Multipoint Study of Solar Wind at Solar Minimum

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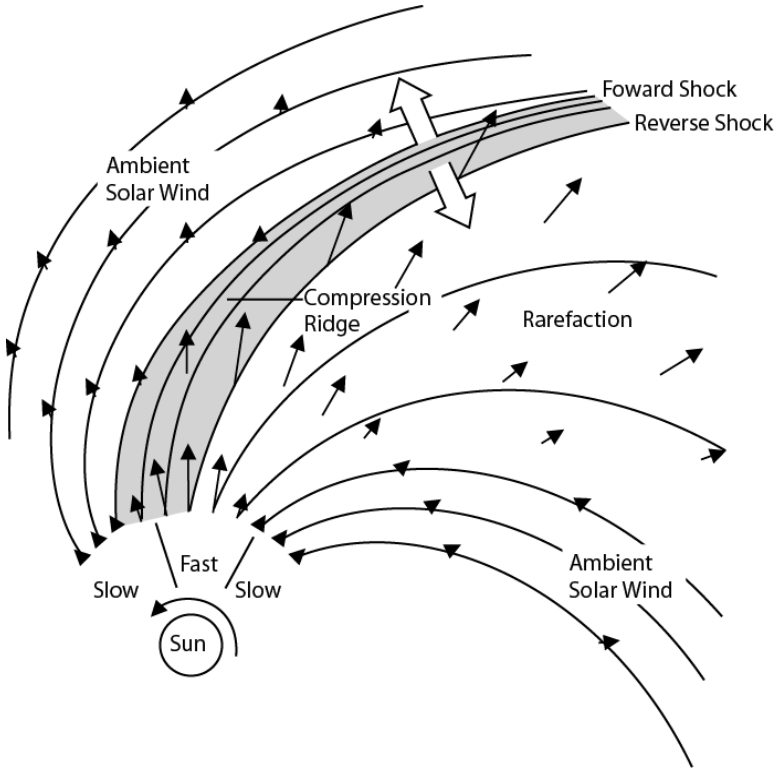
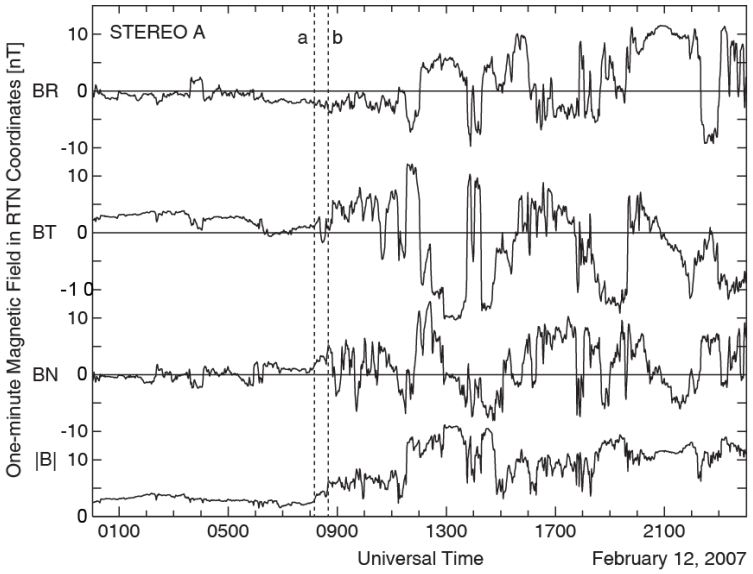
STEREO SWG

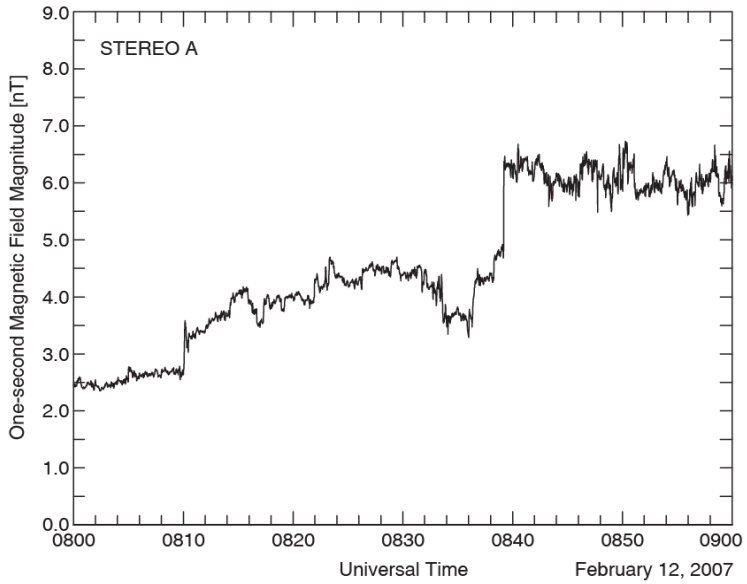
Caltech Nov.14, 2007

Interplanetary Shock Genesis at 1 AU Due to Stream Interaction

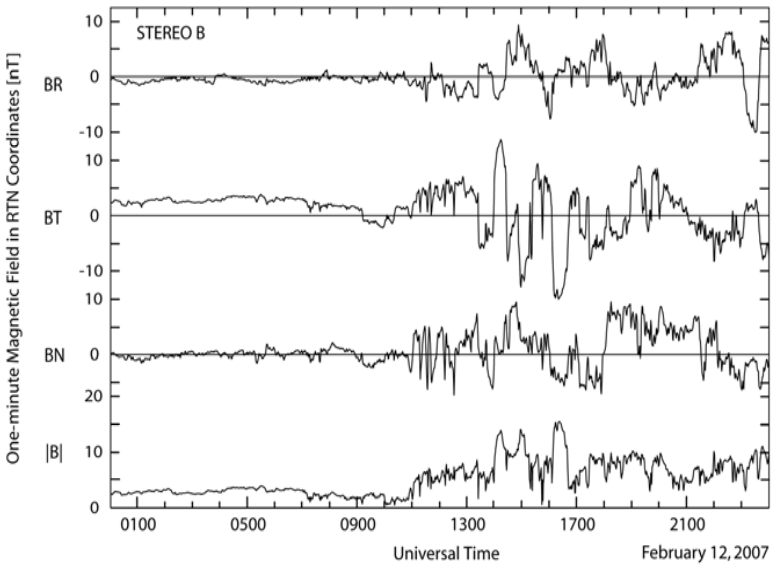


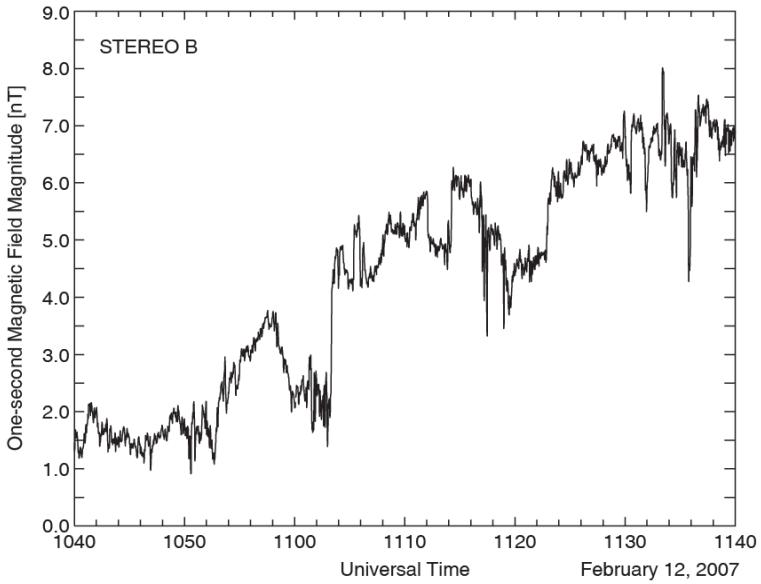
STEREO A



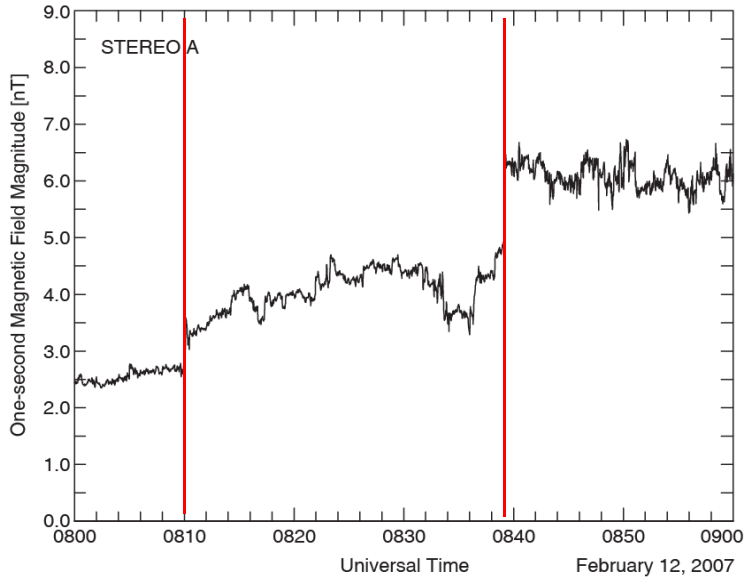


STEREO B

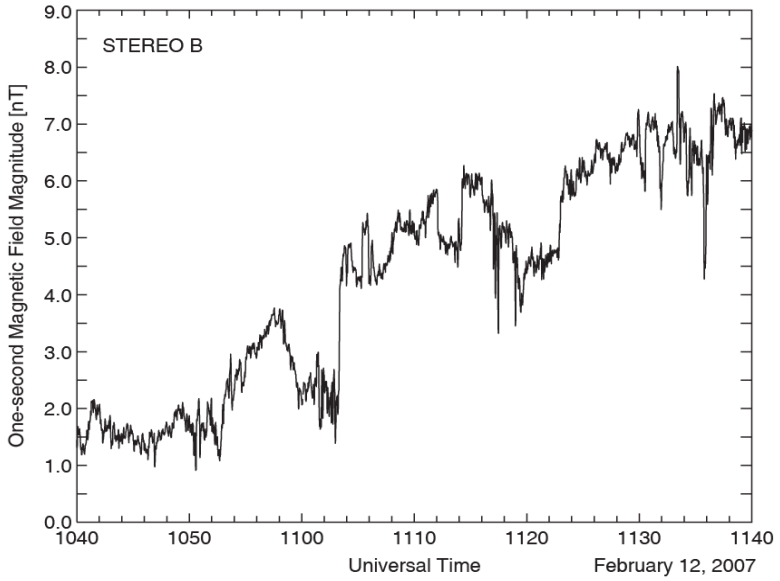




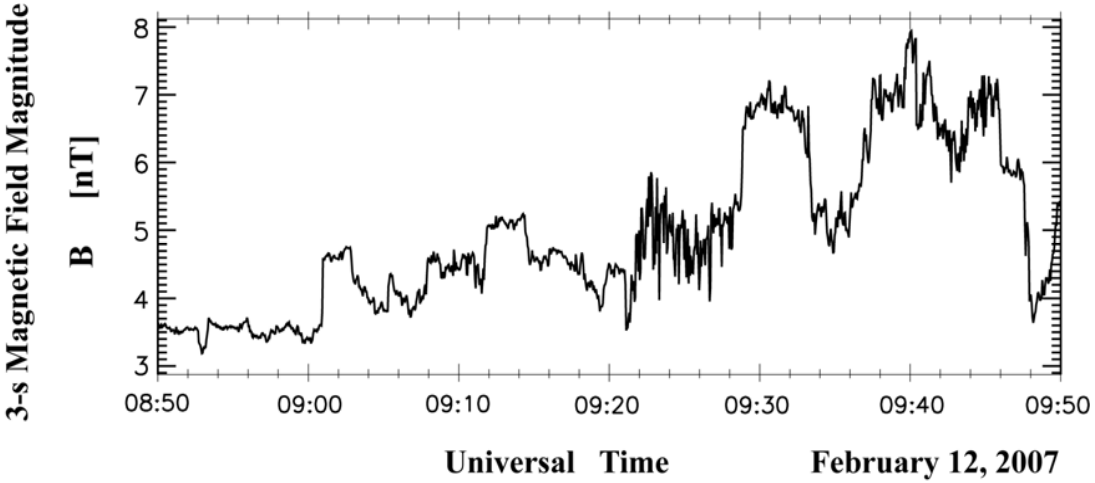
STEREO A

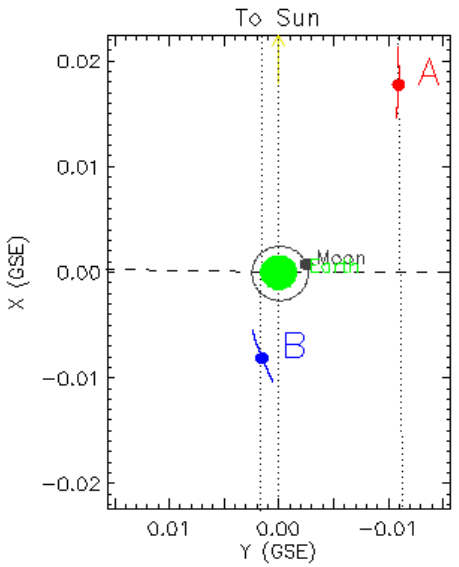


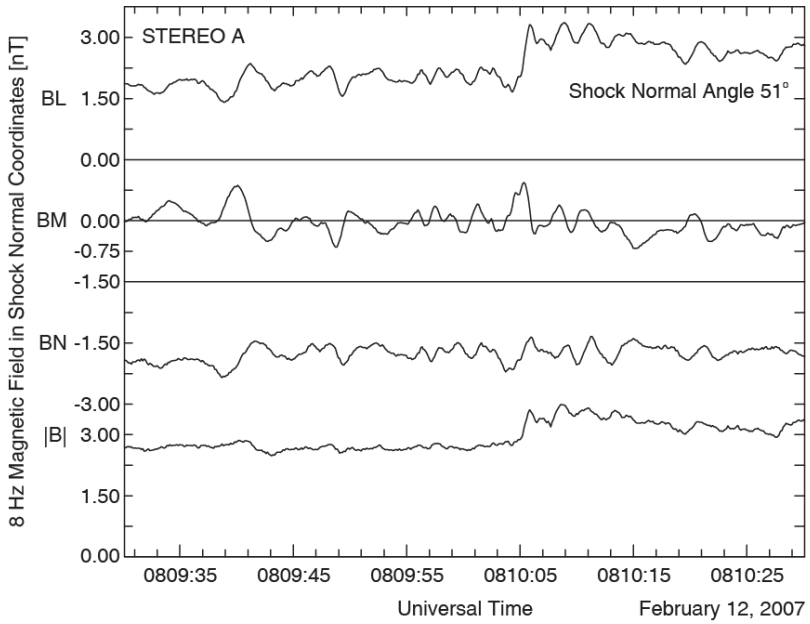
STEREO B

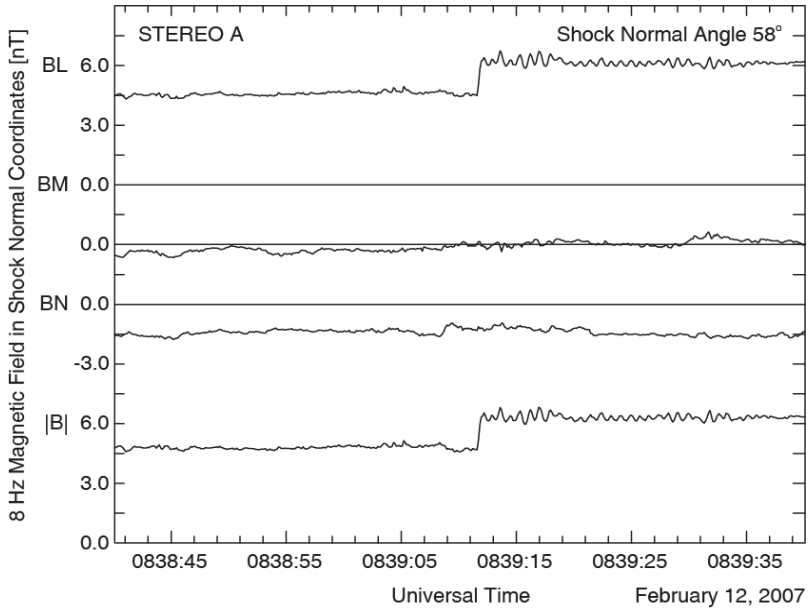


Wind









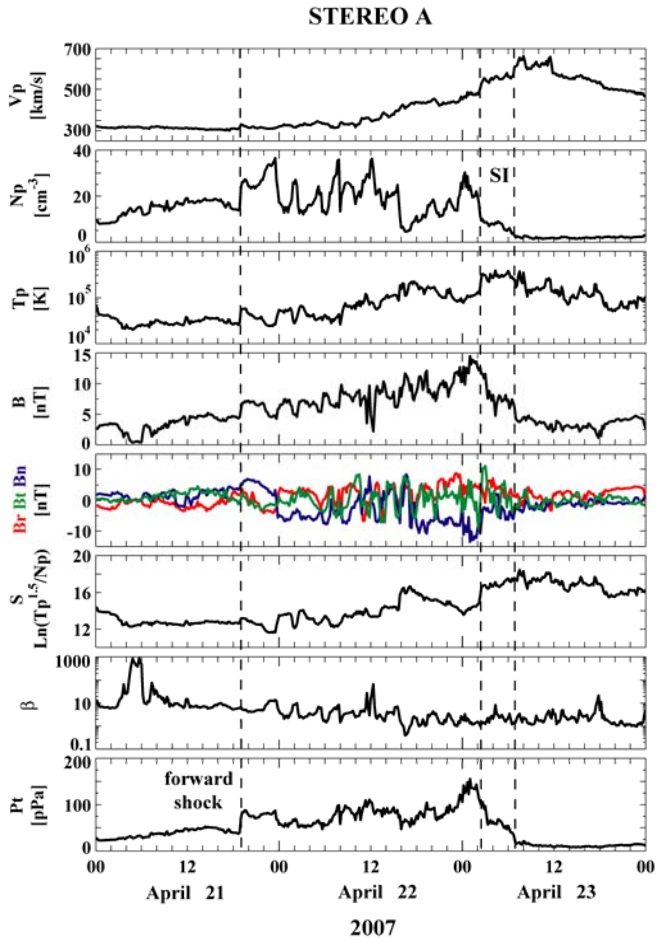
Shock normal:

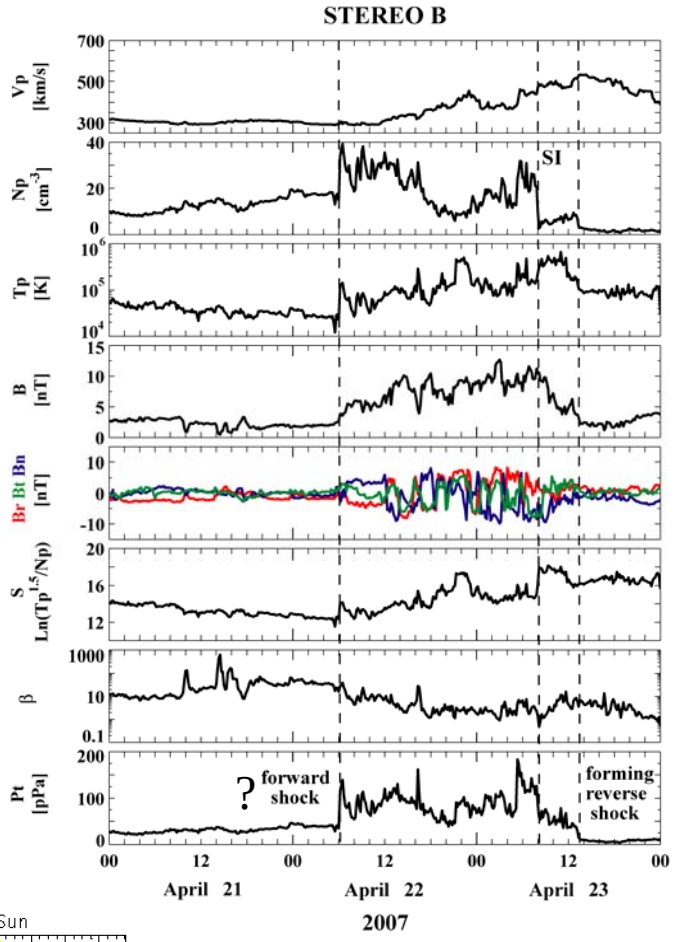
$\mathbf{N}_1 = 0.91\mathbf{R} + 0.37\mathbf{T} - 0.20\mathbf{N}$

$\mathbf{N}_2 = 0.93\mathbf{R} + 0.30\mathbf{T} + 0.22\mathbf{N}$

The normal directions of the two forward shocks at STEREO A were similar. They might eventually form a single forward shock leading the SIR.

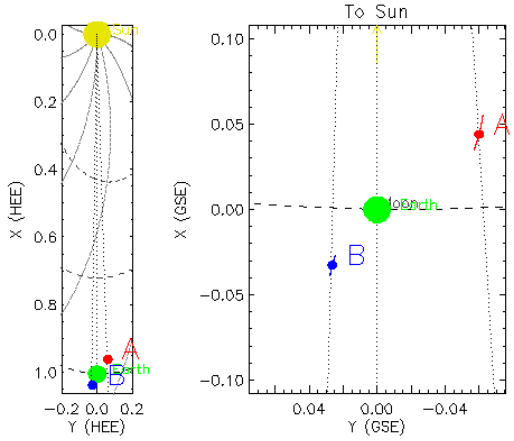
Multipoint Study of Stream Interaction Region (SIR)





Shock normal in **RTN** coordinates

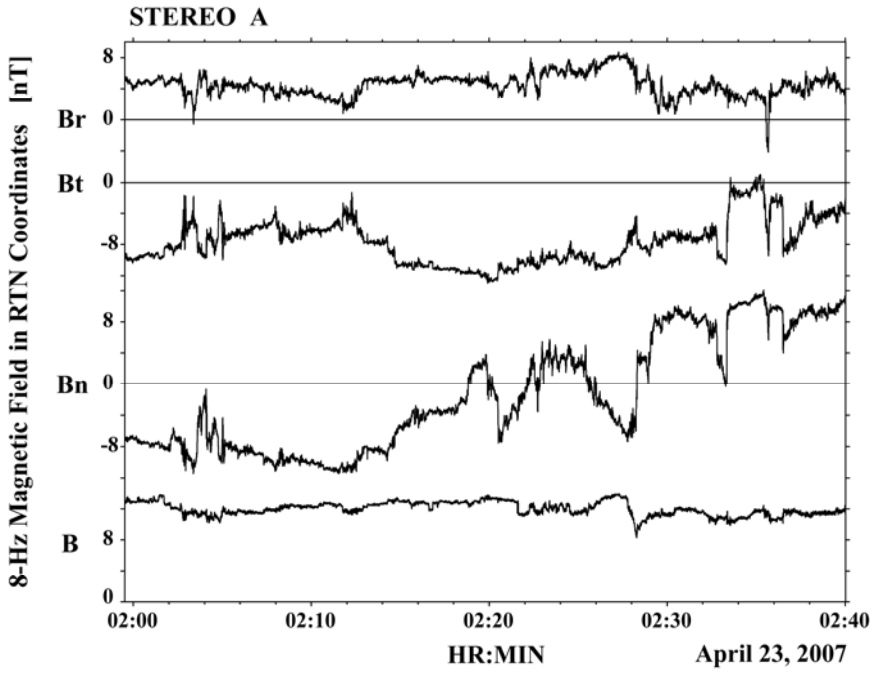
A: 0.64**R**+0.04**T**-0.77**N**
B: 0.16**R**-0.32**T**+0.94**N**
The shock at B is ambiguous, possibly an Earth's bow shock

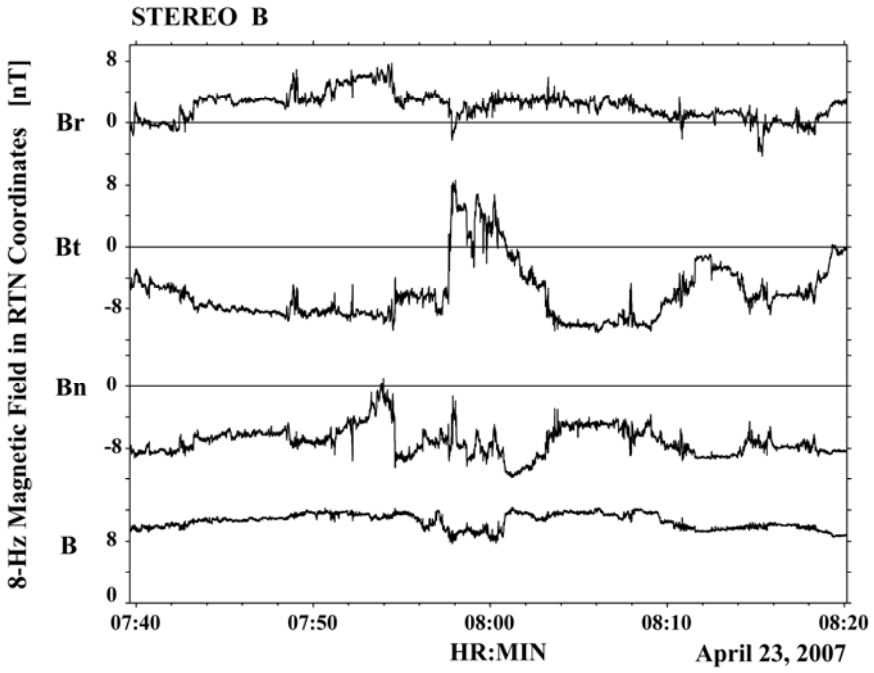


Stream interface (**SI**) in **RTN** coordinates

A: 0.84**R**+0.54**T**–0.04**N**
B: 0.98**R**–0.05**T**+0.17**N**

Magnetic Field Near Stream Interface

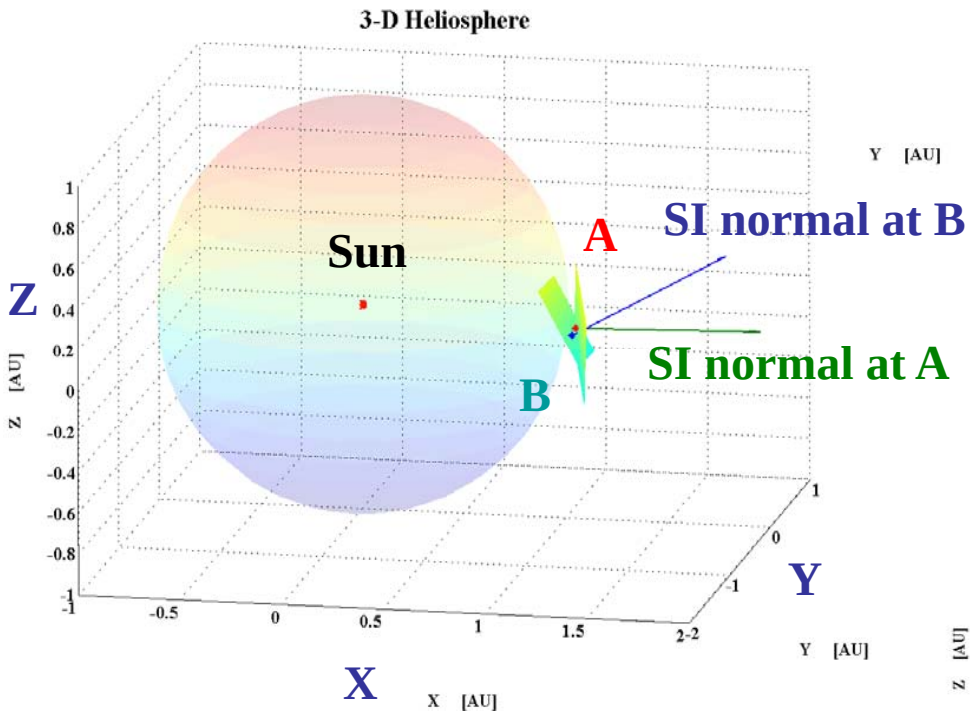


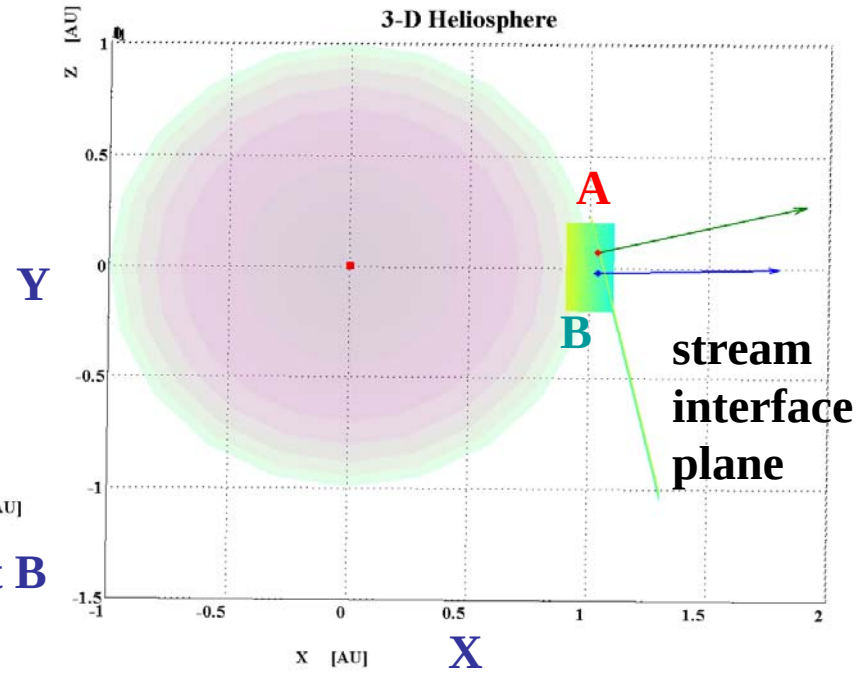


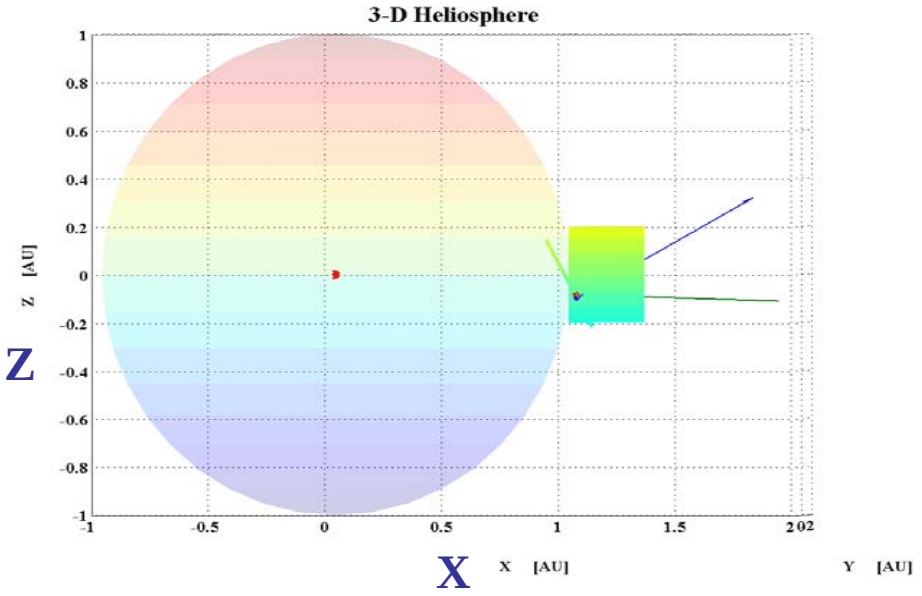
Hard to point out the clear stream interface

Stream interface (SI)
in **RTN** coordinates

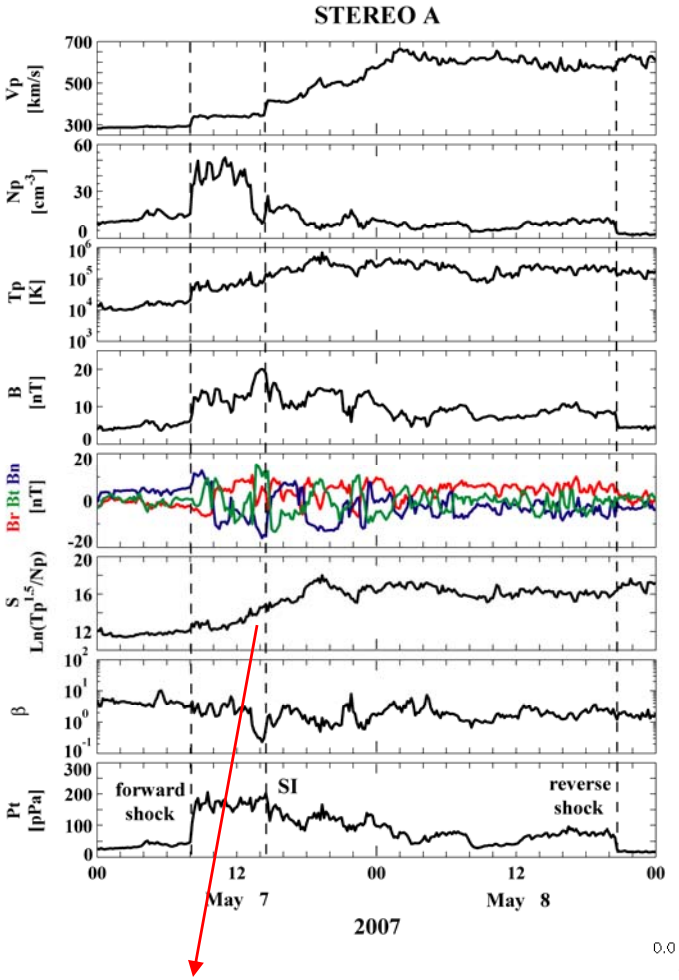
A: 0.84**R**+0.54**T**–0.04**N**
B: 0.98**R**–0.05**T**+0.17**N**

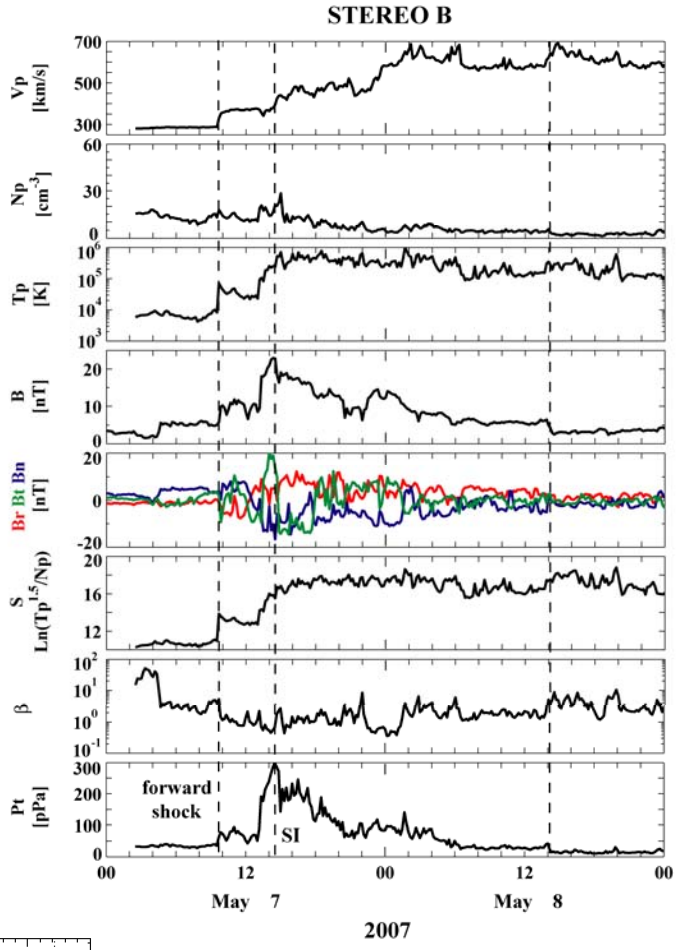




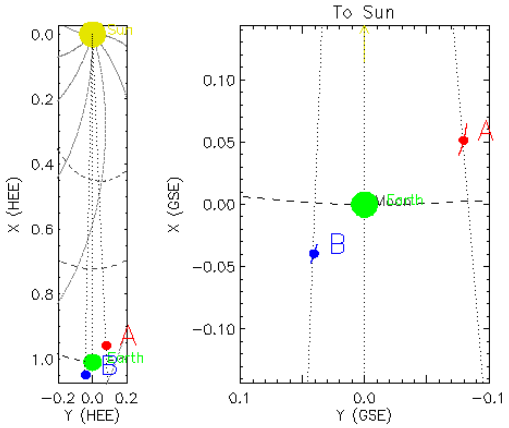


The angle between the two interfaces was about 37.9º





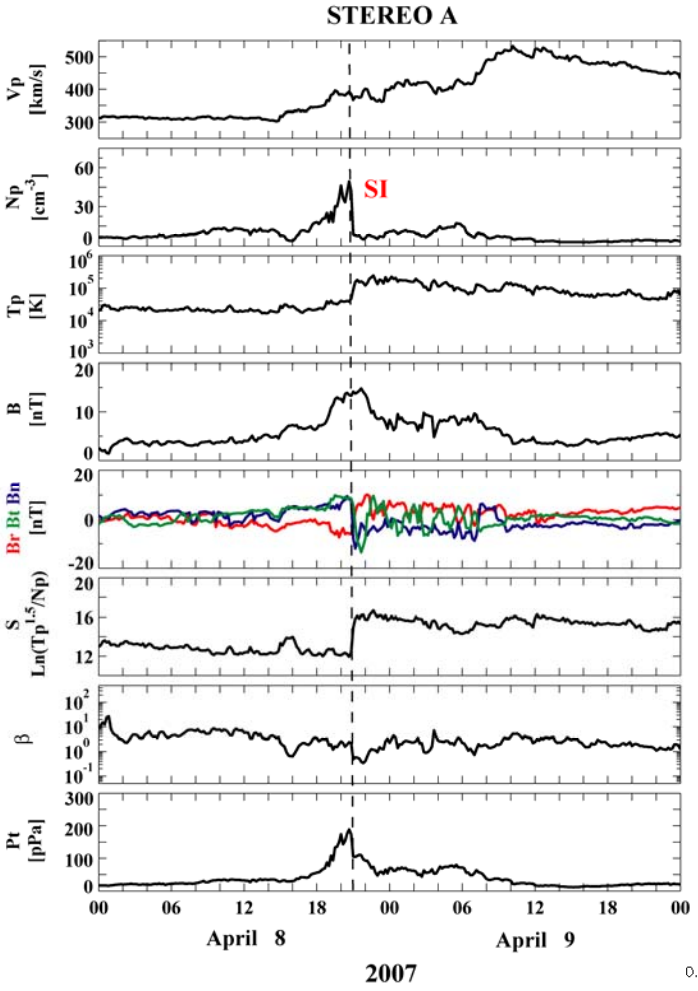
gradual increase of entropy suggests the existence of the dissipation between streams

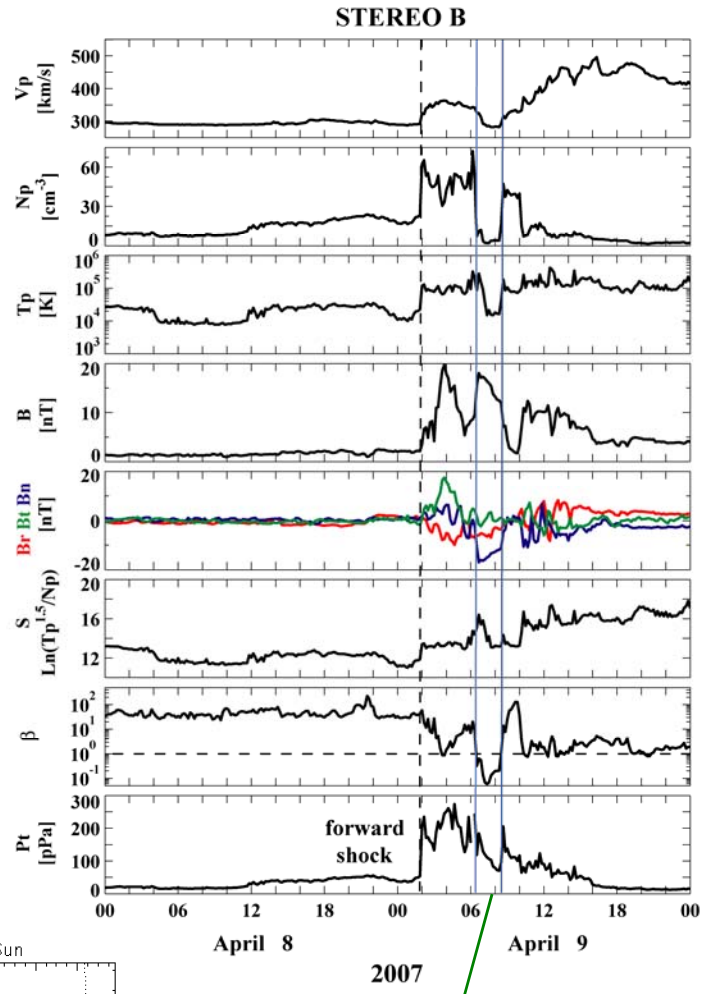


Shock normal in **RTN** coordinates

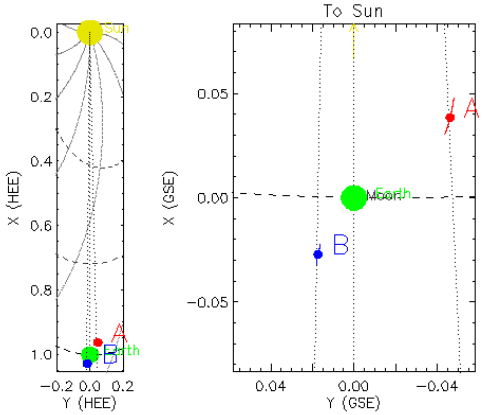
A: 0.85**R**+0.50**T**-0.17**N**

B: 0.86**R**+0.49**T**+0.13**N**

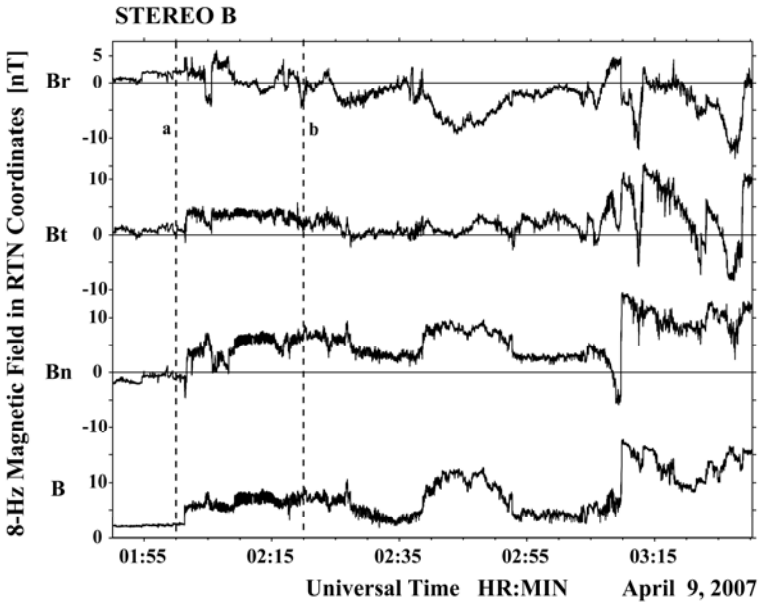




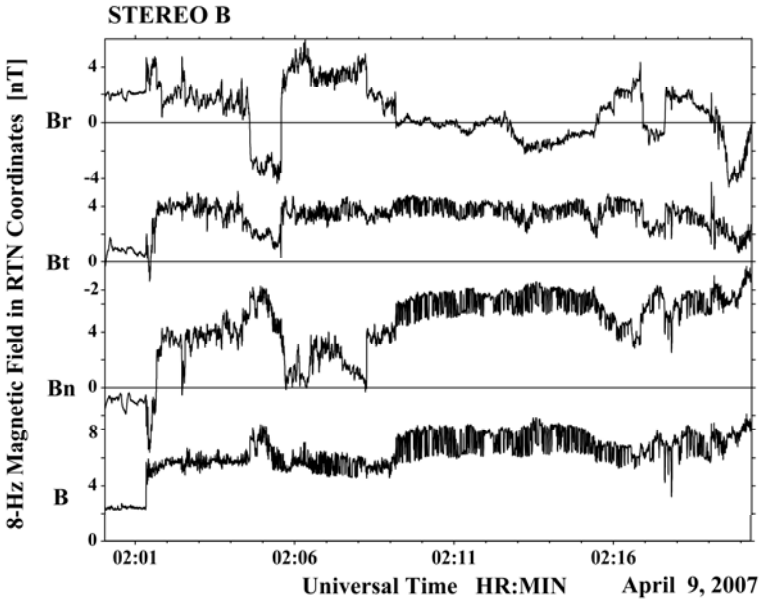
SI: 0.86**R**+0.06**T**+0.51**N**

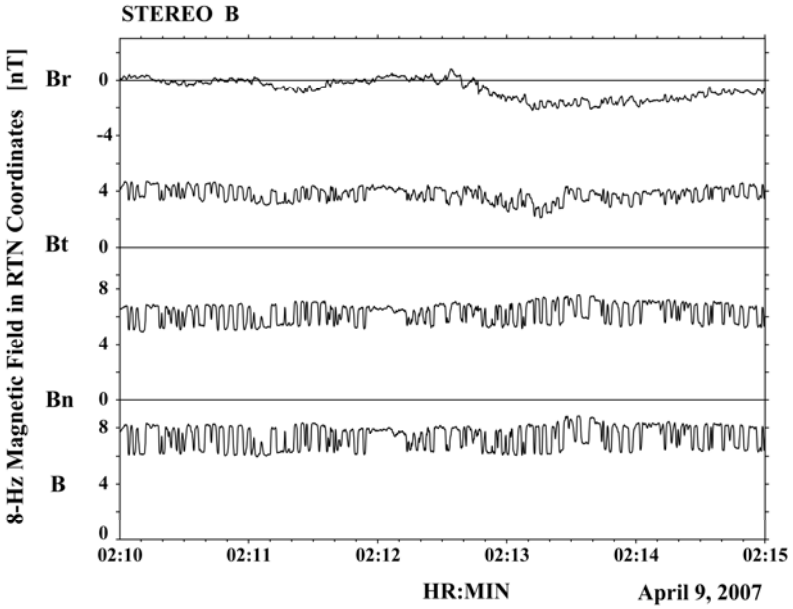


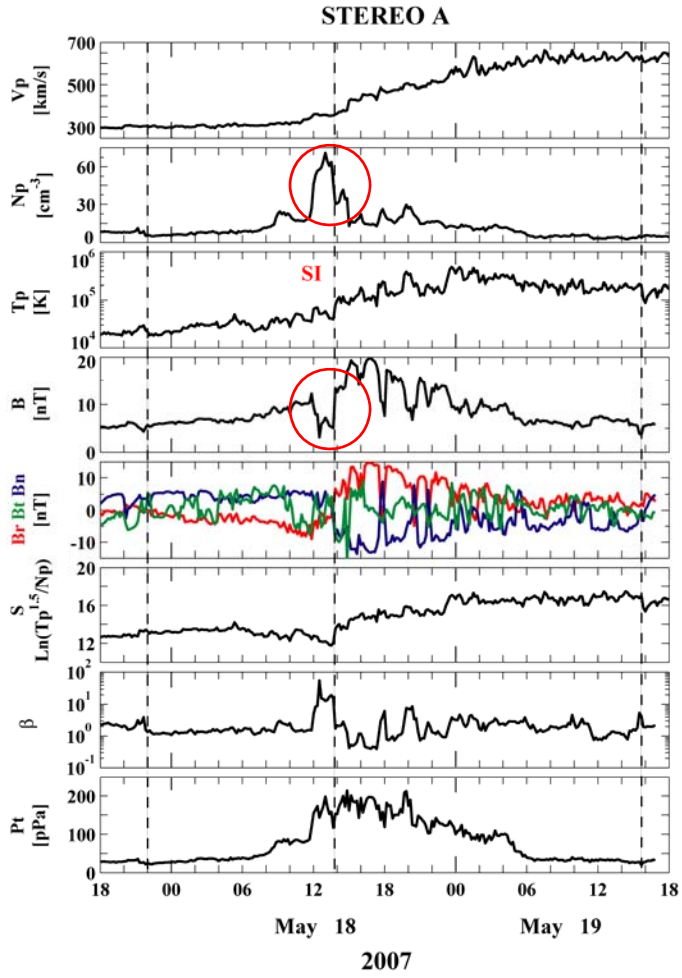
Probably a small flux rope with low Np, Tp, and high B

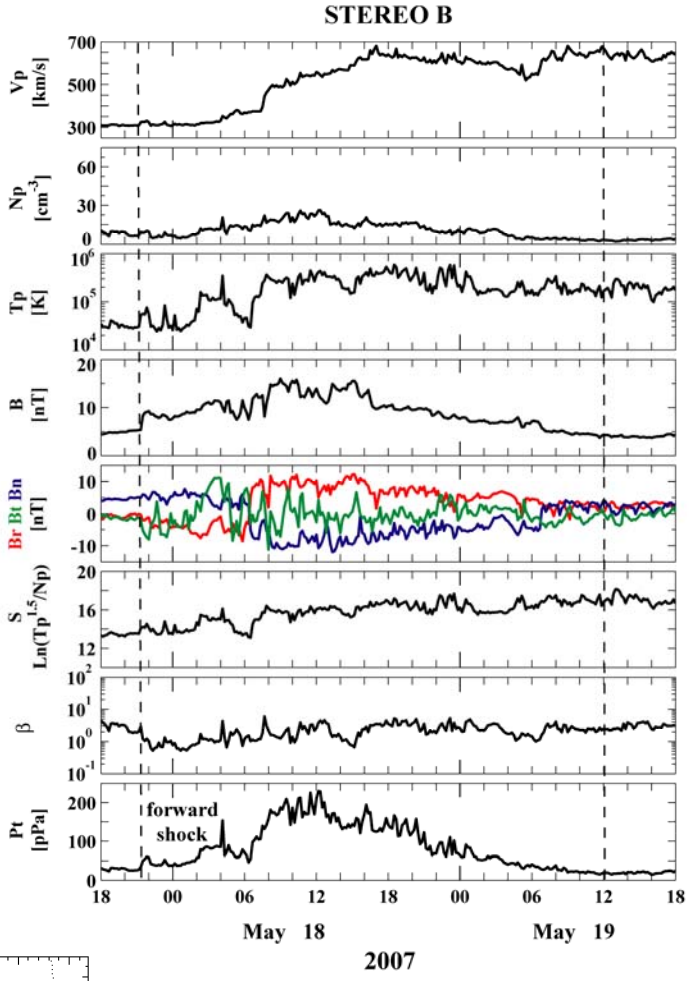


- STEREO B was at about (636, 408, 81) R_E in GSE coordinates
- It observed frequent passes of Earth's bow shock (~2s once)
- Consistent with the flare angle of the Earth's bow shock becoming much larger under a strong solar-wind magnetic field strength

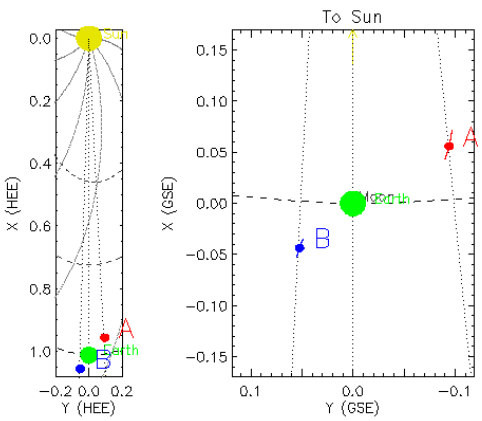








SI: 0.70**R**–0.37**T**+0.62**N**

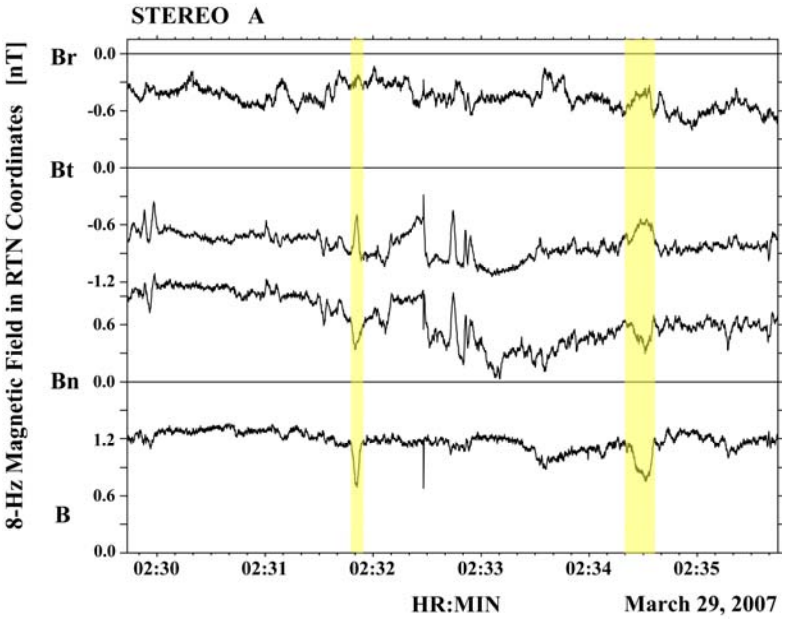


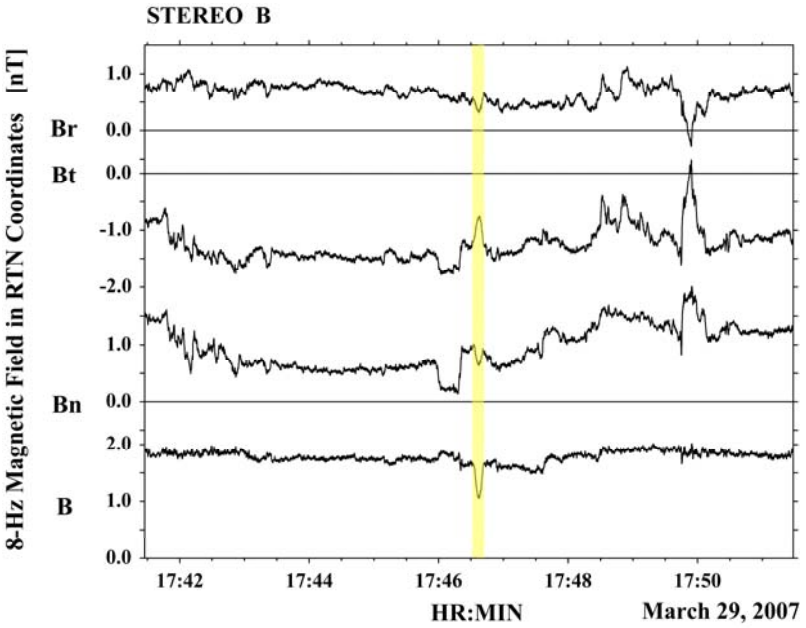
Summary of Mulitpoint Observations of SIRs during Feb – May of 2007

- ✓ **Most SIRs appeared earlier at STEREO A than STEREO B ➔ the radial propagation time from A to B spacecraft was longer than the corotation time from B to A spacecraft for SIRs**
- ✓ **Shock association with SIRs differ between the two spacecraft, but not necessarily more shocks at B spacecraft, which observed SIRs often later**
- ✓ **The plasma properties and magnetic field within the SIRs could differ significantly at the two locations for some events**
- ✓ **The temporal profiles of the combined parameters (entropy and Pt), could also change much from A to B spacecraft**
- ✓ **Heliospheric current sheet crossings were observed at several SIRs**
- ✓ **The stream interfaces did not strictly follow the Parker spiral, and the shock driven by SIRs near 1 AU should be of small scales and somewhat transient.**

Small-Scale Structures

Magnetic Holes

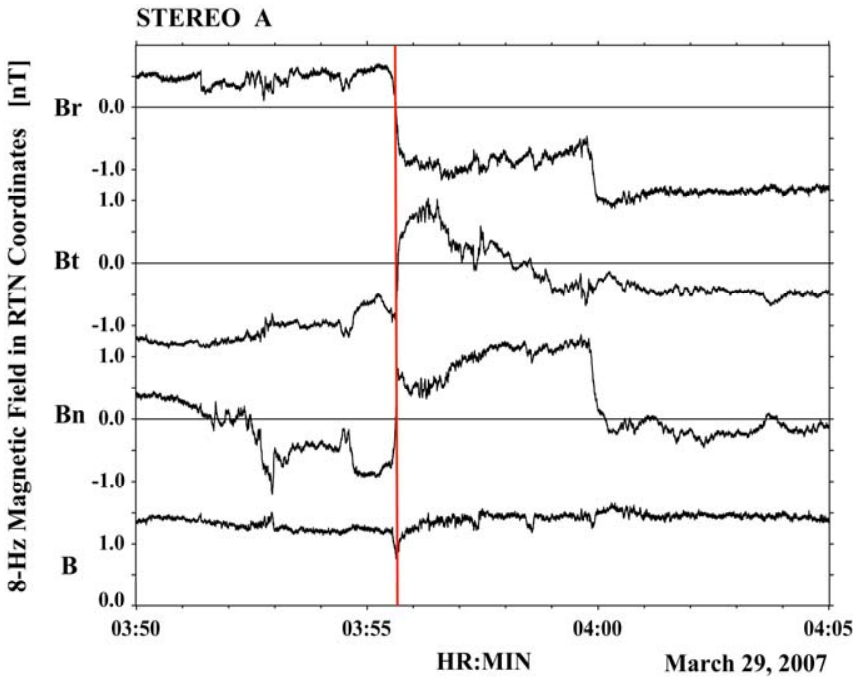


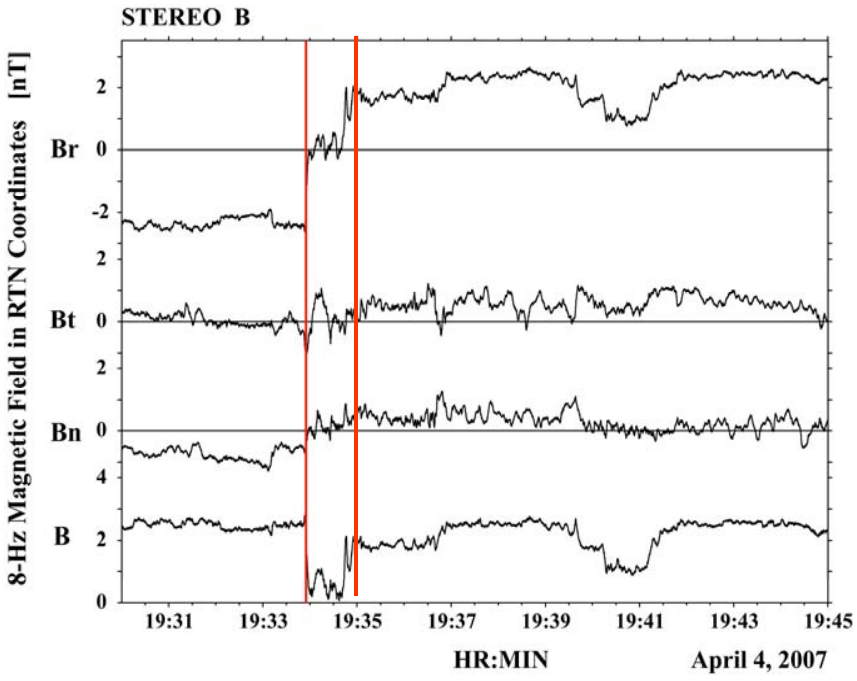


To study

- **the occurrence rate and the properties of magnetic holes vs. the plasma properties**
- **the variations of the occurrence rate and properties of magnetic holes from STEREO A to B spacecraft**

Discontinuities

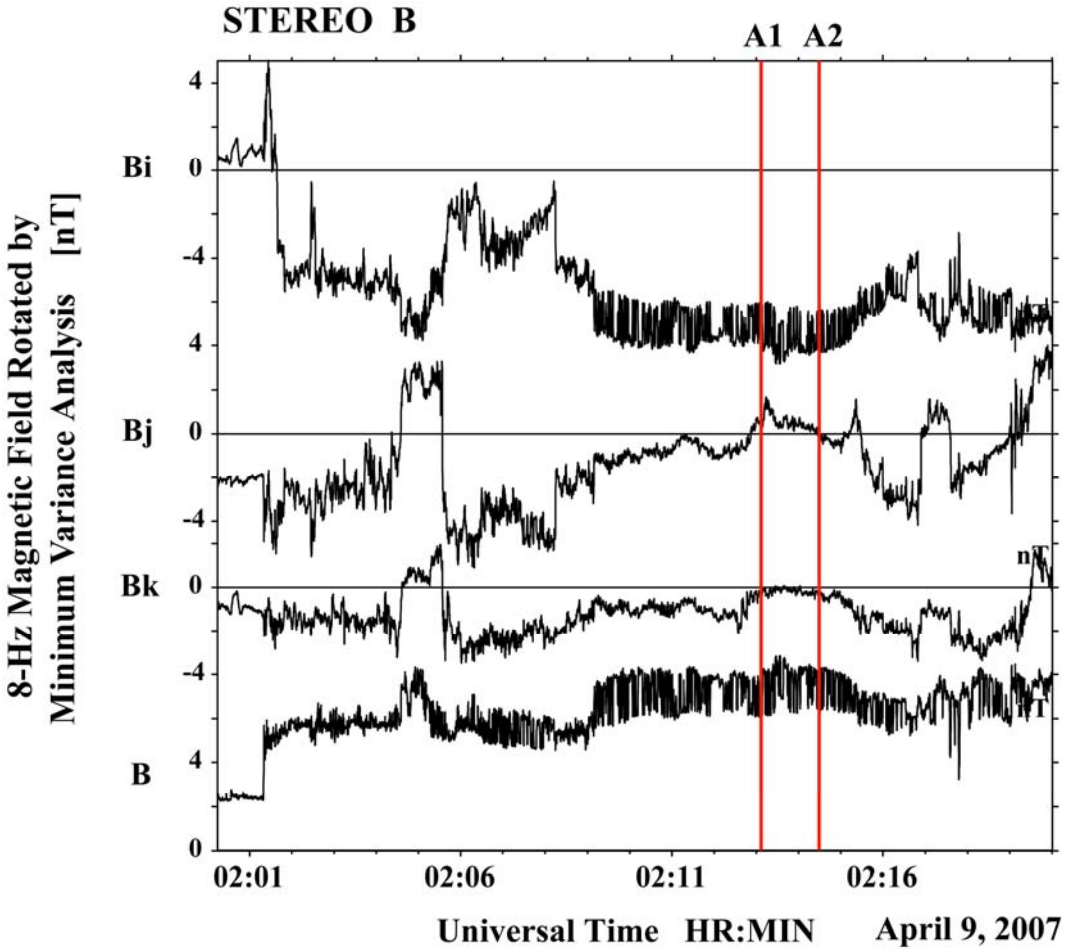




B1 ^ B2 = 158^{O}

B1 ^ B2 = 162^{O}

Backup


STEREO B
A1
A2
8-Hz Magnetic Field Rotated by
Minimum Variance Analysis [nT]
Bi
Bj
Bk
B
4
0
-4
4
0
-4
4
0
-4
4
0
nT
02:01
02:06
02:11
02:16
Universal Time HR:MIN
April 9, 2007

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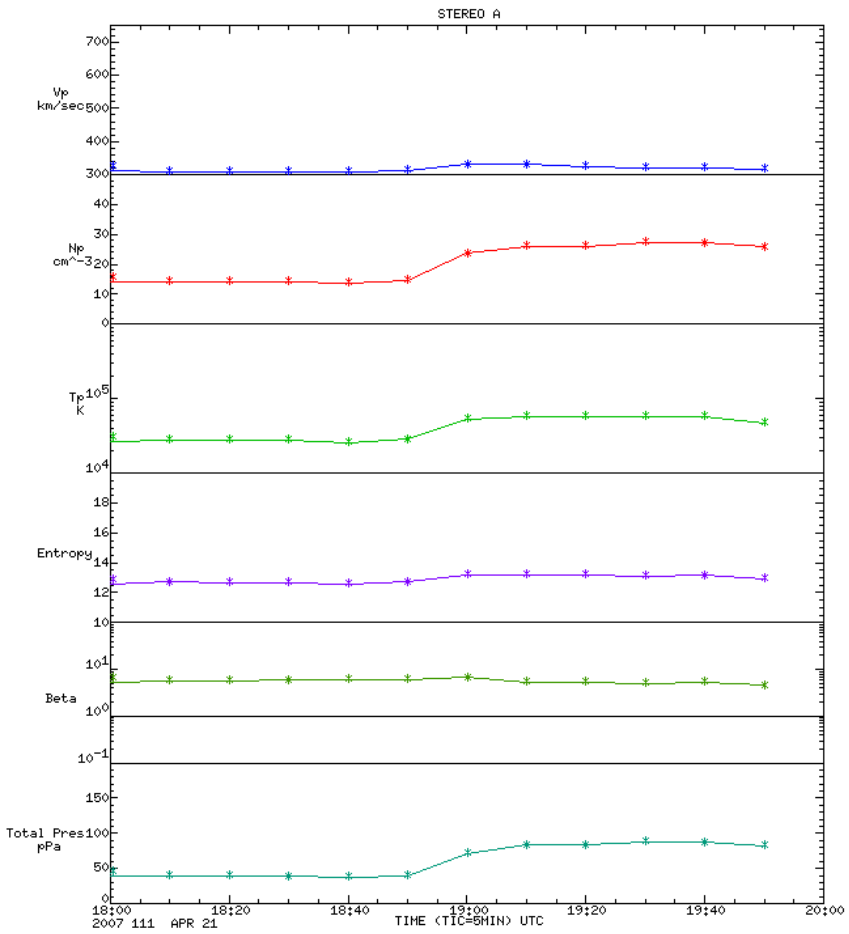

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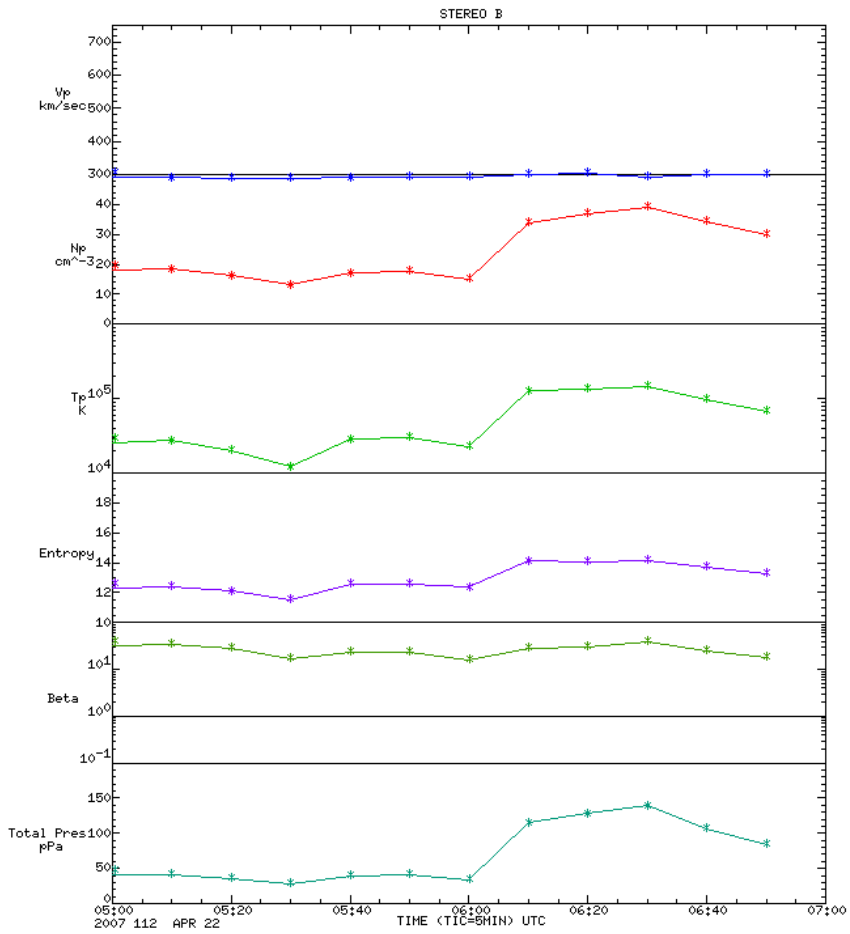

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