Cluster-II Observations of Continuous Reconnection at the Dusk Magnetopause

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FGM:

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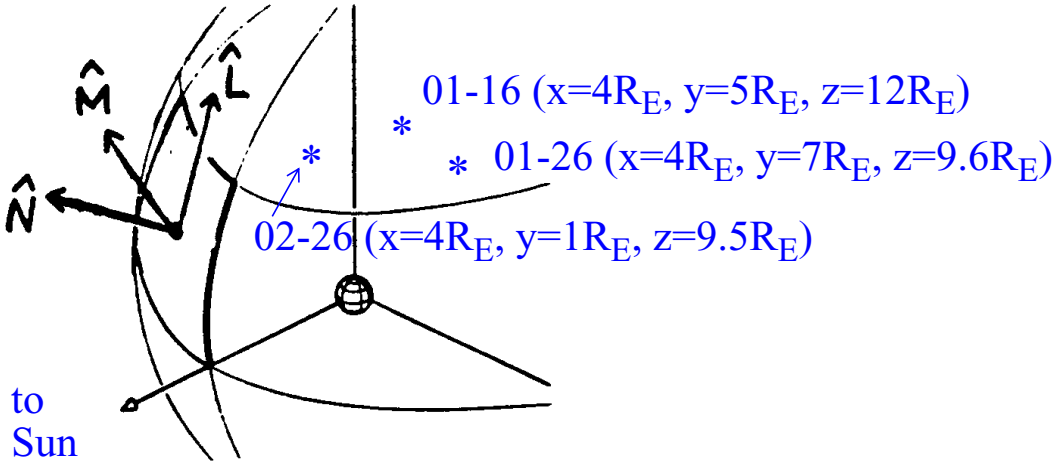
Data:

* CIS: Onboard moments (4 s resolution)

* FGM: spin-averaged (4 s)

Orbits and Questions Addressed

I. MP crossings on Jan16, Jan 26 and Feb 26, 2001

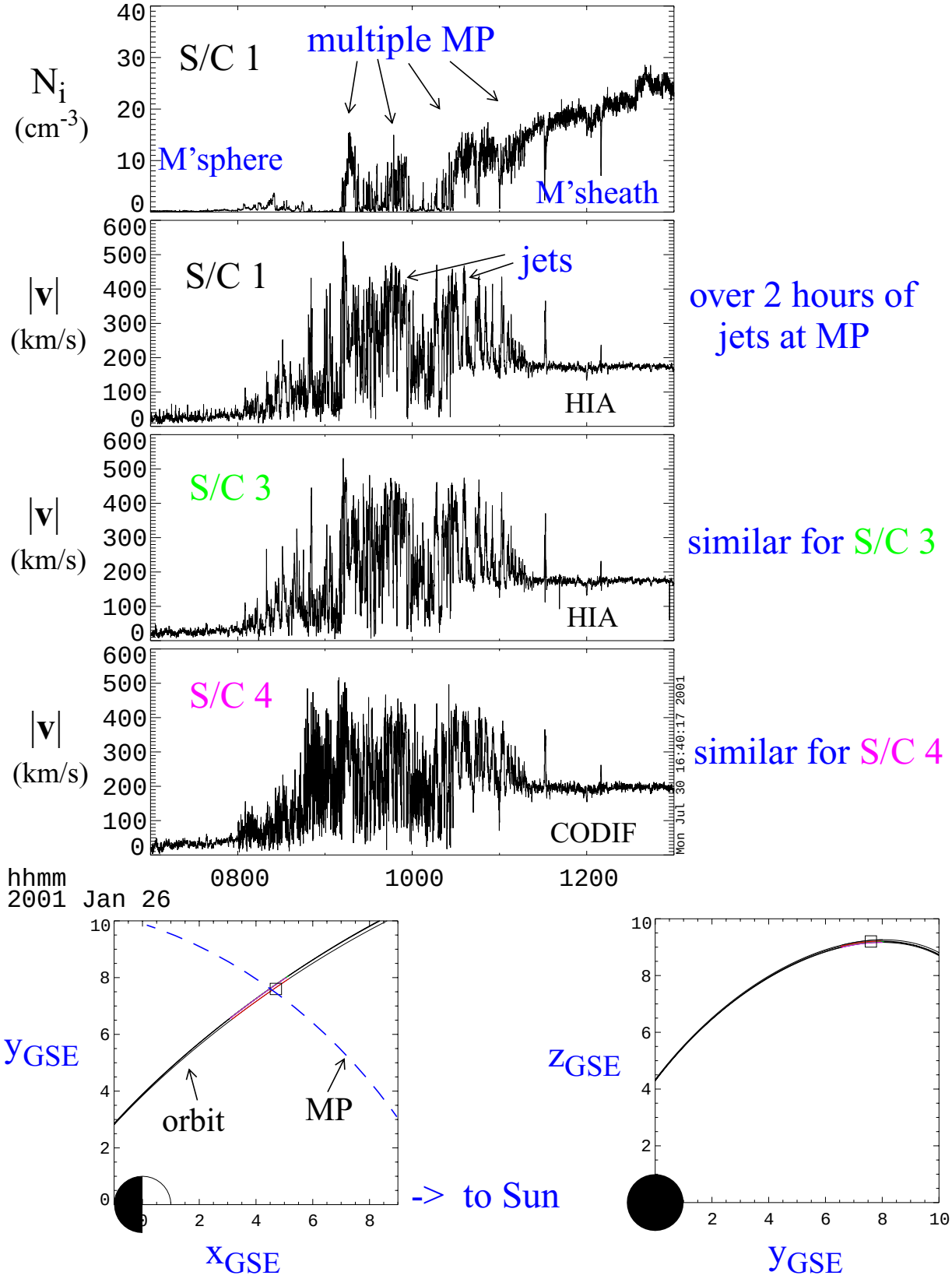


II. Questions addressed: Under steady IMF:

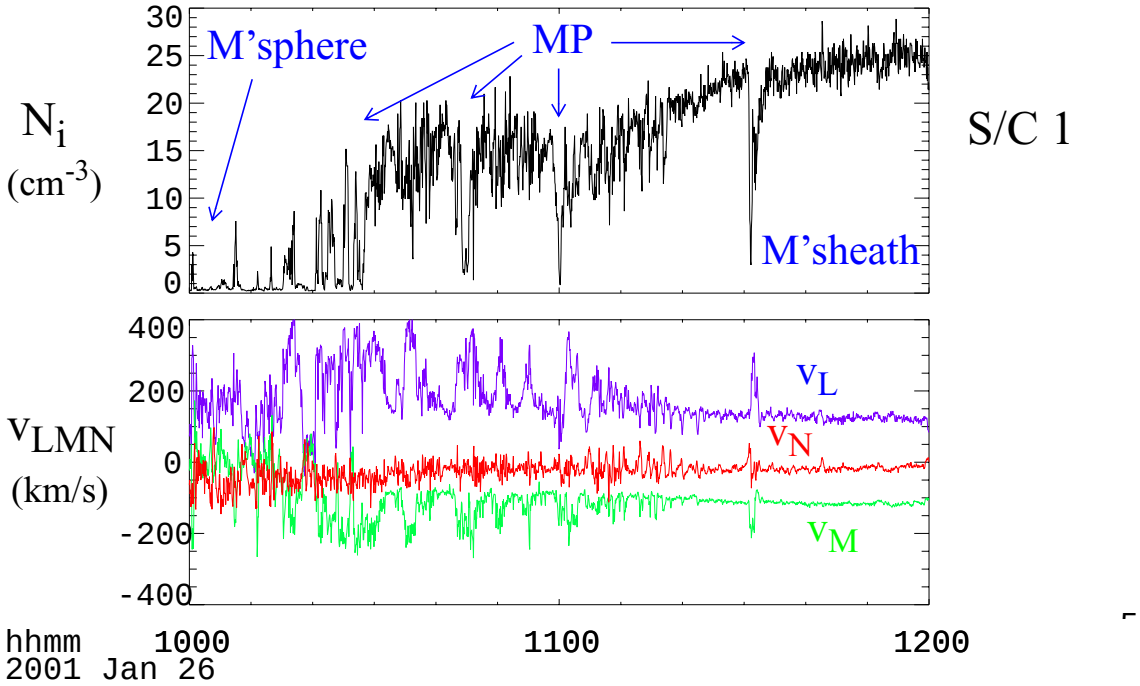
* Continuous or intermittent reconnection?

* Single or multiple reconnection X-line(s)?

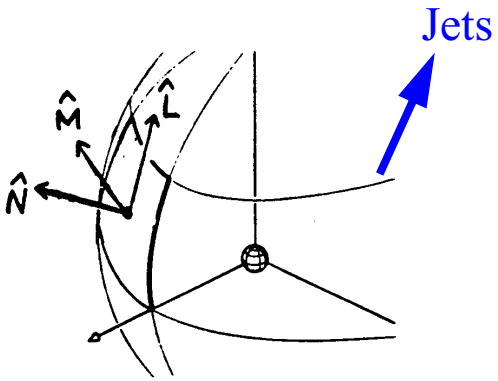
Dusk Flank MP on 2001-01-26: Overview



2001-01-26: Accelerated flows



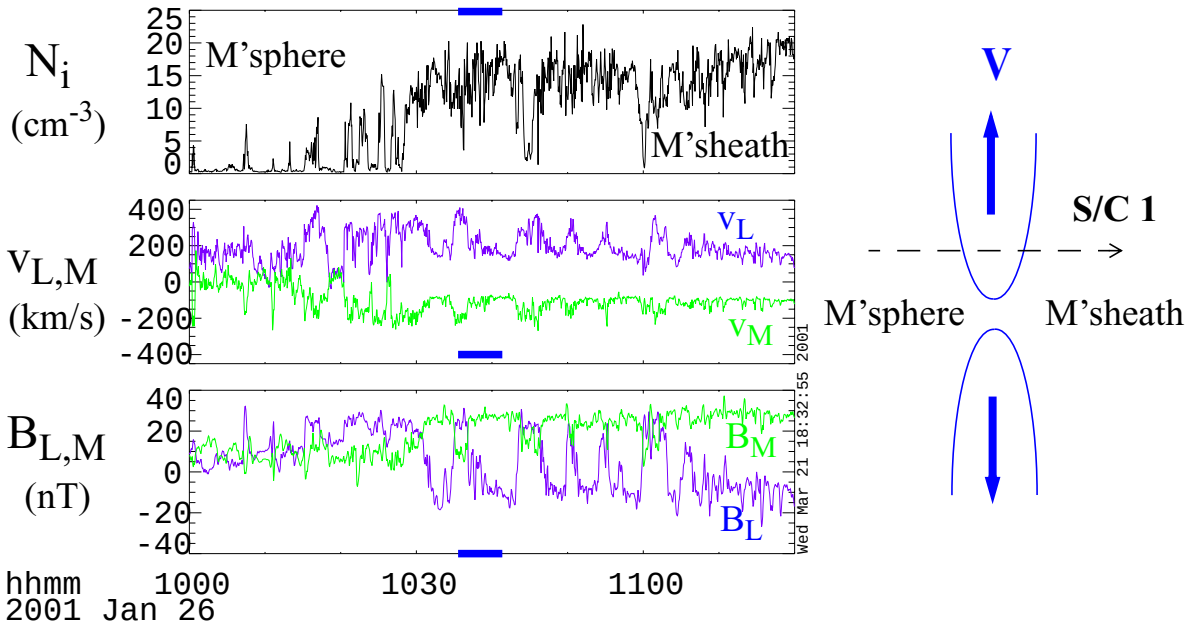
* Plasma jets detected at all complete MP crossings and FTEs

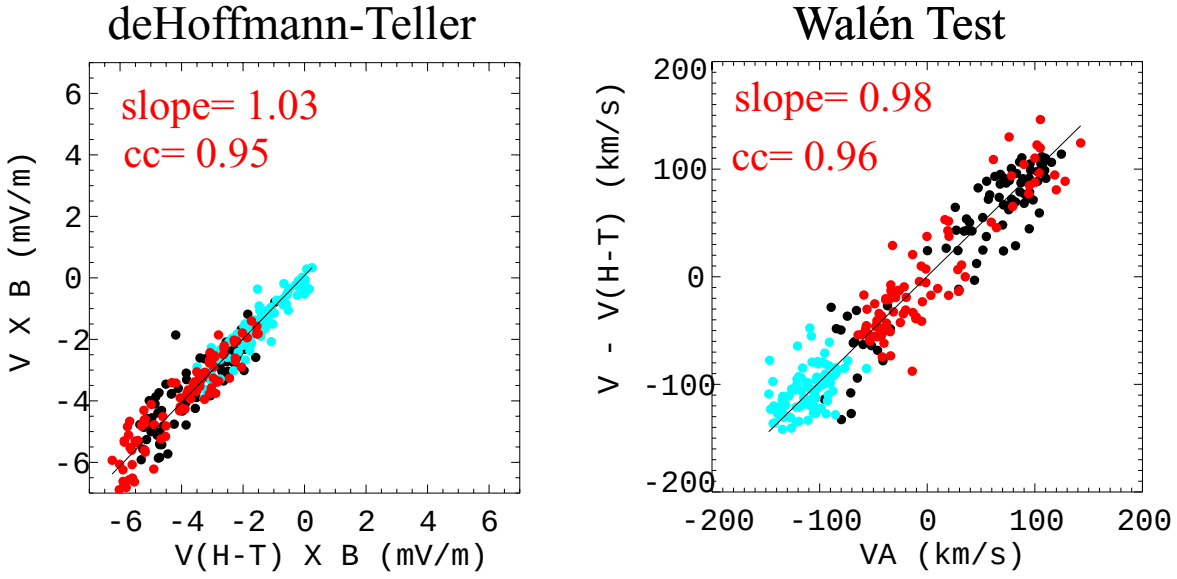


Test of Reconnection: Walén Test [Sonnerup 1987]

(1) Good deHoffmann-Teller frame: $\mathbf{E}_{H\text{-}T} = (\mathbf{V} - \mathbf{V}_{H\text{-}T}) \times \mathbf{B} \approx 0$

(2) $\mathbf{V} - \mathbf{V}_{H\text{-}T} = \pm \mathbf{V}_A$

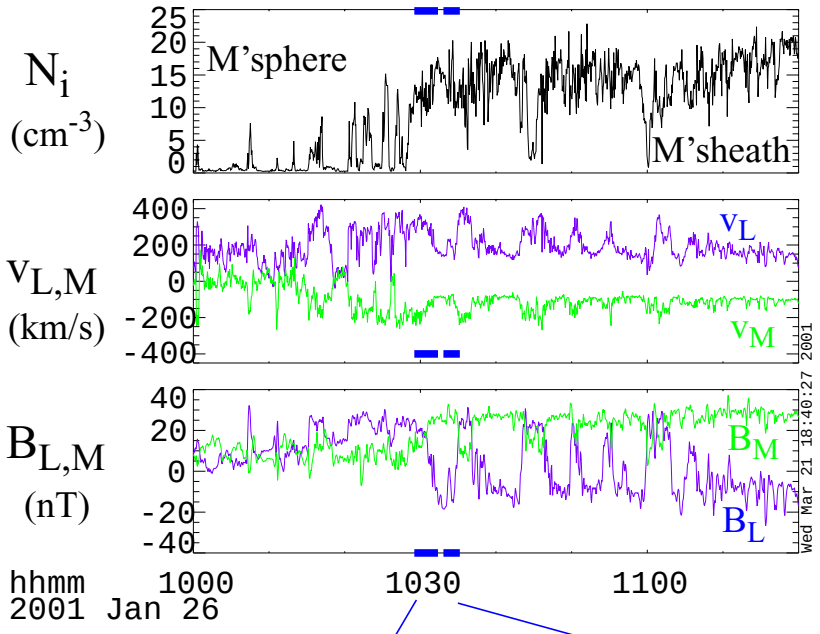


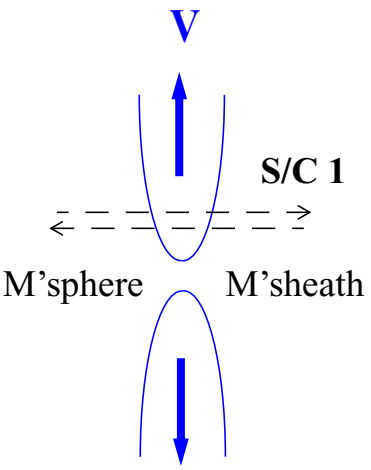


* Excellent agreement with theory !

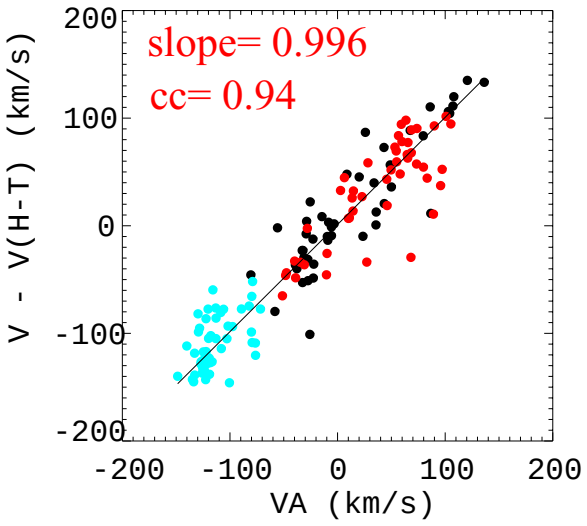
* Positive Walén slope --> crossing north of X-line

More Evidence for Reconnection at MP

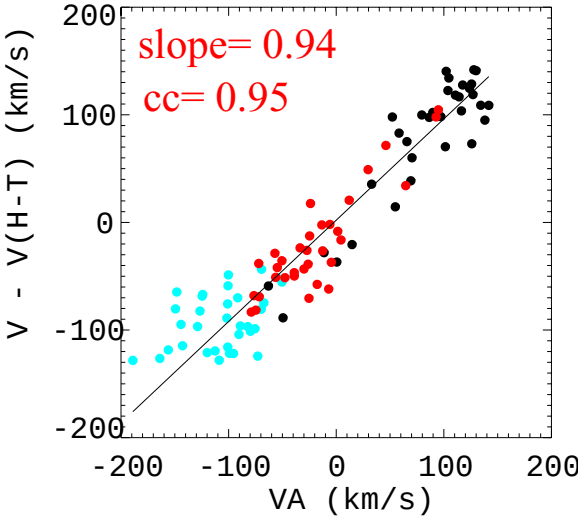




Walén Test

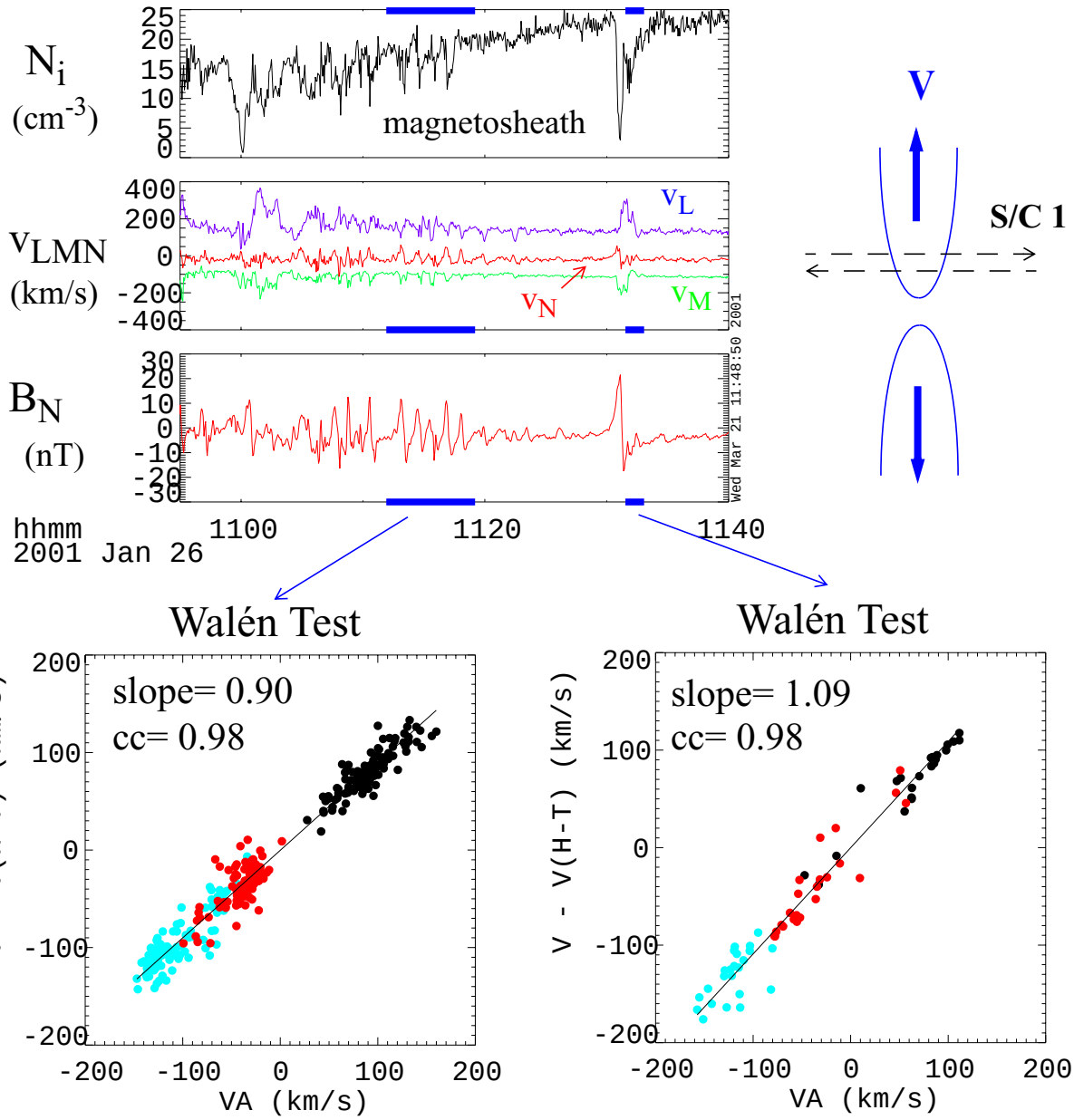


Walén Test



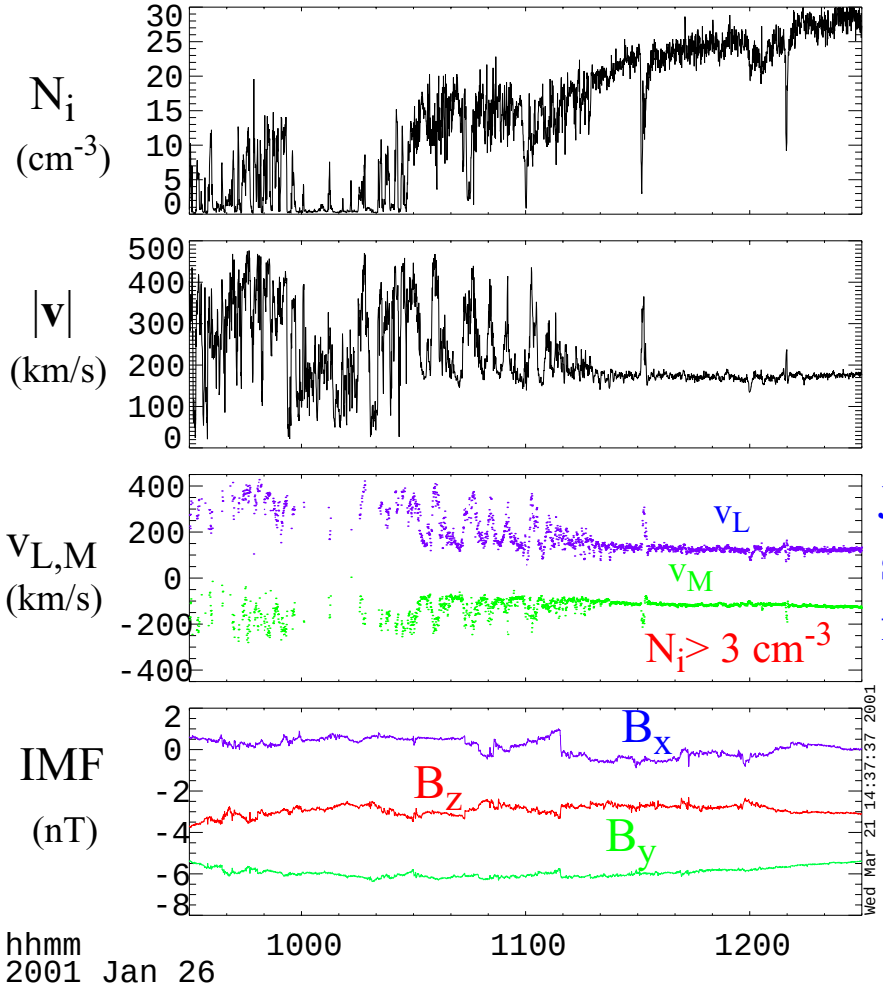
* Excellent agreement with theory for other MP as well

Evidence for Reconnection in FTEs



* Flows in FTE satisfy the Walén relation remarkably well

Evidence for Single, Stable X- Line



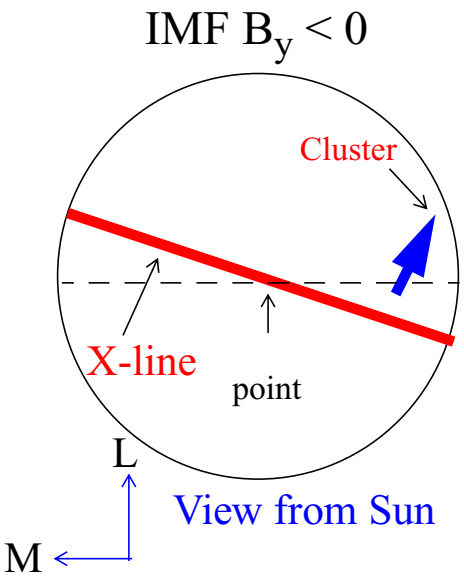
Jettings in the same direction for 2 hours!

Steady IMF

$B_z < 0$

$B_y < 0$

Component Merging [Sonnerup, 1974; Gonzales and Mozer, 1974]

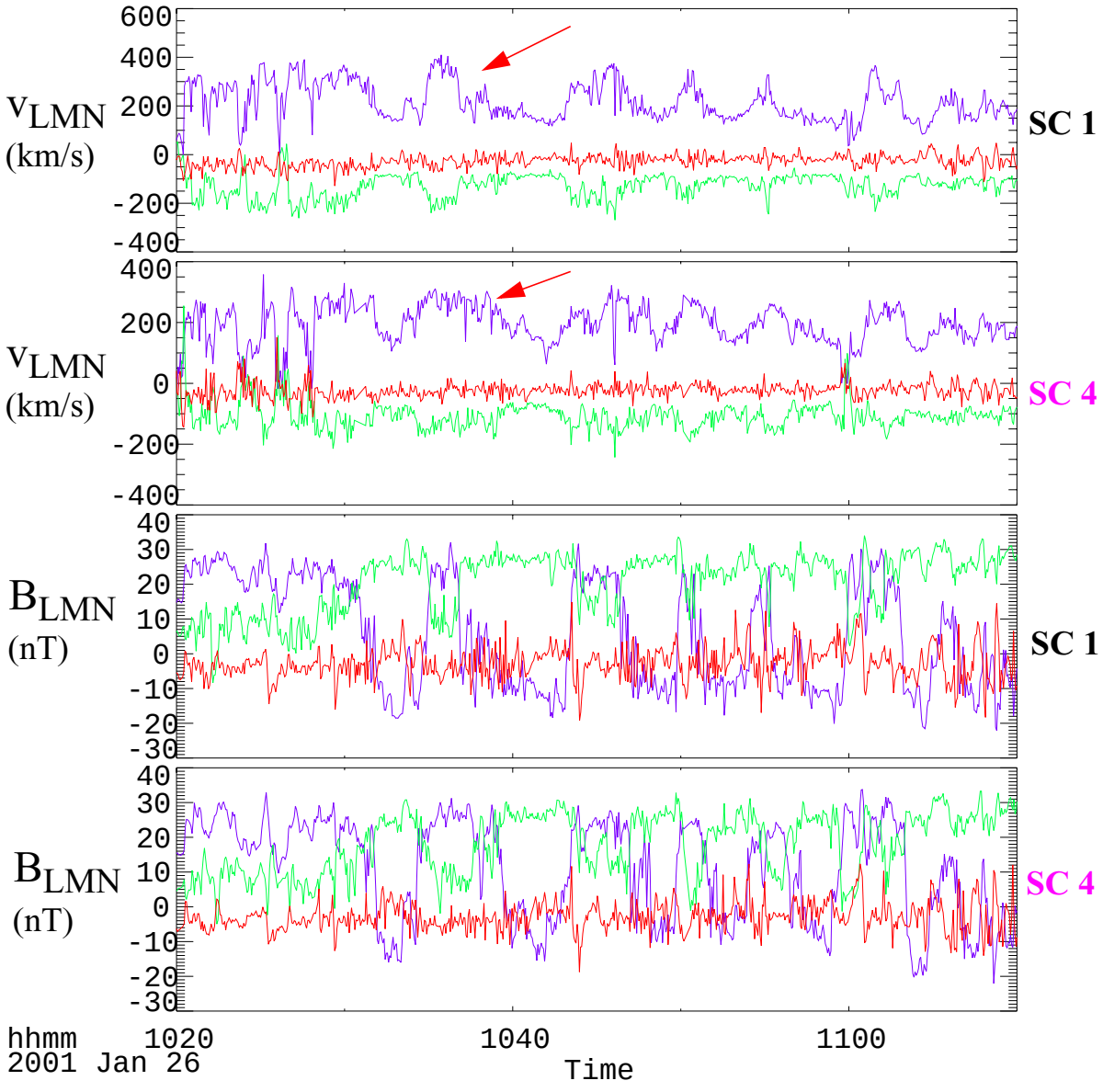


Reconnection site below and sunward of Cluster-II for 2 hours

For steady IMF:

- reconnection large-scale (≠ random)
- reconnection sites controlled by IMF

Multi-Point Observations of Continuous Reconnection

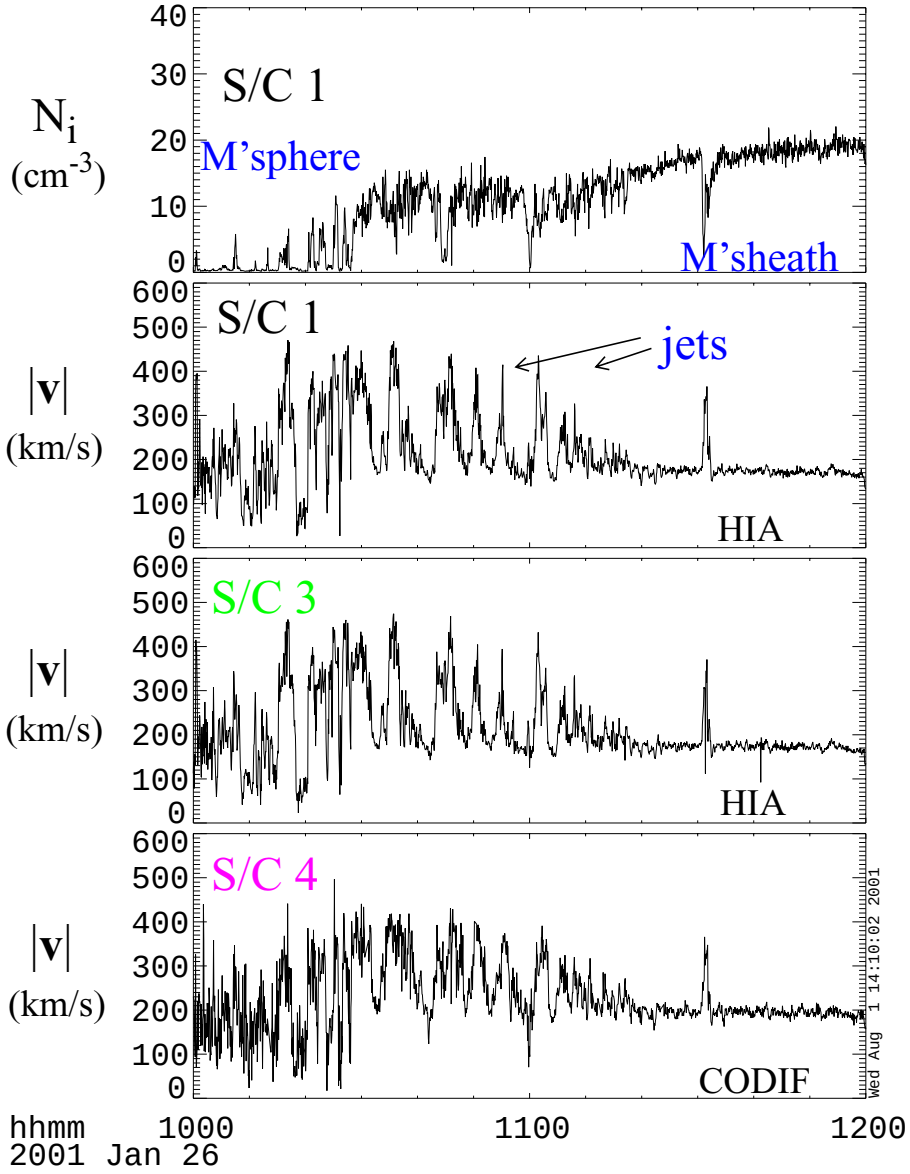


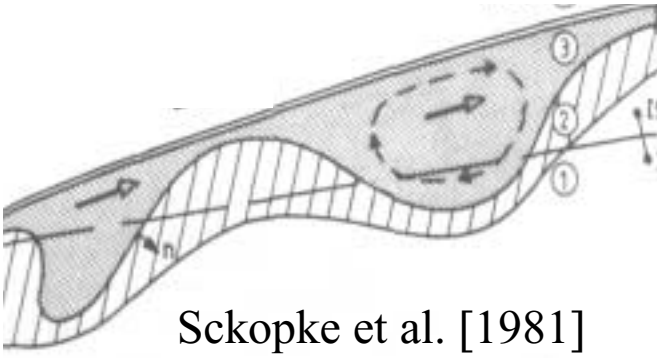
* Jets seen at every MP crossing by all spacecraft.

* S/C 4 stayed longer in MP, detected jets longer.

-> Continuous reconnection. Jets persist even when S/C exits MP

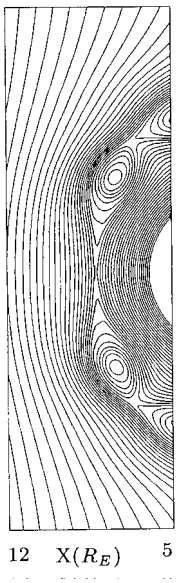
Partial MP crossings: Evidence for Bulges





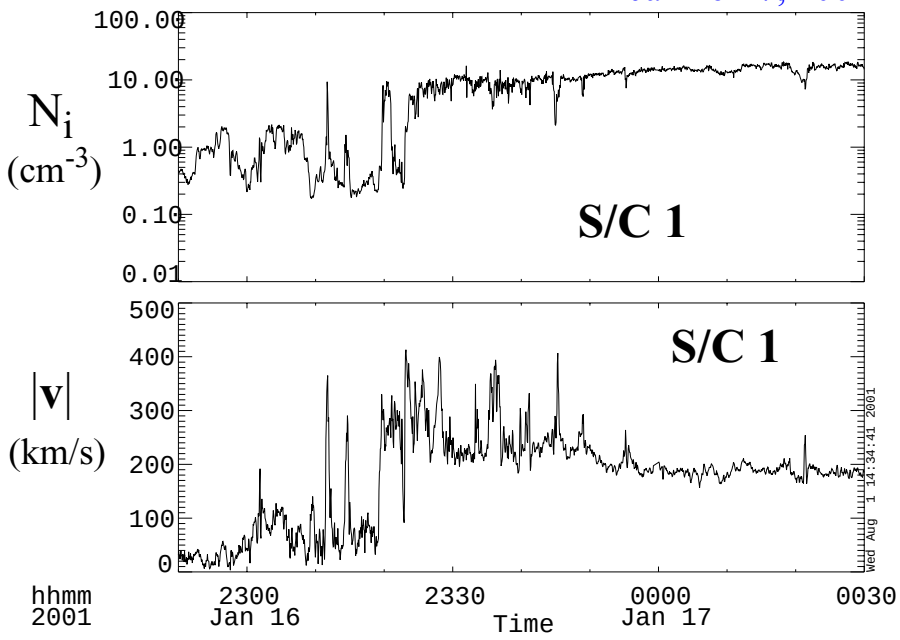
Sckopke et al. [1981]

Shi et al. [1988]

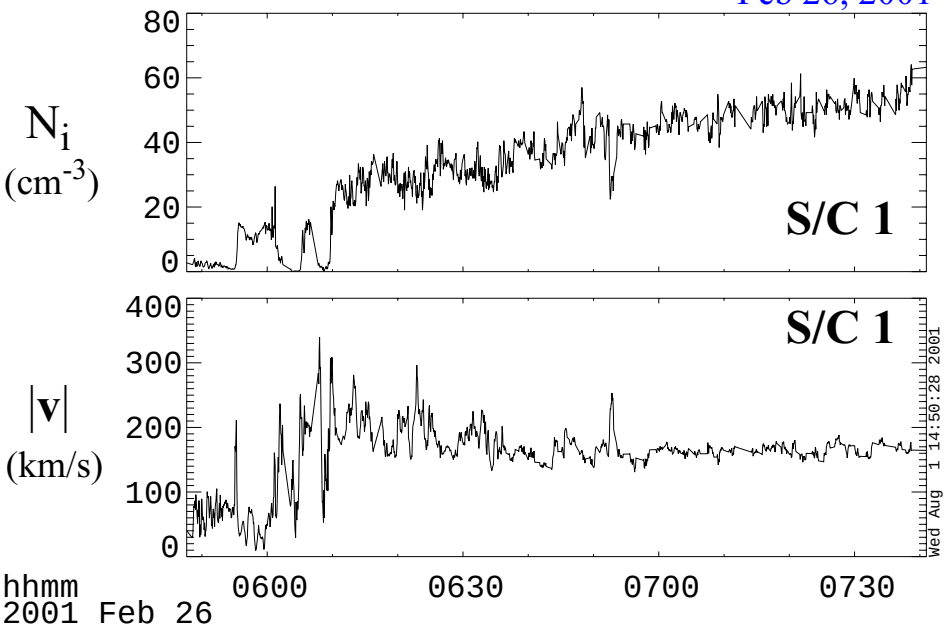


More Examples: Other Passes

Jan 16-17, 2001



Feb 26, 2001



Summary

* High quality CIS and FGM data for MP investigations

* Excellent Walen relation at most MP crossings-> Reconnection

* The reconnection site appears stationary for steady IMF

  -> Reconnection site (including FTE) controlled by IMF

* Continuous (perhaps not steady) reconnection embedded in bulges propagating along the MP -> FTEs?