

# Summary Shock List Since 1996

Aim: To consolidate several of the existing shock lists into a “working list” of shocks and their properties to compare with energetic particle observations. Help to fill gaps in individual lists.

Incorporates:

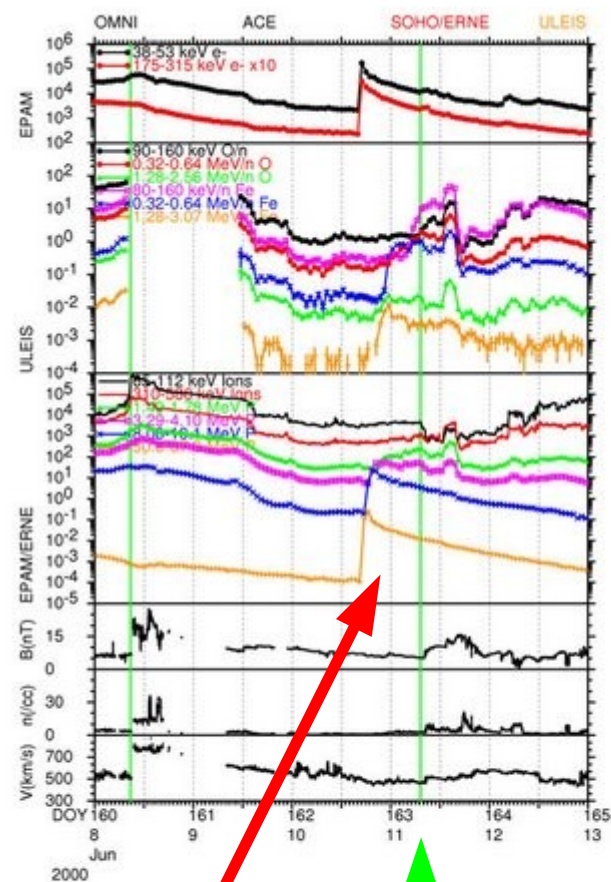
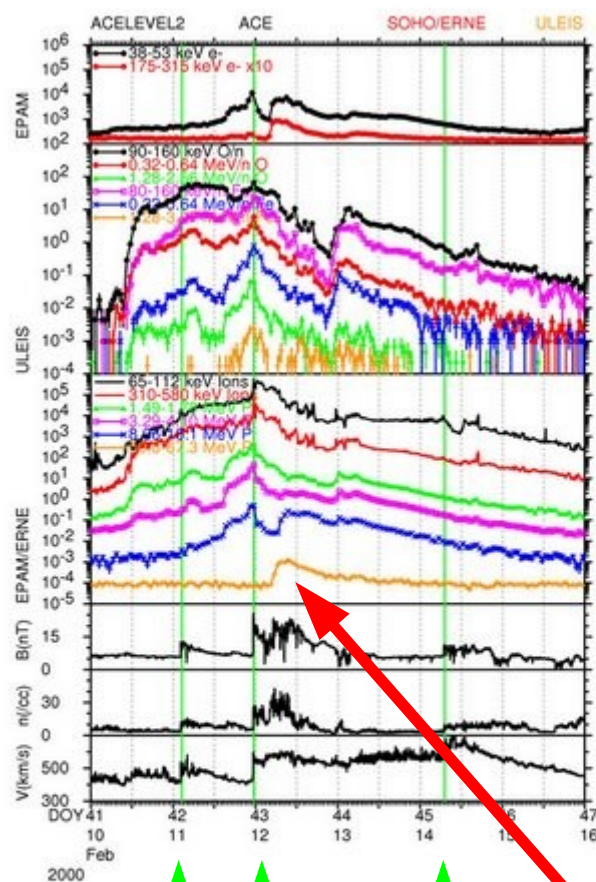
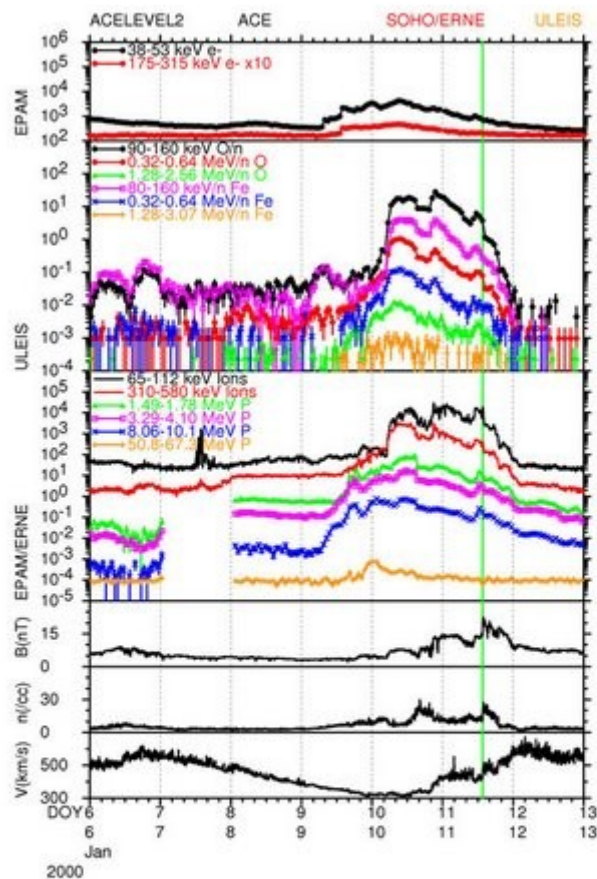
- Kasper Shock database;
  - ACE shock list;
  - SOHO “Shockspotter” list (plasma only; confident identifications are usually on other lists; weak identifications are not usually shocks (e.g., tangential discontinuities)
  - Geomagnetic storm sudden commencements. Often associated with shock passage, but not always (e.g., may be discontinuity)
  - Berdichevsky et al. (2000) WIND list.
- 
- Scanned ~1 minute solar wind data (OMNI, ACE, WIND) to verify that each shock is evident
  - A few reported shocks could not be located, or were extremely weak and unlikely to be interesting from the particle viewpoint.
  - ~400 shocks (fast/slow/forward/reverse) in 1996 - 2007.

Generated a summary plot of plasma/  
field/energetic particle observations in the vicinity  
of each shock.

Plots are available at

<http://picasaweb.google.com/ihrich3/ShockPlots?authkey=mHeV2nGTEbg>

# Examples of plots



EPAM Electrons  
ULEIS Fe, O  
ERNE/EPAM Protons  
Solar wind B, n V.

Shocks

Unrelated  
SEP event

Shock

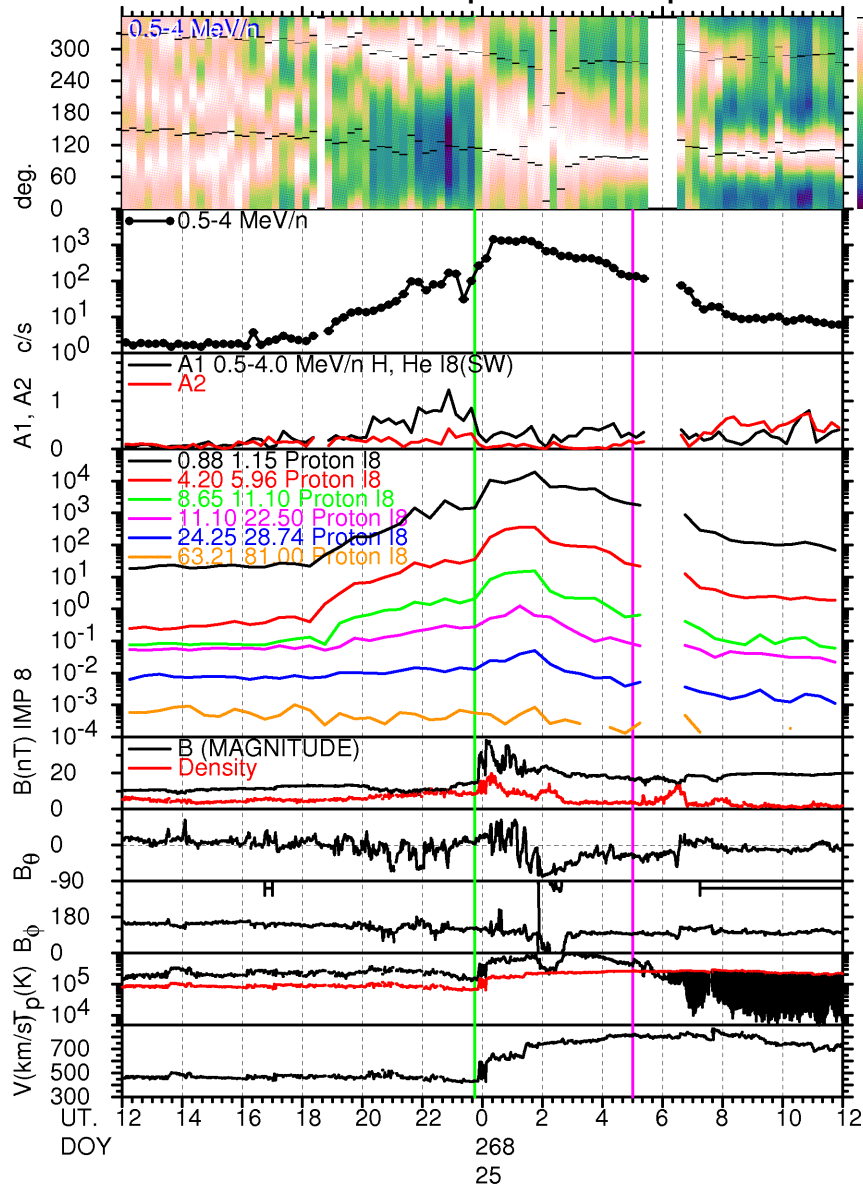
June 11, 2000

# Examples of IMP 8 Anisotropy Observations in the Vicinity of Shocks (0.5-4 MeV H + He)

September 25, 1998 (Cohen ESP Event)

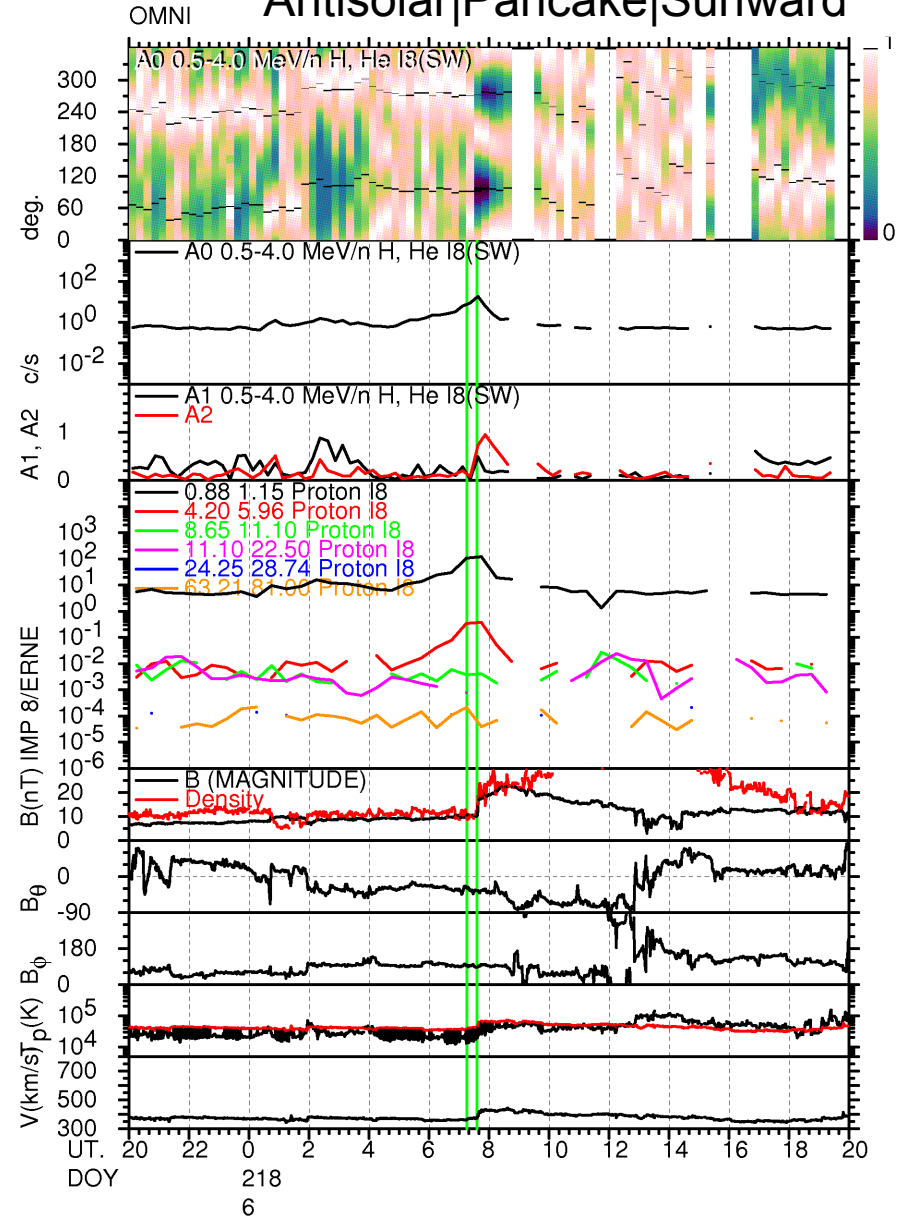
August 6, 1998 (Shock spike at quasi-perp. shock)

Antisolar | Sunward | Bidirectional



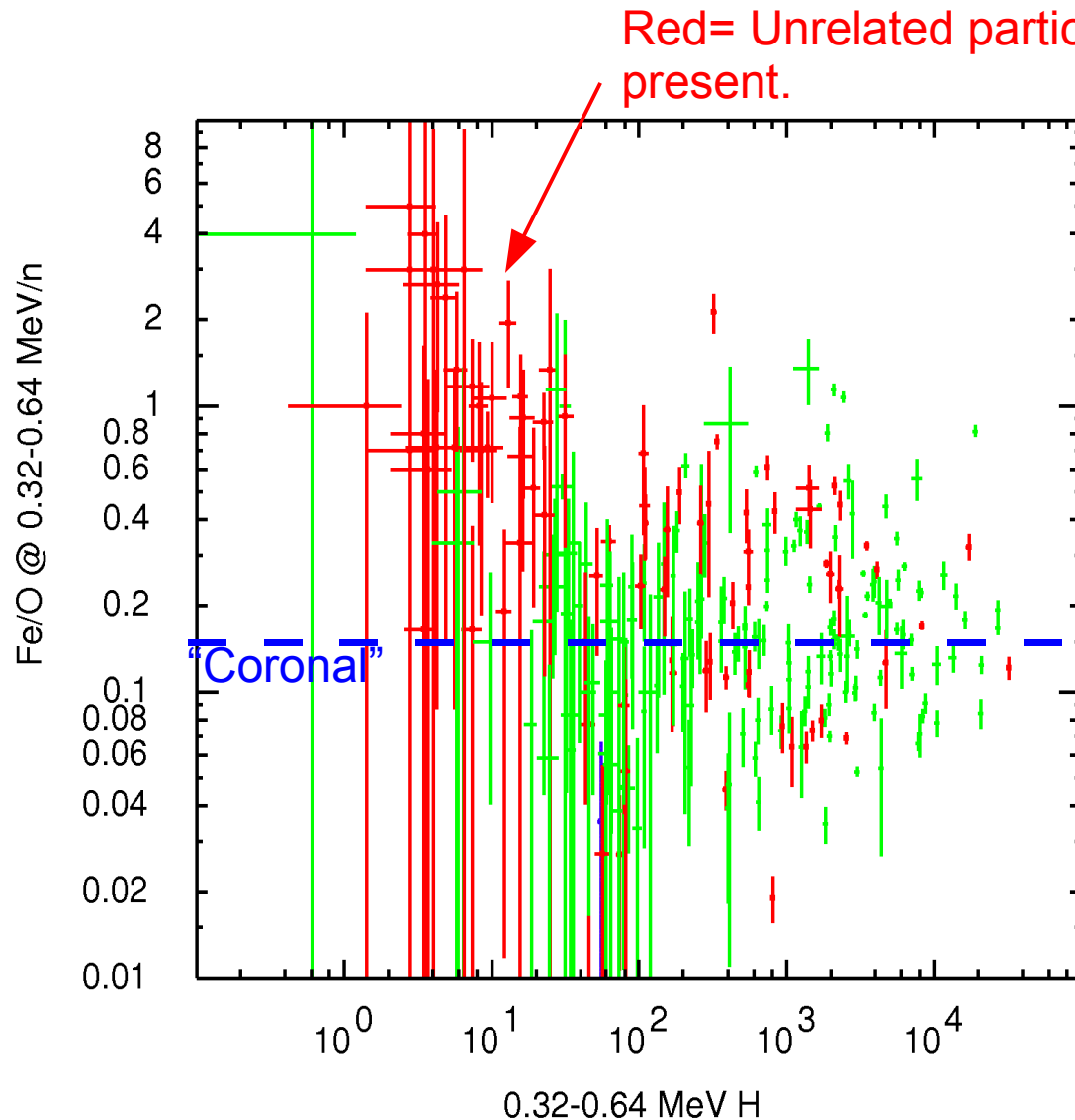
Sep  
1998

Antisolar | Pancake | Sunward



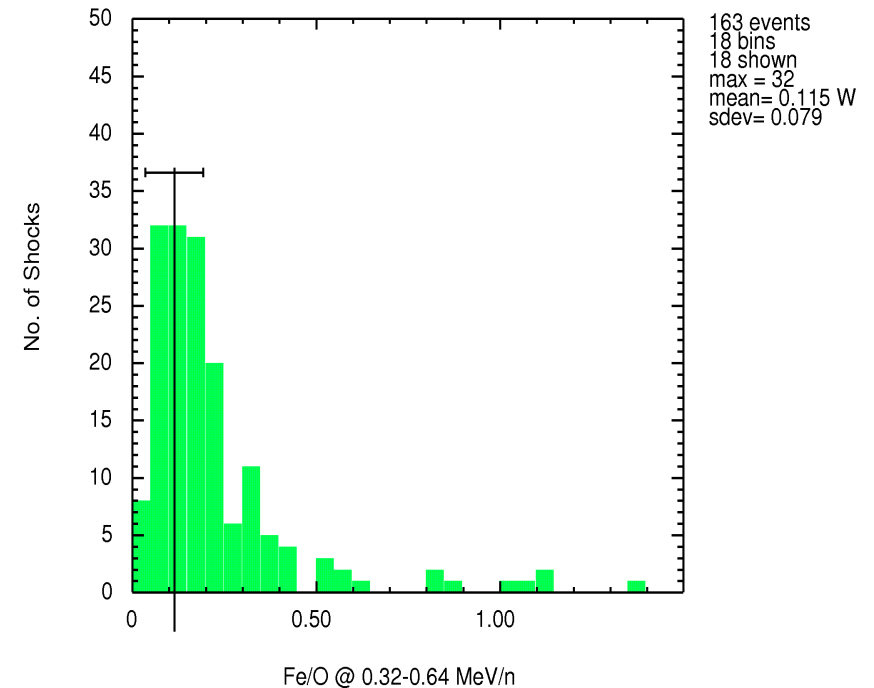
Aug  
1998

# ULEIS Fe/O at 0.32-0.64 MeV/n, 1 hour average at passage of 251 Fast Forward Shocks in 1998 - 2006

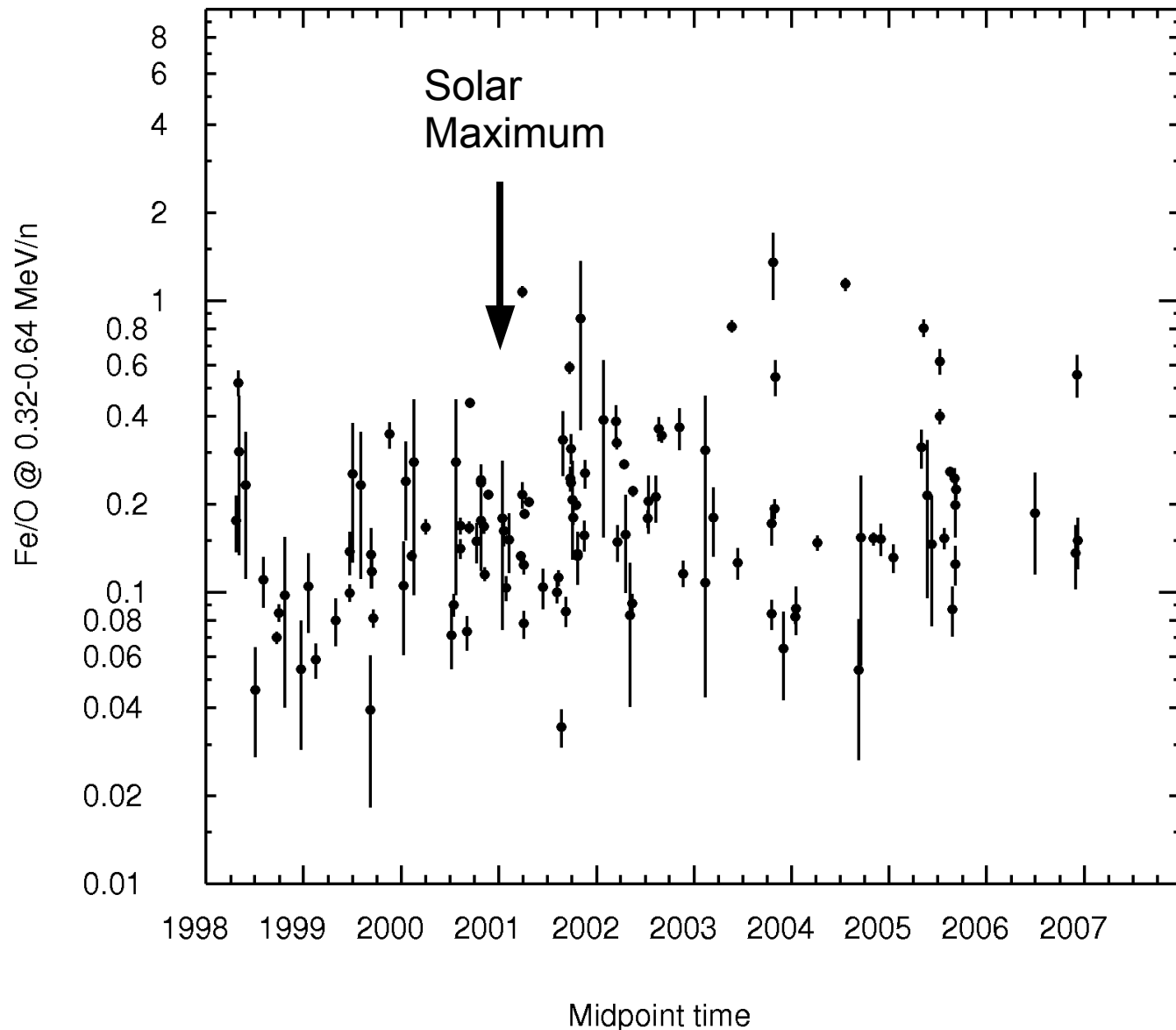


251 events

Mean Fe/O for 163 events without unrelated particles =  $0.115 \pm 0.006$



# ULEIS Fe/O at 0.32-0.64 MeV/n at Fast Forward Shocks in 1998 - 2006



No unrelated particles; large error points removed (value < 1.5 error)

Large values of Fe/O (>~0.5) are generally associated with most intense events, probably saturated.

But March 31, 2001 is Fe-rich throughout SEP event.

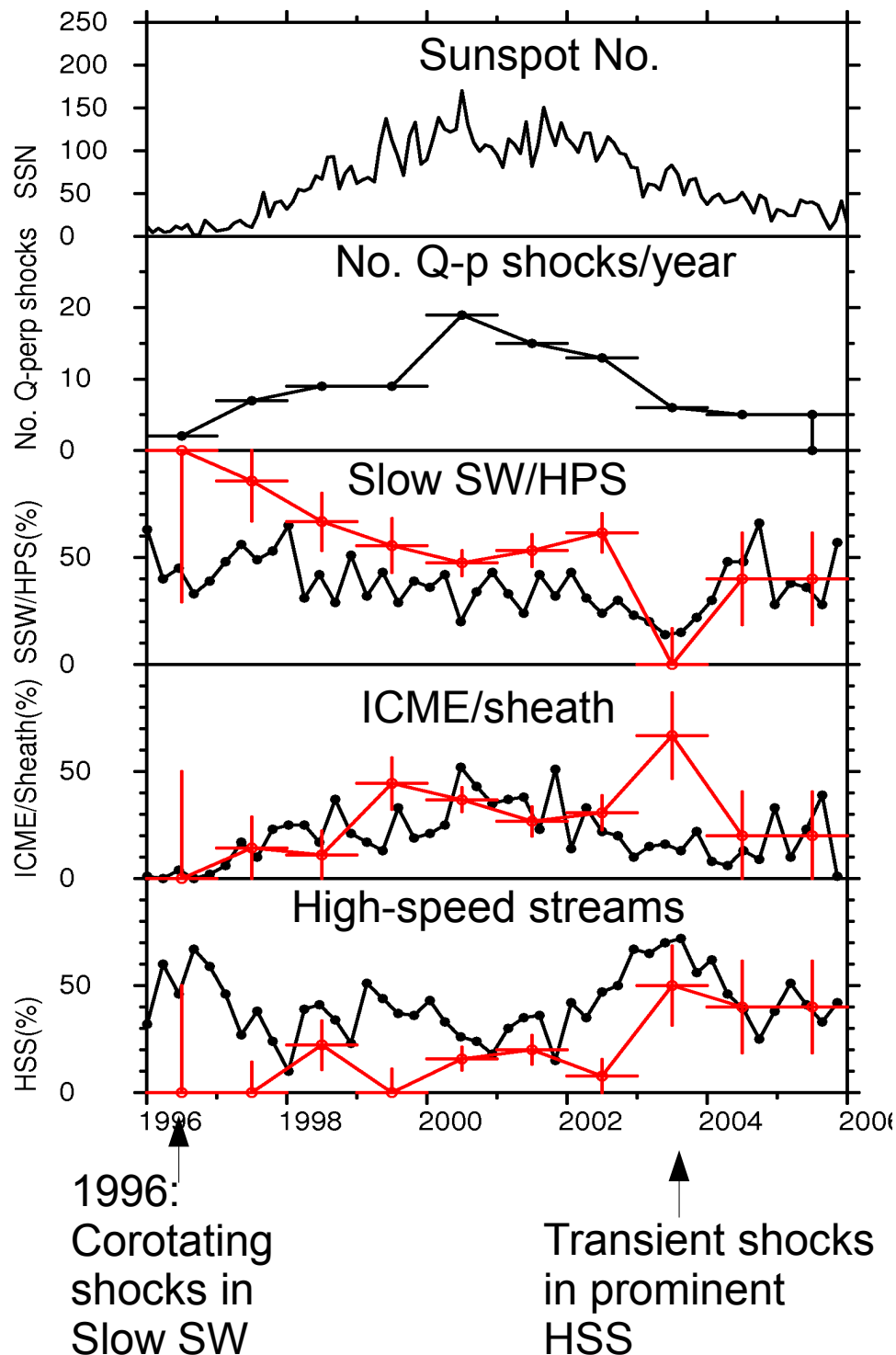
# Quasi-Perpendicular Shocks

- 94 shocks with  $\theta_{Bn} \geq 80^\circ$  in 1996-2005

Compiled from:

- Kasper shock list
- ACE shock list
- Evidence of shock spikes/pancake distributions in IMP 8  $\sim 1$  MeV ion observations (some do not have  $\theta_{Bn} \geq 80^\circ$ !)
- What solar wind structures are involved in producing quasi-perp. Shocks? (deviations from Parker spiral)





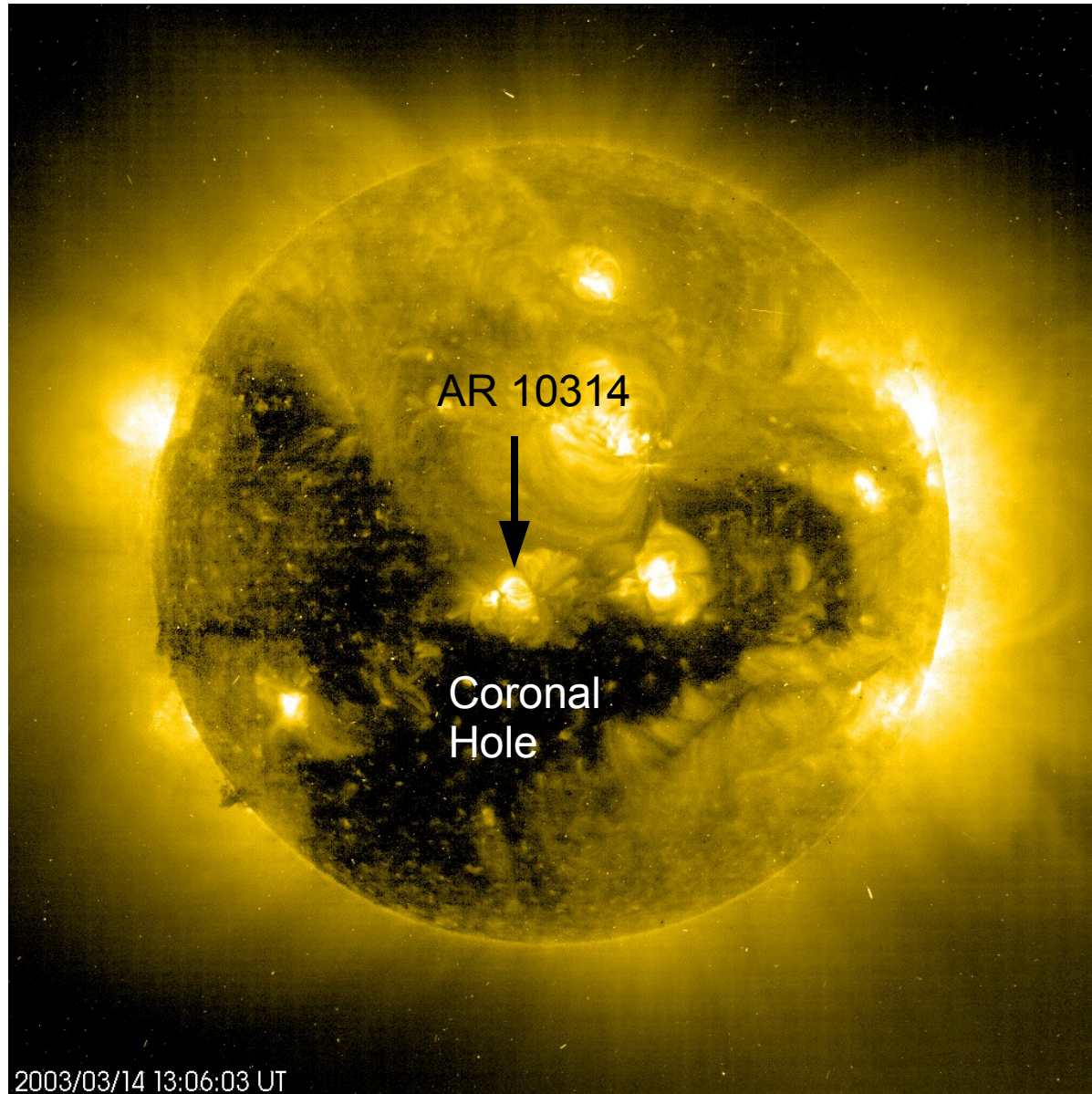
Percentage of Q-perp shocks propagating through slow solar wind, ICMEs/sheaths, high-speed streams in 1996-2005 (**red**) compared to the fraction of the near-Earth solar wind occupied by each type of wind (**black**; 3 Carrington rotations, updated from *Richardson et al.*, JGR, 2001).

Might expect ICMEs (with their deviant fields) to be especially important producers of Q-p shocks, but fraction of such shocks associated with ICMEs is largely consistent with the ICME occurrence in the SW.

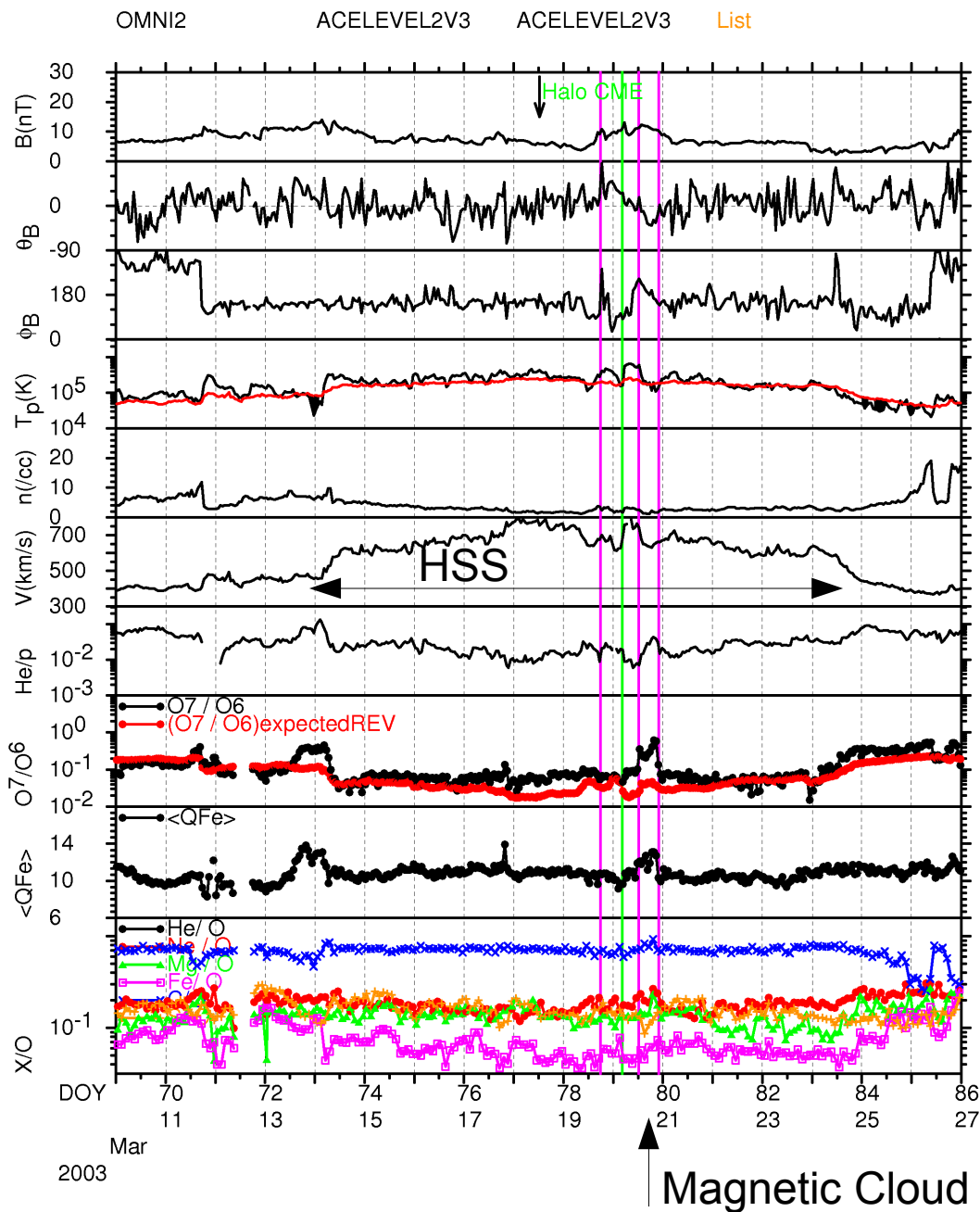
Shocks tend to avoid HSS (corotating shocks/no AR in coronal holes), but are seen in HSS during declining phase, when HSS are especially dominant (next slide)



# March 14, 2003: Y-shaped Coronal Hole With AR 10314 (source of Magnetic Cloud Observed in High-Speed Stream)



Berdichevsky,  
Richardson,  
Lepping, Martin,  
JGR 2004.



Shock (not q-perp!)/  
Magnetic Cloud on  
19-20 March, 2003  
propagating through  
~11 day duration  
high-speed stream  
from Y-shaped  
coronal hole (cf  
Berdichevsky et al.,  
2004)

March 10 - 27, 2003 Solar Wind

# Unusual extended pancake distributions at IMP 8 upstream of non-perpendicular shocks (Are they seen at other S/C? Or Bow/shock/instrumental?)

