

Venus magnetic environment – Lessons from Venus Express to BepiColombo

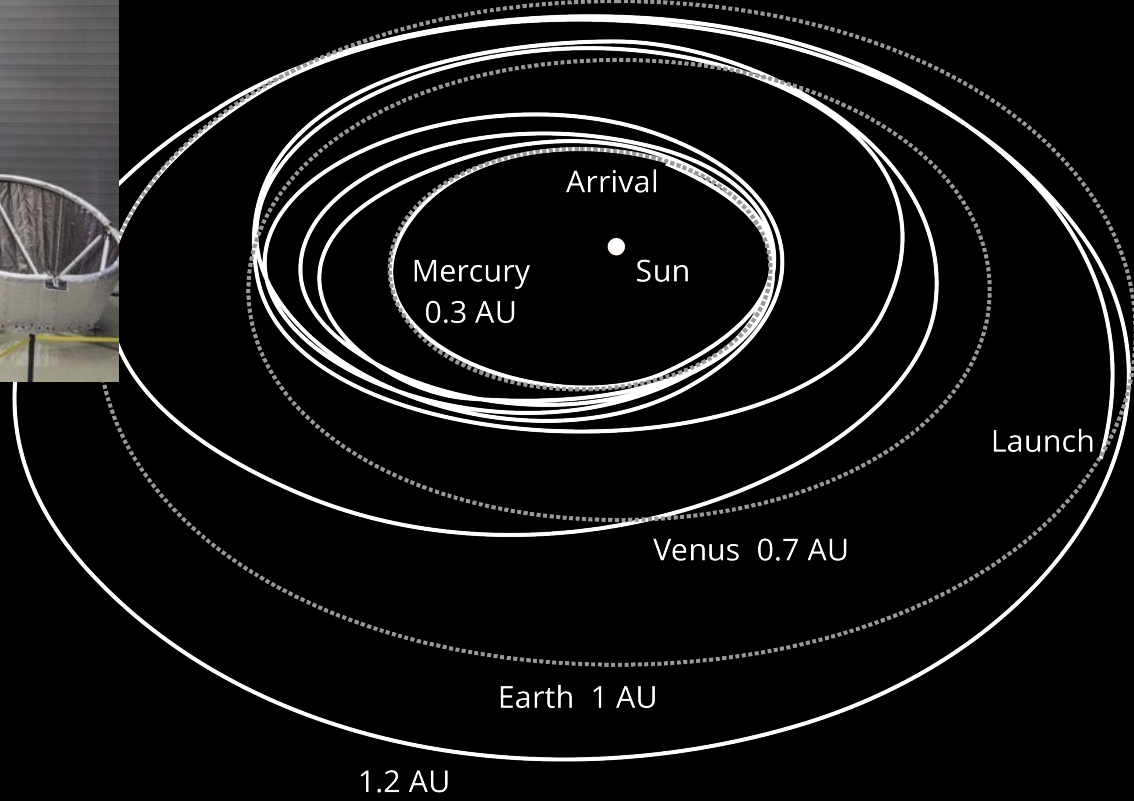
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BepiColombo Venus flybys in 2020

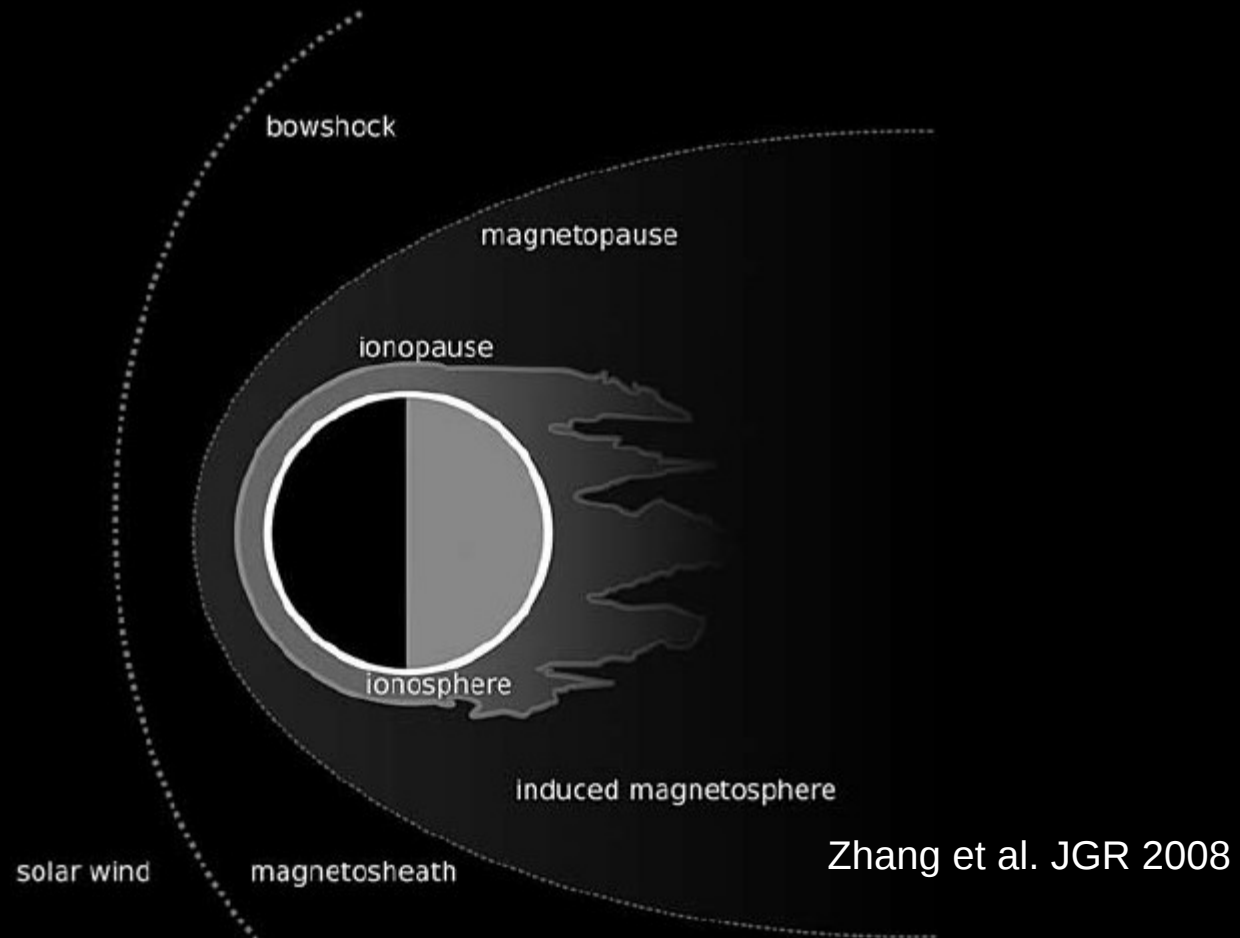


MMO
MPO
MTM



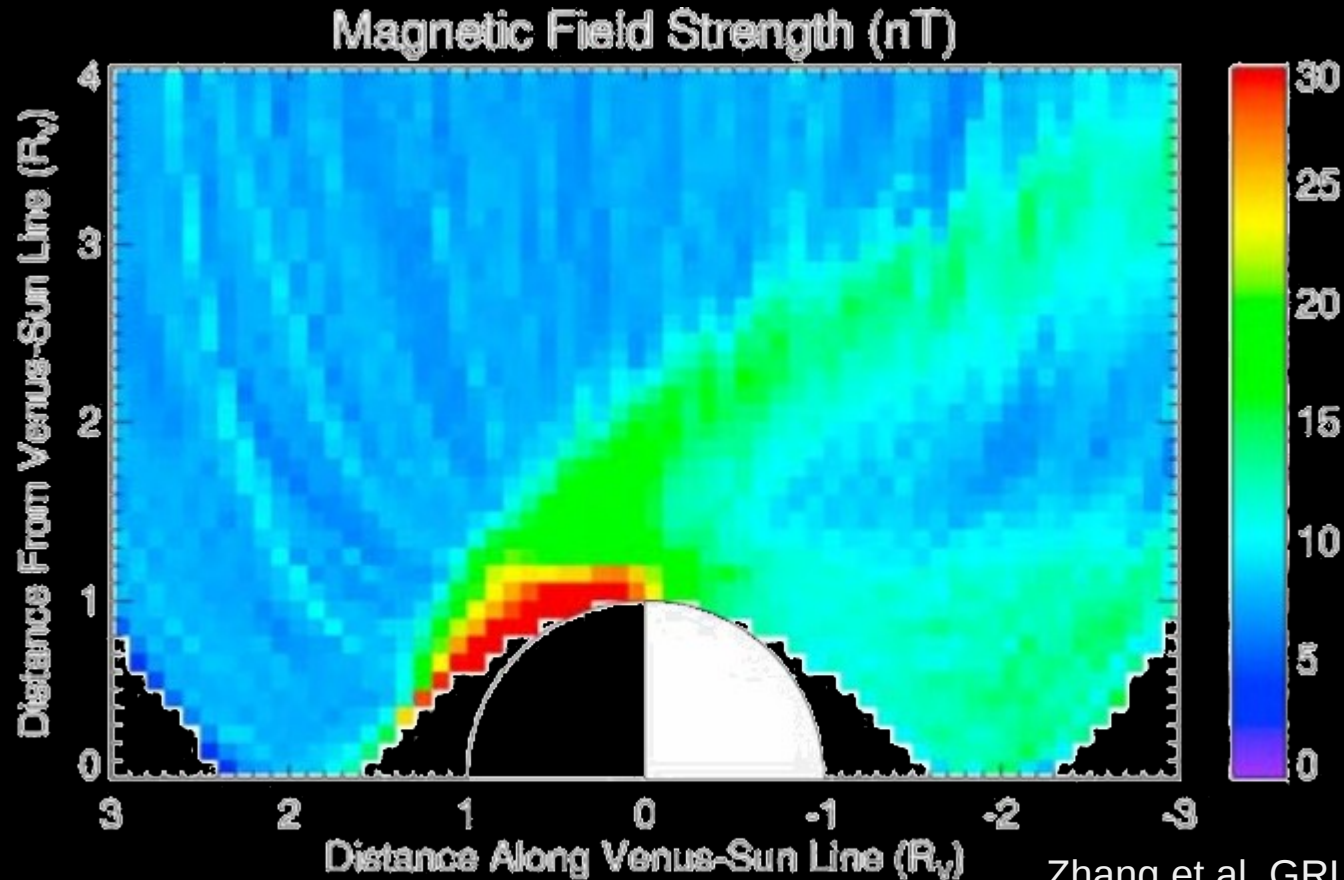
Launch in October 2018
Venus flyby (twice) in 2020
Mercury orbit in December 2025

Induced magnetosphere



Empirical magnetic field model available using IMF and solar activity index F10.7 as inputs (He et al. 2016)

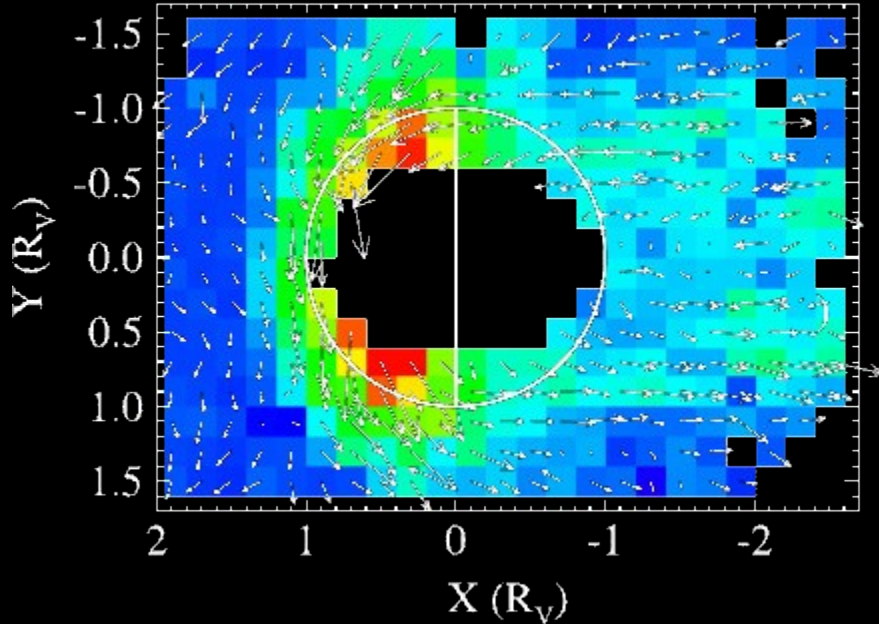
Venus bow shock



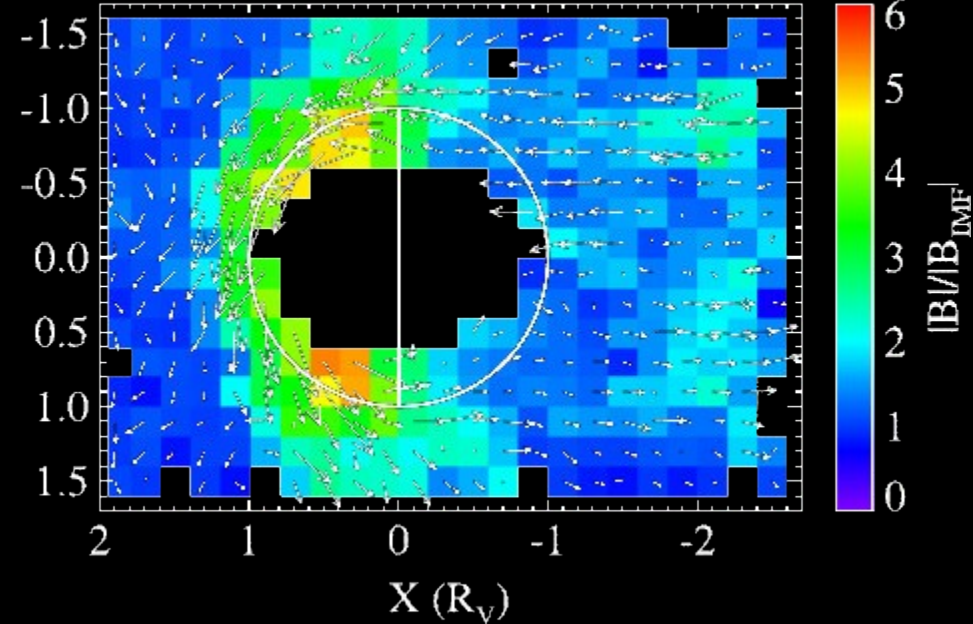
- Bow shock and magnetic barrier (Zhang et al. PSS 2008a,b)
- IMF control on bow shock position (Chai et al. JGR 2014)
- Asymmetric shock positions (Chai et al. JGR 2015)

Field line draping

(a) +E Hemisphere ($0.2 < Z < 0.8 R_V$)



(b) -E Hemisphere ($-0.8 < Z < -0.2 R_V$)

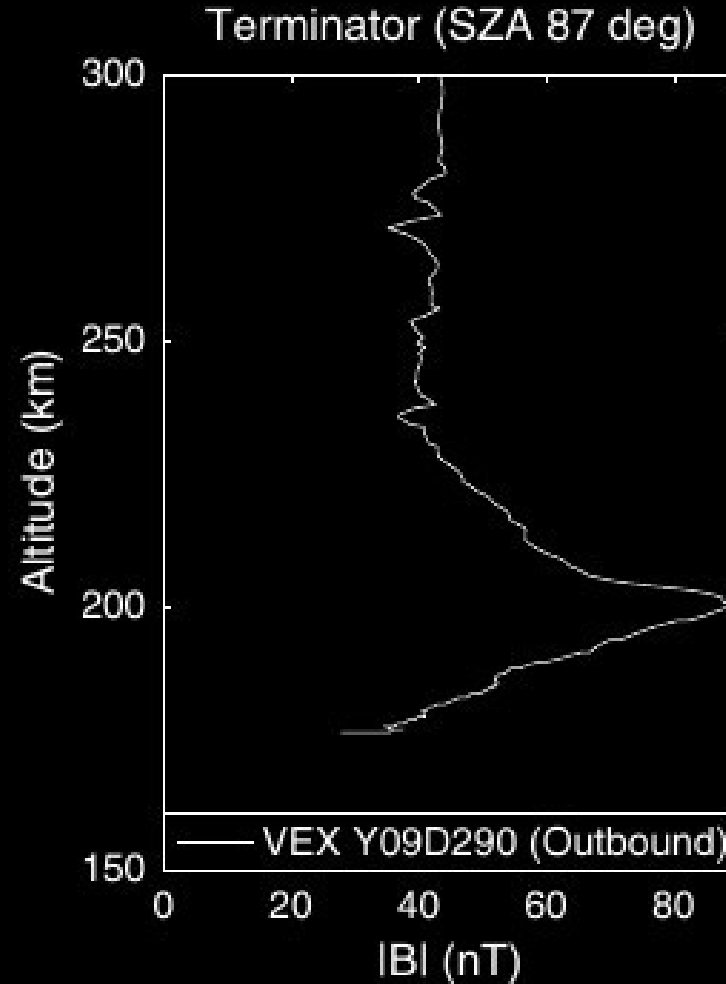


Du et al. JGR 2013

Dubinin et al. PSS 2013, JGR 2014

- Reconfiguration of the induced magnetosphere against IMF polarity change
- (Vech et al. JGR 2016)
- Hemispheric asymmetry (Xiao et al. 2016)

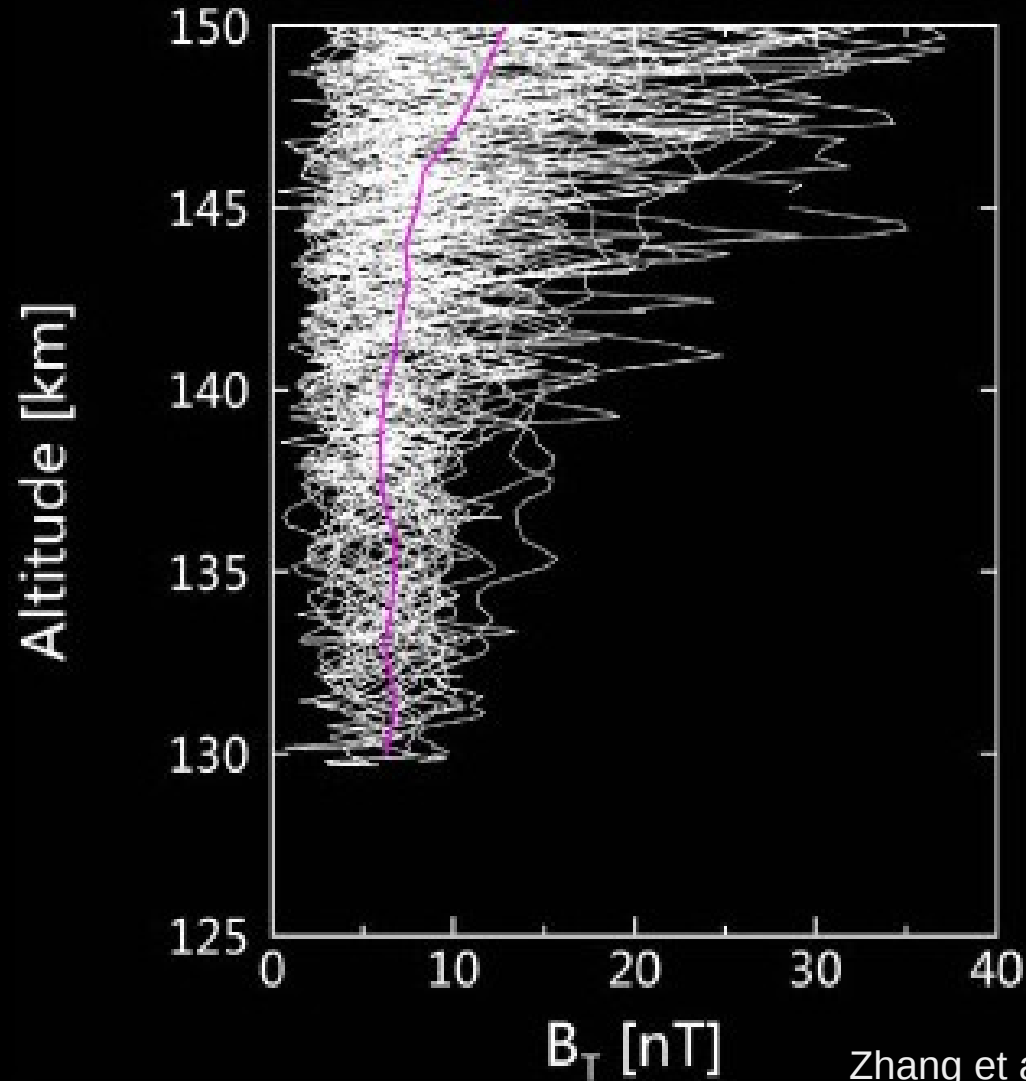
Low-altitude field enhancement (180 km)



Villarreal et al. 2015

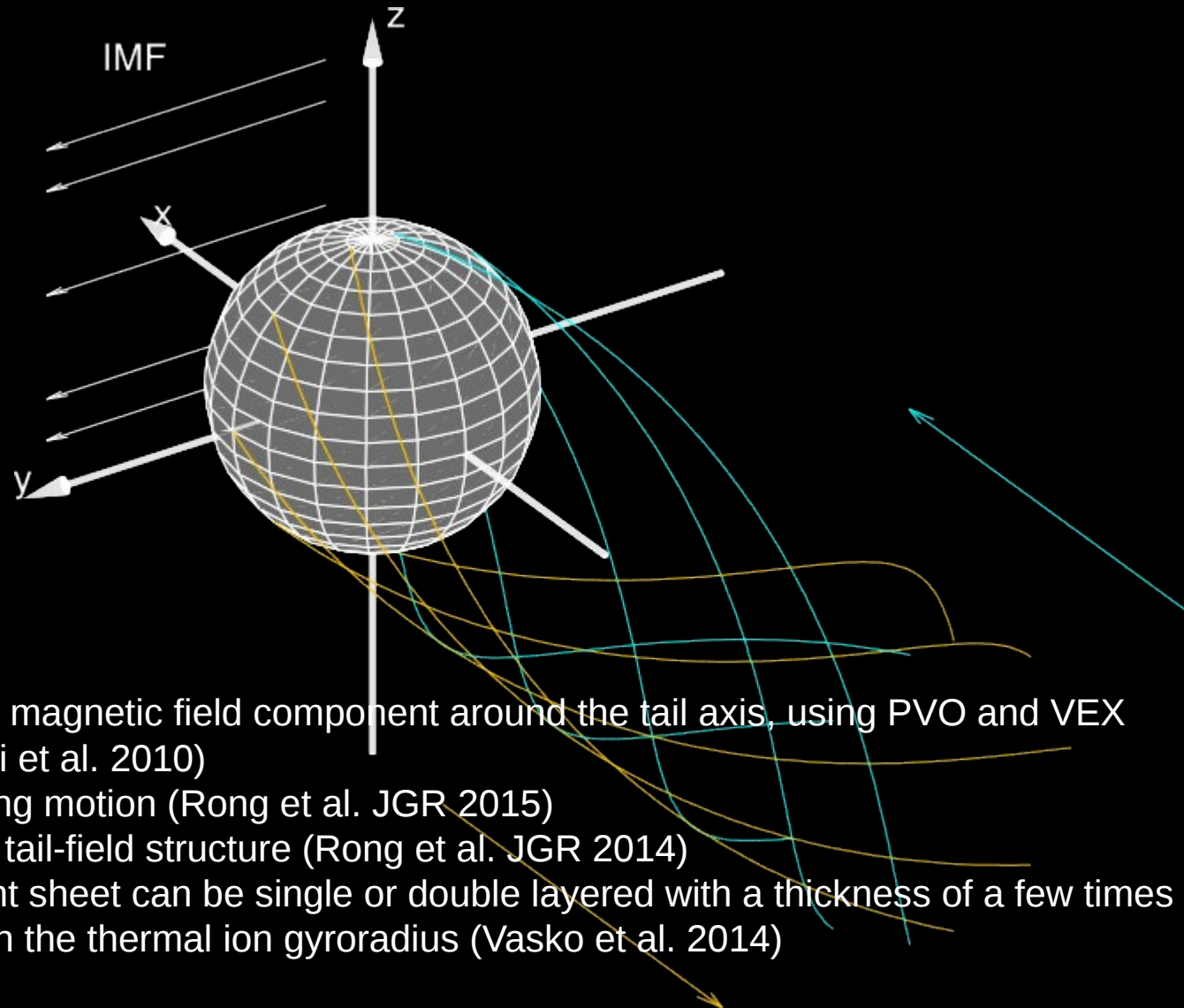
Average enhancement about 45 nT (Zhang et al. 2015)

Weak field below 150-km altitude



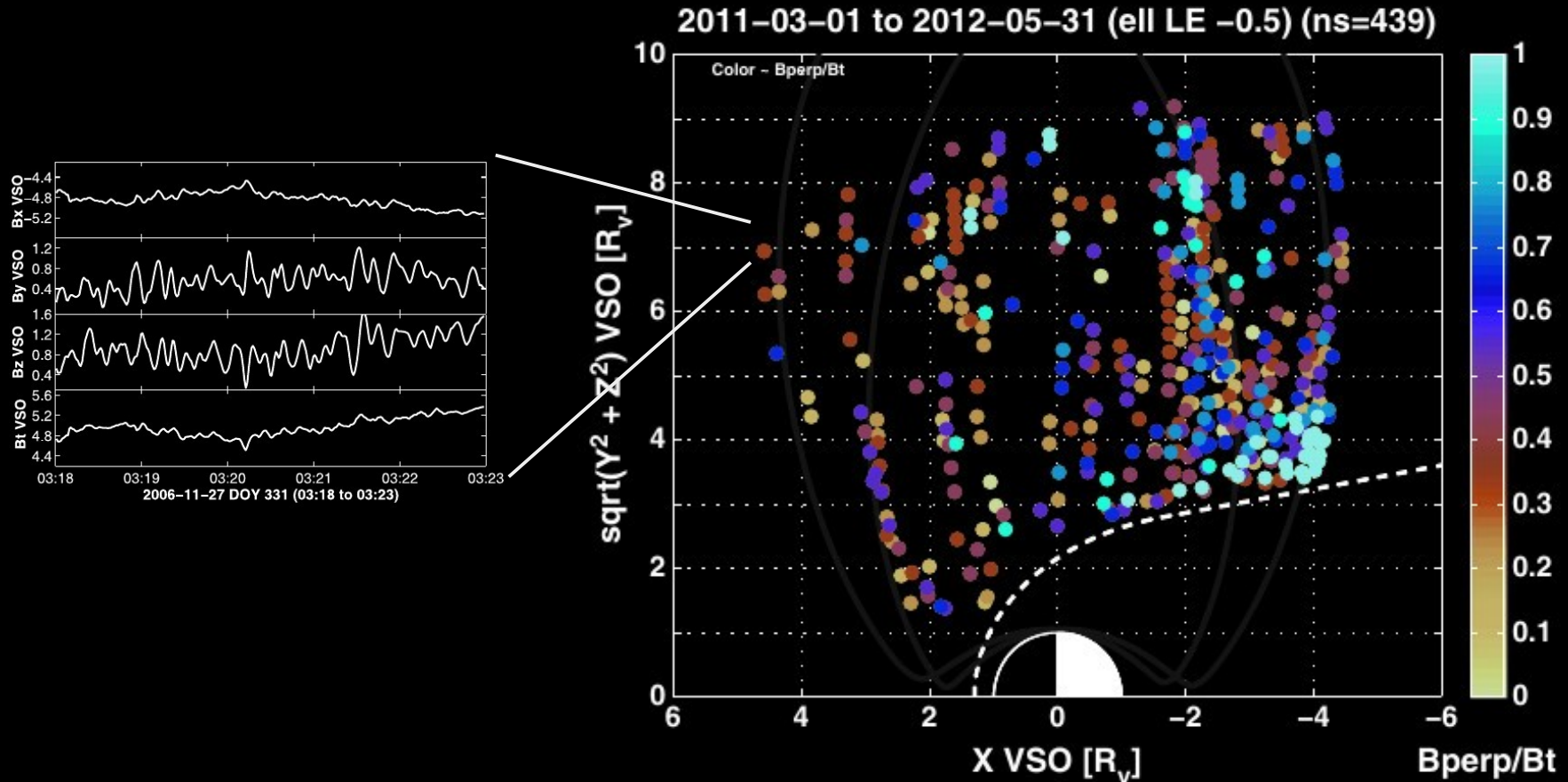
Zhang et al. Nature Sci. Rep. 2016

Tail structure and motion



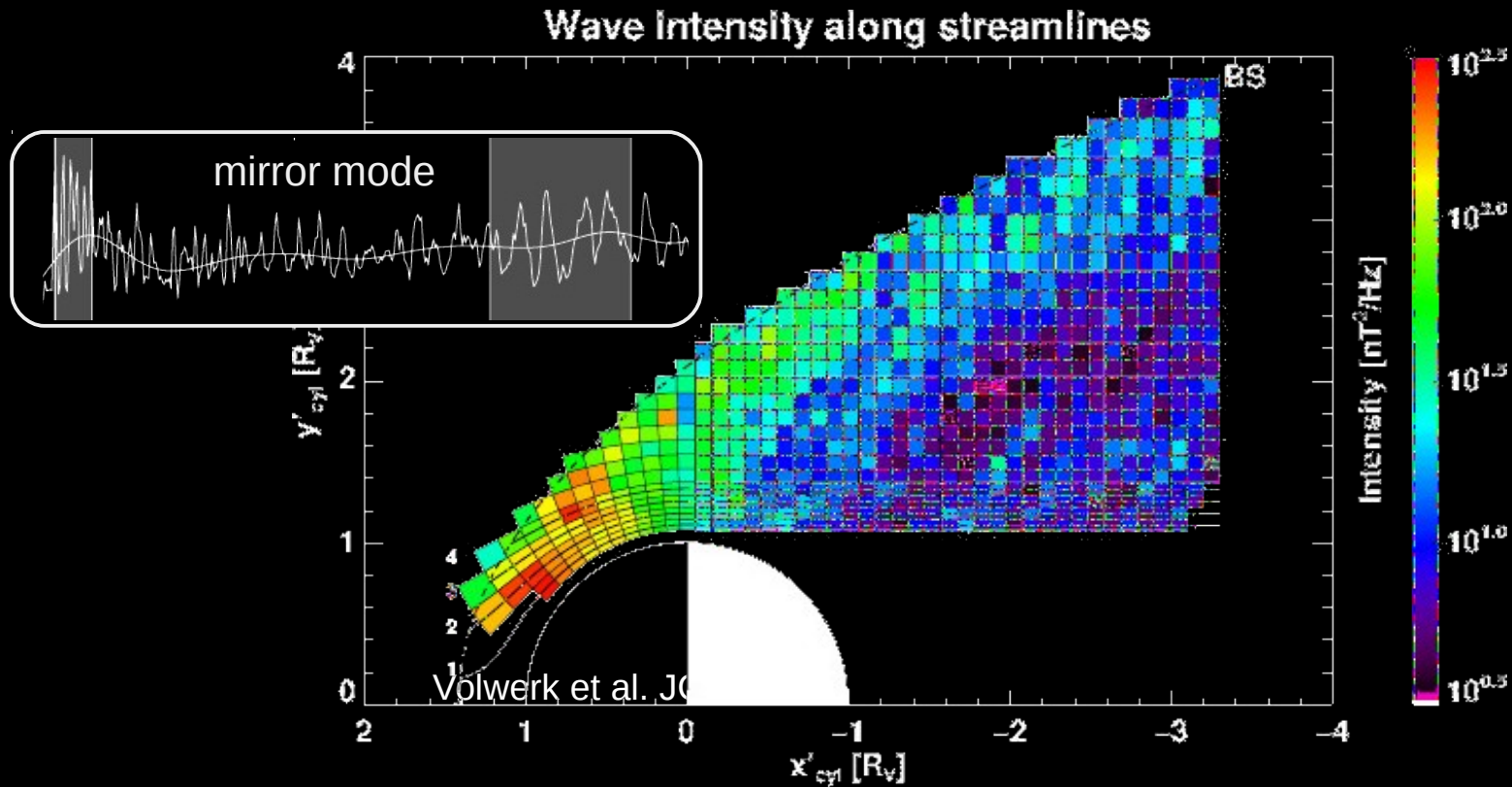
- Azimuthal magnetic field component around the tail axis, using PVO and VEX data (Chai et al. 2010)
- Tail flapping motion (Rong et al. JGR 2015)
- Averaged tail-field structure (Rong et al. JGR 2014)
- Tail current sheet can be single or double layered with a thickness of a few times larger than the thermal ion gyroradius (Vasko et al. 2014)

Cyclotron waves by pickup protons



- Upstream pick-up ions unstable to the cyclotron mode (Delva et al. GRL, JGR, PSS 2008)
- Statistics for solar minimum and maximum (Delva et al. JGR 2011 and 2015)

Venus magnetosheath

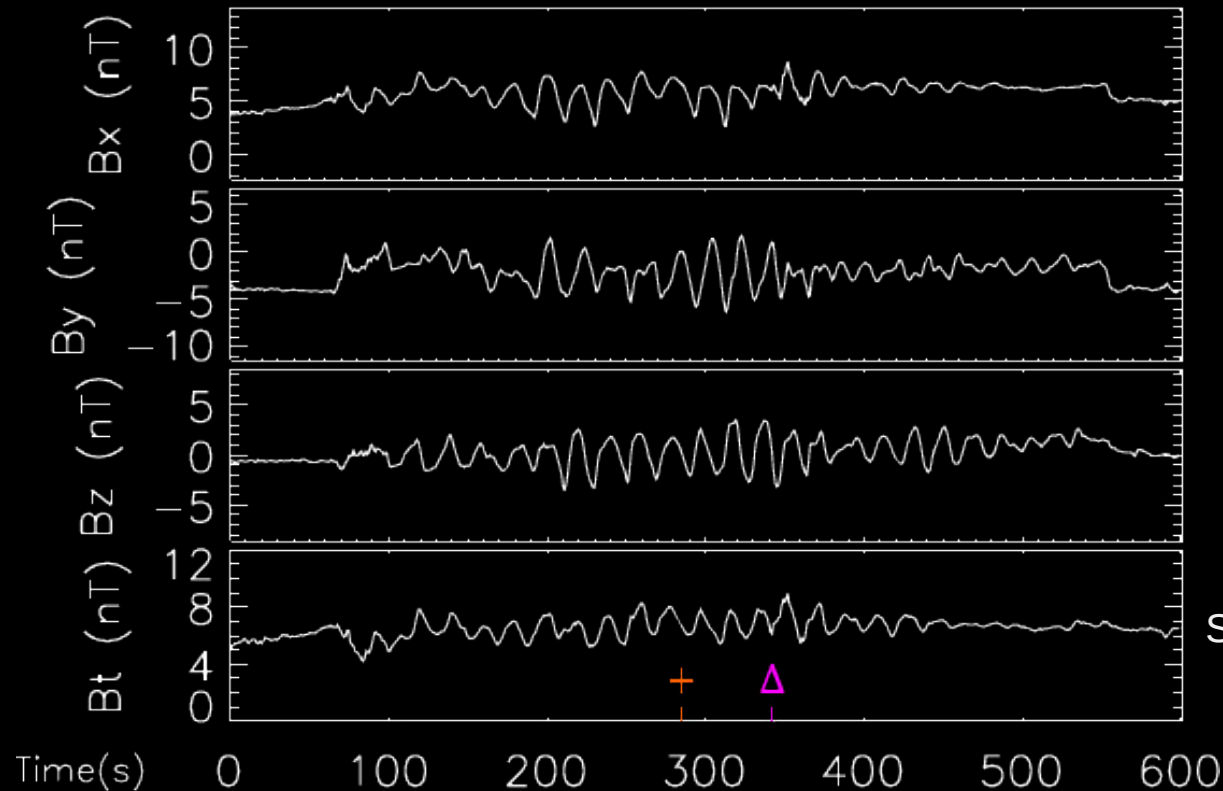


Guicking et al. 2010

- Mirror mode observations: Volwerk 2008, 2010, 2016; Schmid et al. 2014
- Turbulence energy spectra: Guicking et al. AnGeo 2010, Dwivedi et al. EPS 2015
- Interpretation as a large-amplitude nonlinear mode: Golbraikh et al. JGR 2013

Venus foreshock

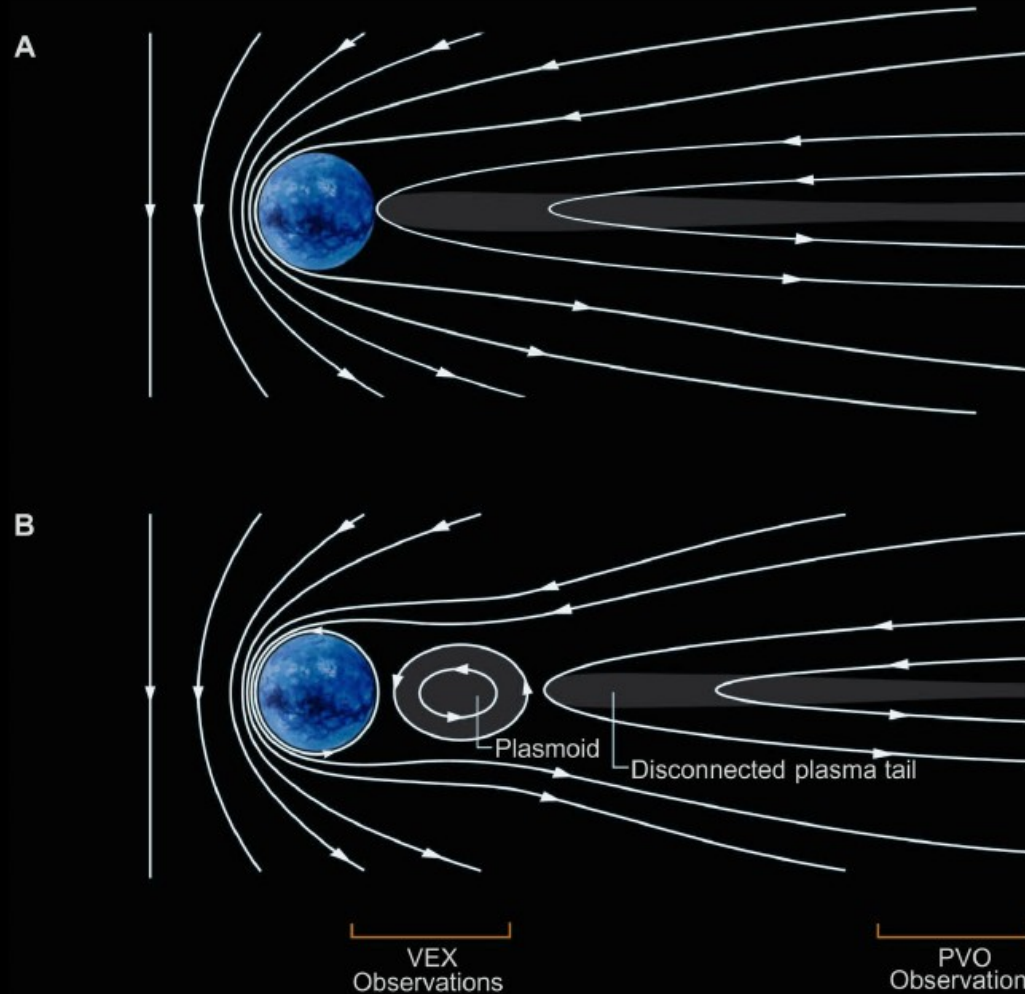
MAG 2006-06-02
00:04:33-00:14:33 UT



Shan et al. JGR 2016

- Beam instability due to shock-reflected, backstreaming ions (Shan et al. 2014, 2016).
- Appearance only in the magnetically-connection upstream region.

Magnetic reconnection in the tail

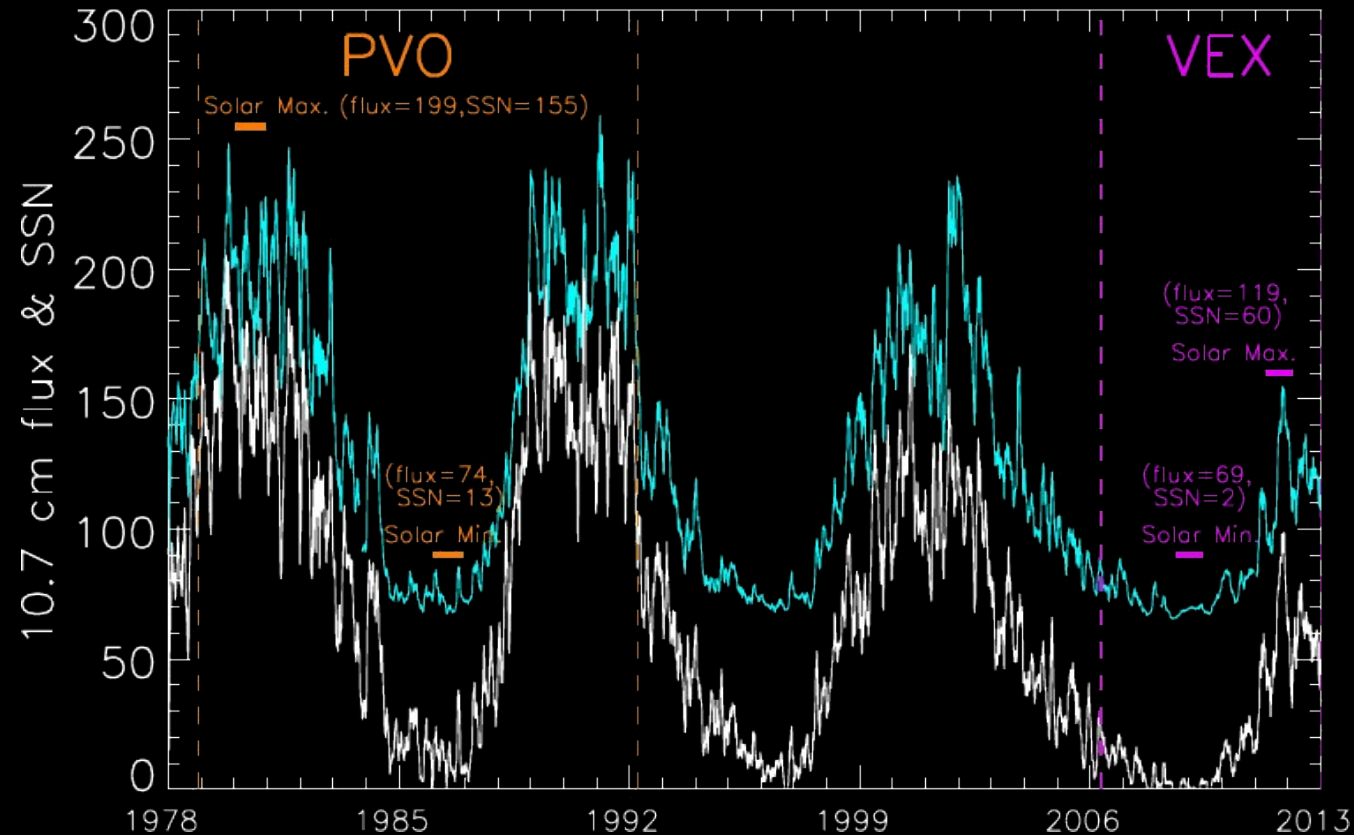


Plasmoid formation
Zhang et al. Science 2012

- Substorm-like activity also found, Volwerk et al. AnGeo 2009

Solar cycle dependence

Daily flux and SSN (30 days smoothed)
10.7 cm flux & Sunspot number



- Impacts on bow shock position (Shan et al. 2015)
- Impacts on the location of mirror mode excitation (Volwerk et al. 2016)

Shan et al. 2015