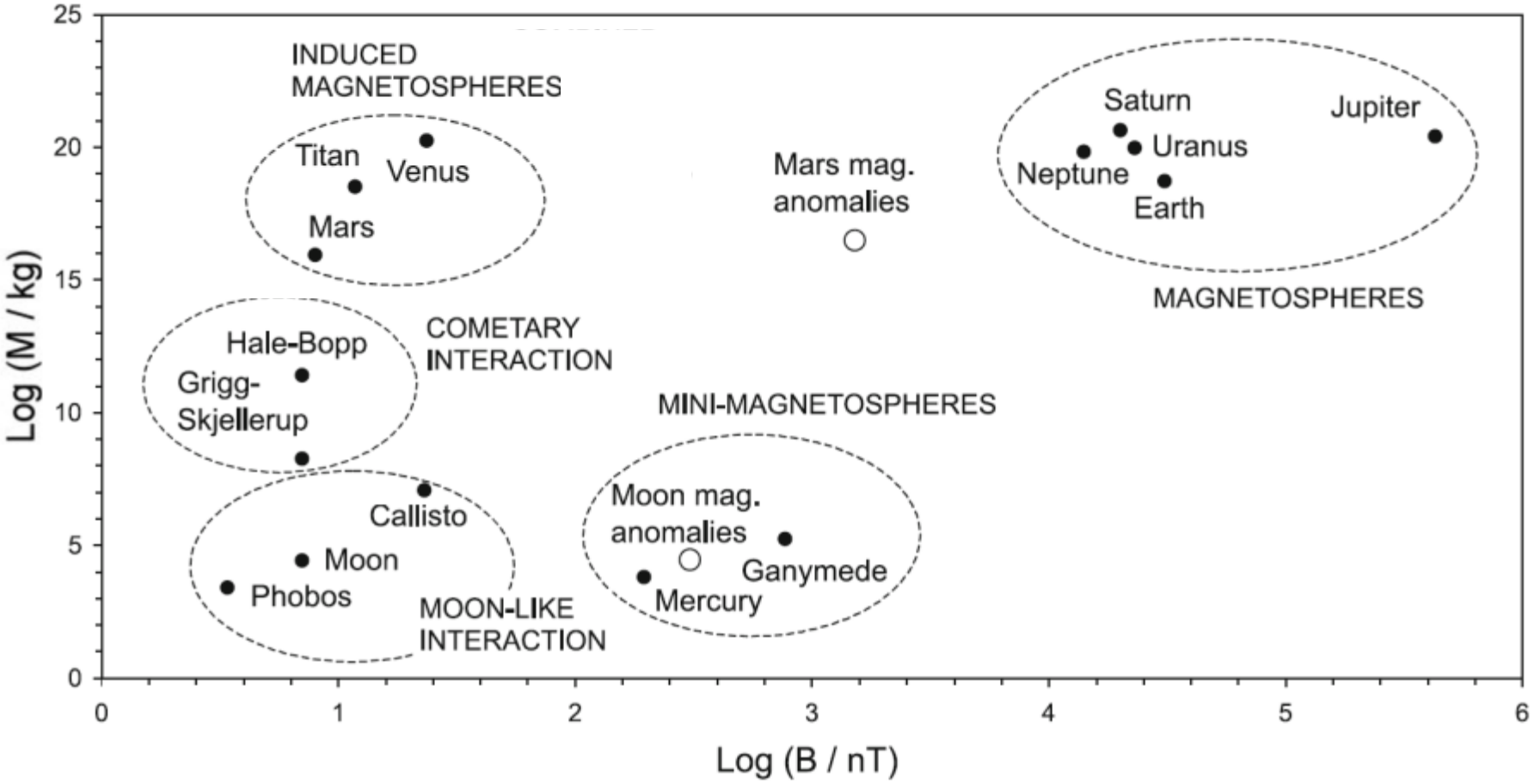
DiBraccio et al., 2018

Open field lines means reconnection



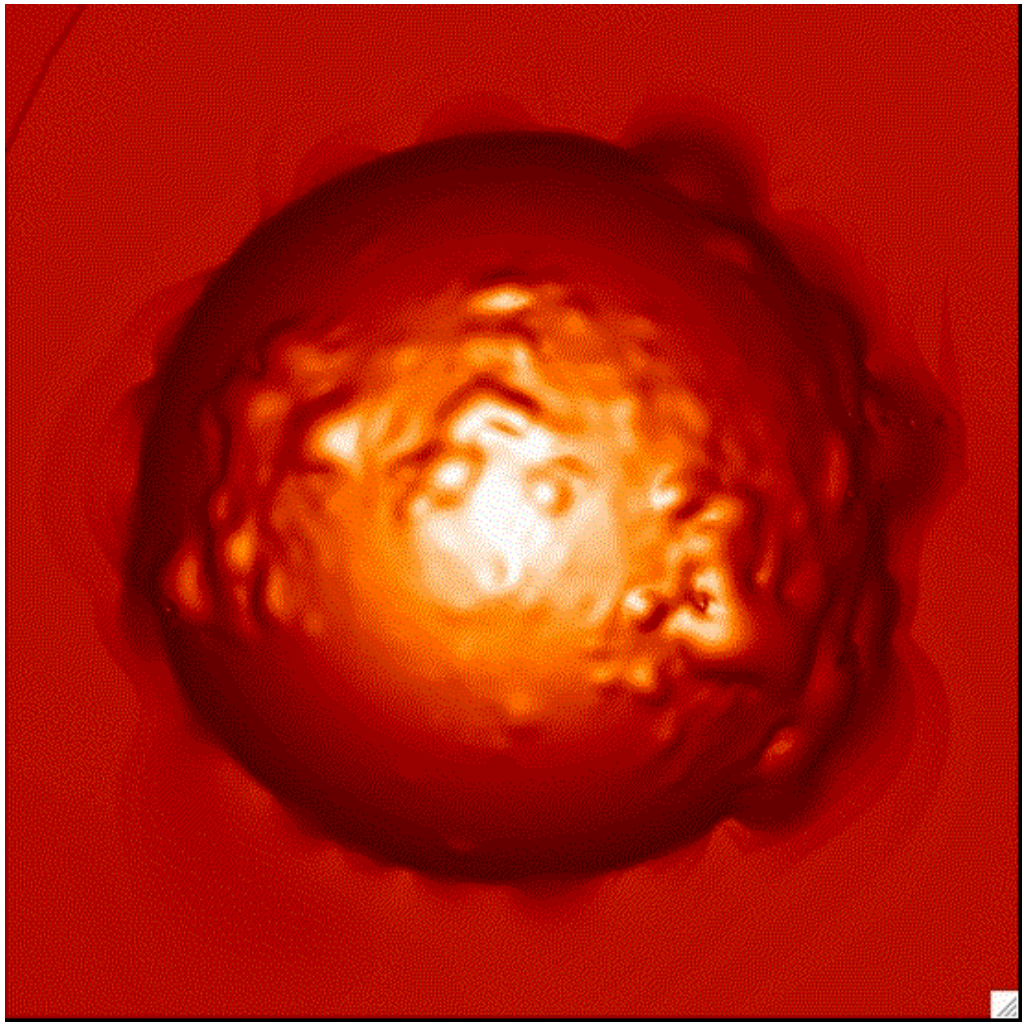
DiBraccio et al., 2018

Types of magnetospheres?



modified from Barabash, 2012

Mars' many mini-magnetospheres



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Extras

Additional topics

- Solar wind wave heating of the ionosphere
  - See presentation by Chris Fowler in ionospheres session
- Quantifying the magnetospheric disturbance from space weather at Mars
  - See presentation by Jacob Gruesbeck later in magnetospheres session

Coverage of recent missions