DSCOVR Solar Wind Observations

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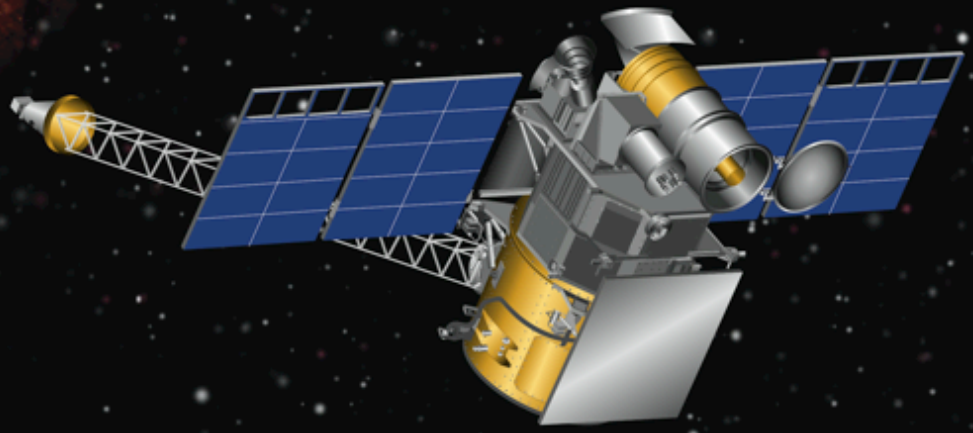


DSCOVR

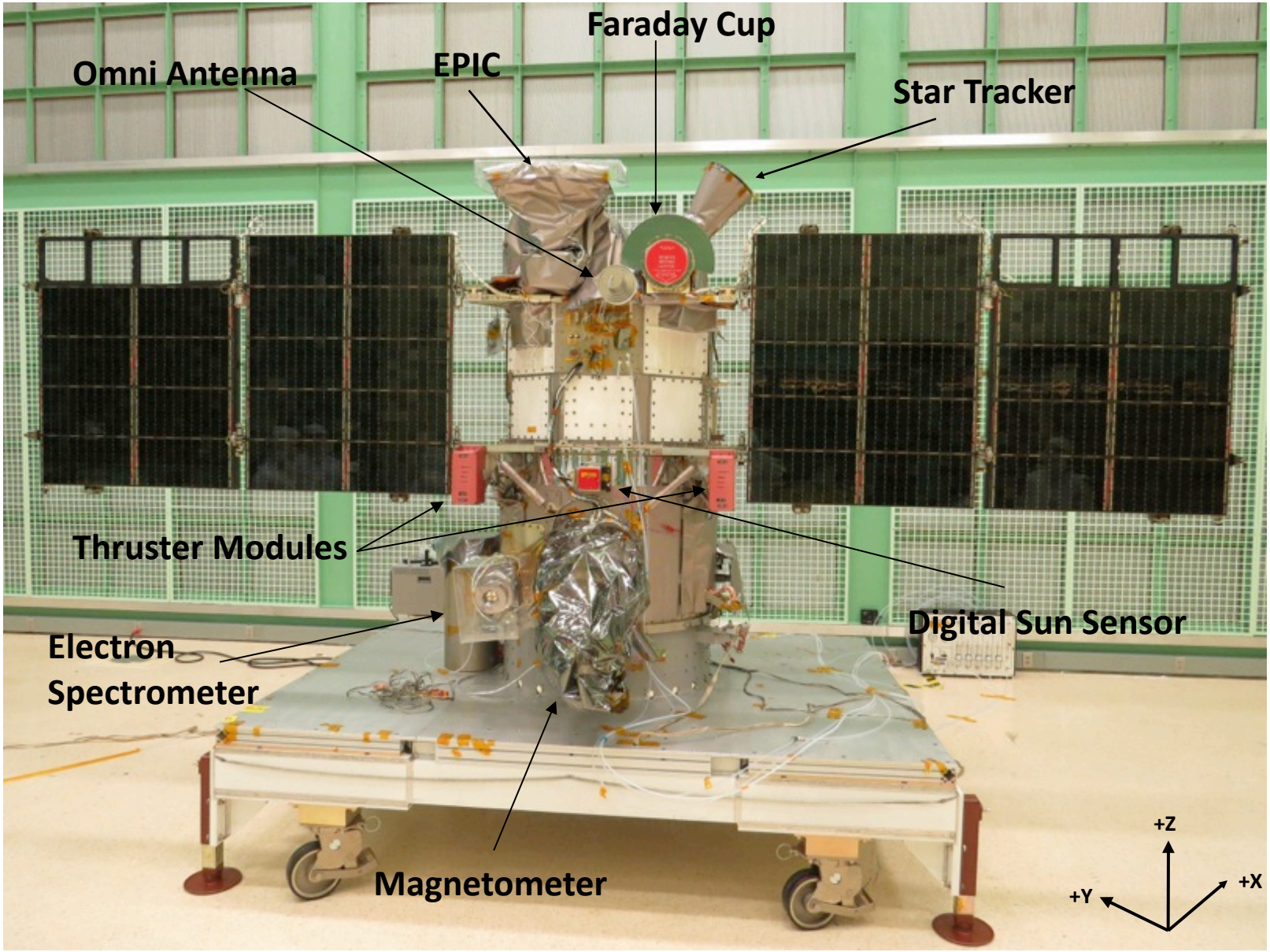
DEEP SPACE CLIMATE OBSERVATORY

advanced warning of approaching solar storms

http://www.nesdis.noaa.gov/DSCOVR

DSCOVR Poster_NOAA_NASA_AF.ai
40" x 30"

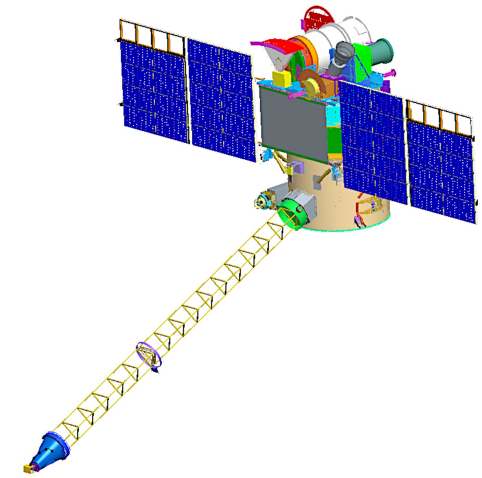
Locations of the Instruments



Goddard Fluxgate Magnetometer

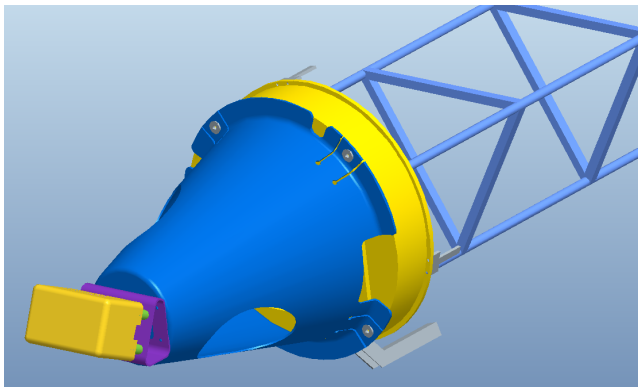
The Fluxgate Magnetometer measures the interplanetary vector magnetic field

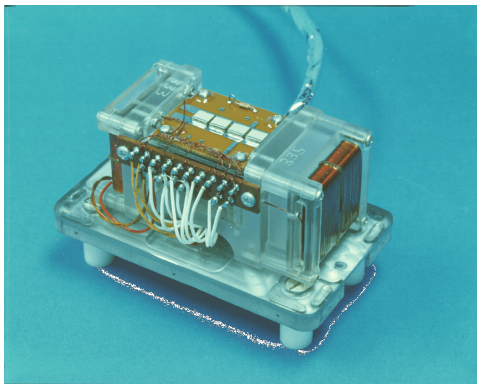
It is located at the tip of a 4.0 m boom to minimize the effect of spacecraft fields



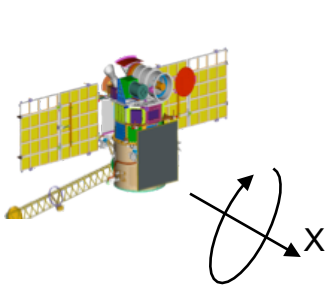
Magnetometer

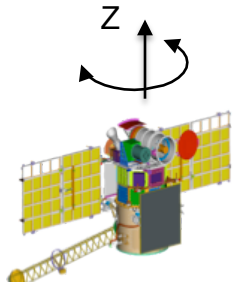
Requirement	Value	Method	Performance
Range	0.1-100 nT	Test	0.004-65,500 nT
Accuracy	+/- 1 nT	Measured	+/- 0.2 nT
Cadence	1 min	Measured	50 vector/sec



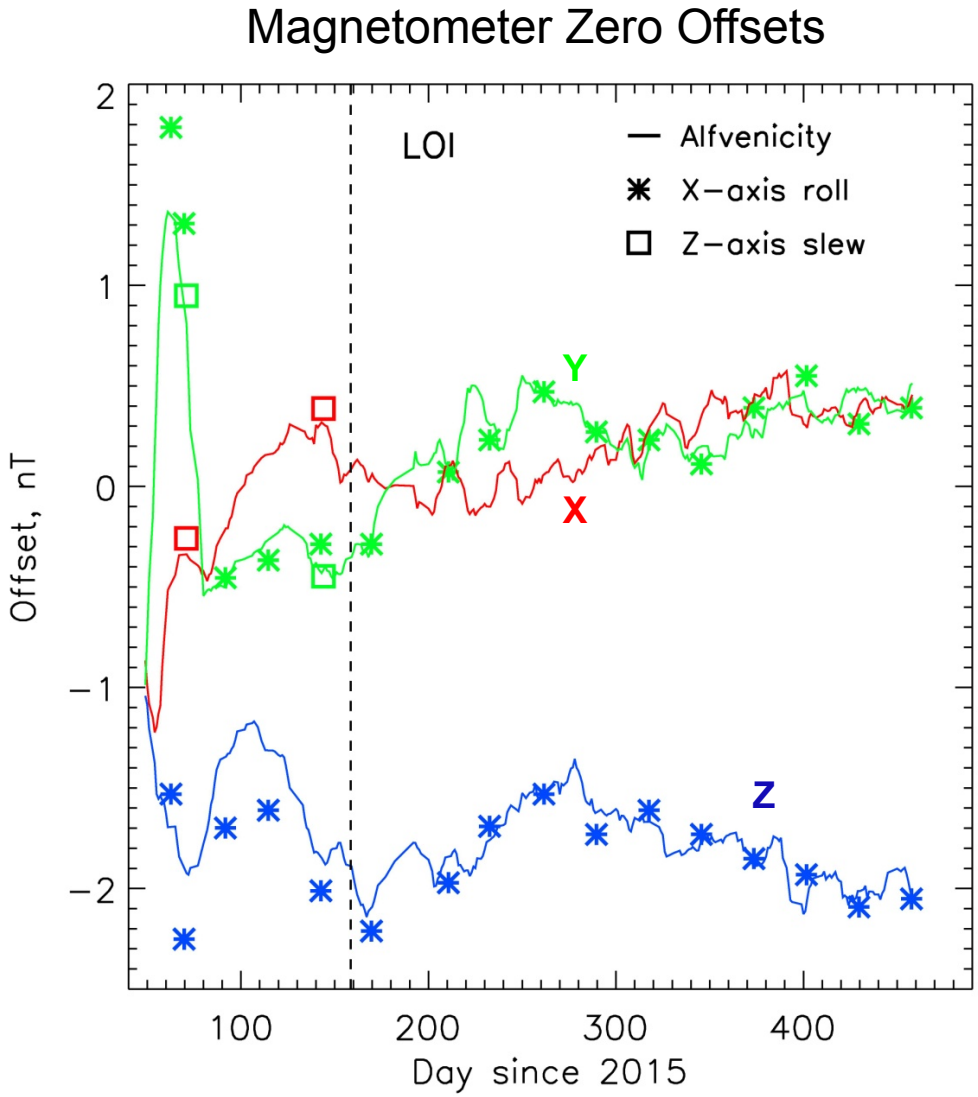


In-Flight Magnetometer Calibrations



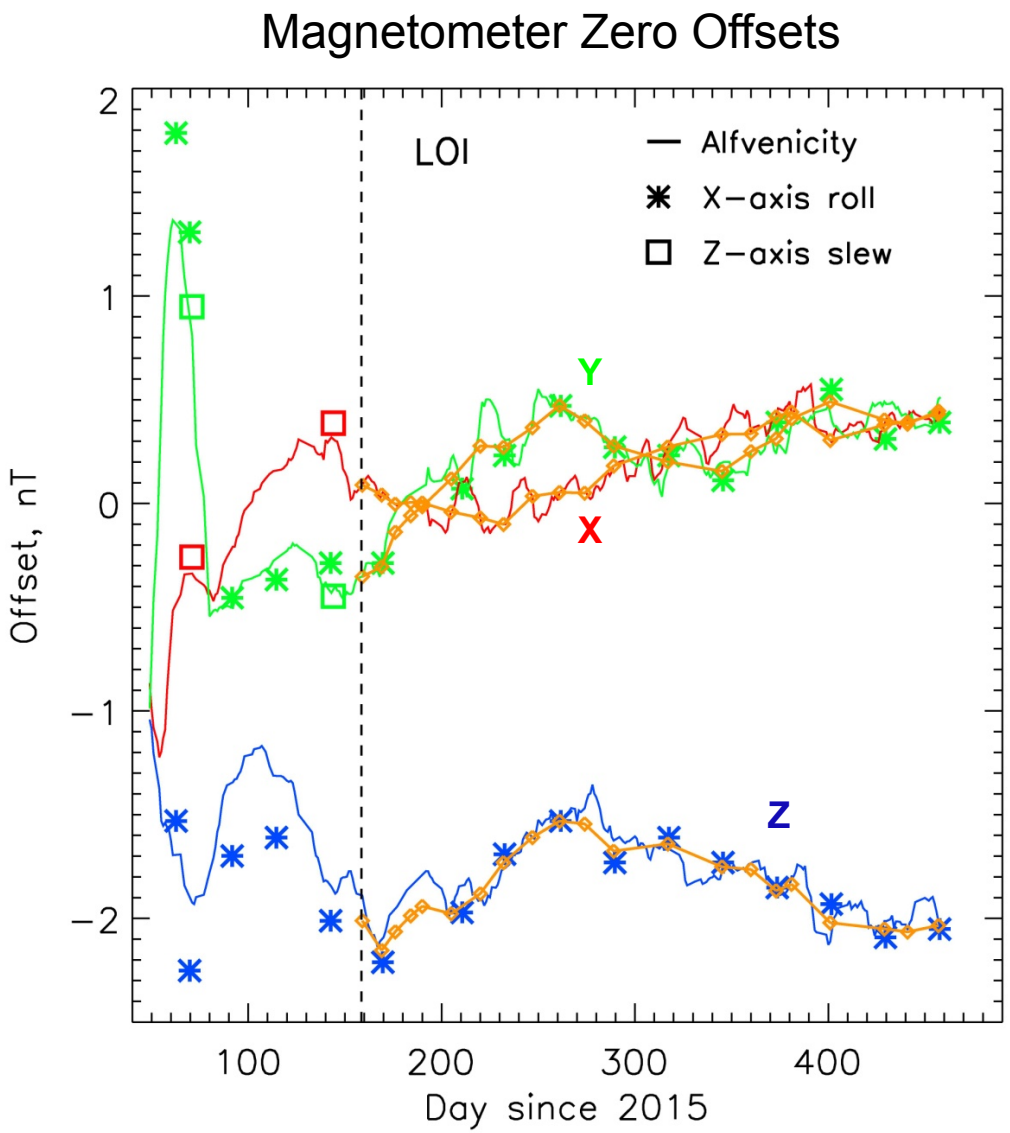


- X axis Roll and Z axis Slew data is consistent with ground calibration estimates
- Independent zero offset determination by rolls, slews and using solar wind Alfvenicity give consistent values
- Time variation is consistent with yearly orbital change.
- Resulting magnetic field accuracy since LOI is ~0.2 nT, exceeding requirements.



In-Flight Magnetometer Calibrations (2)

- Orange curve shows the offset values provided to NOAA SWPC.
- Updates are provided at least monthly or when sudden changes are identified.



Intercalibrations with ACE and Wind

Require spacecraft separation <25 Re.

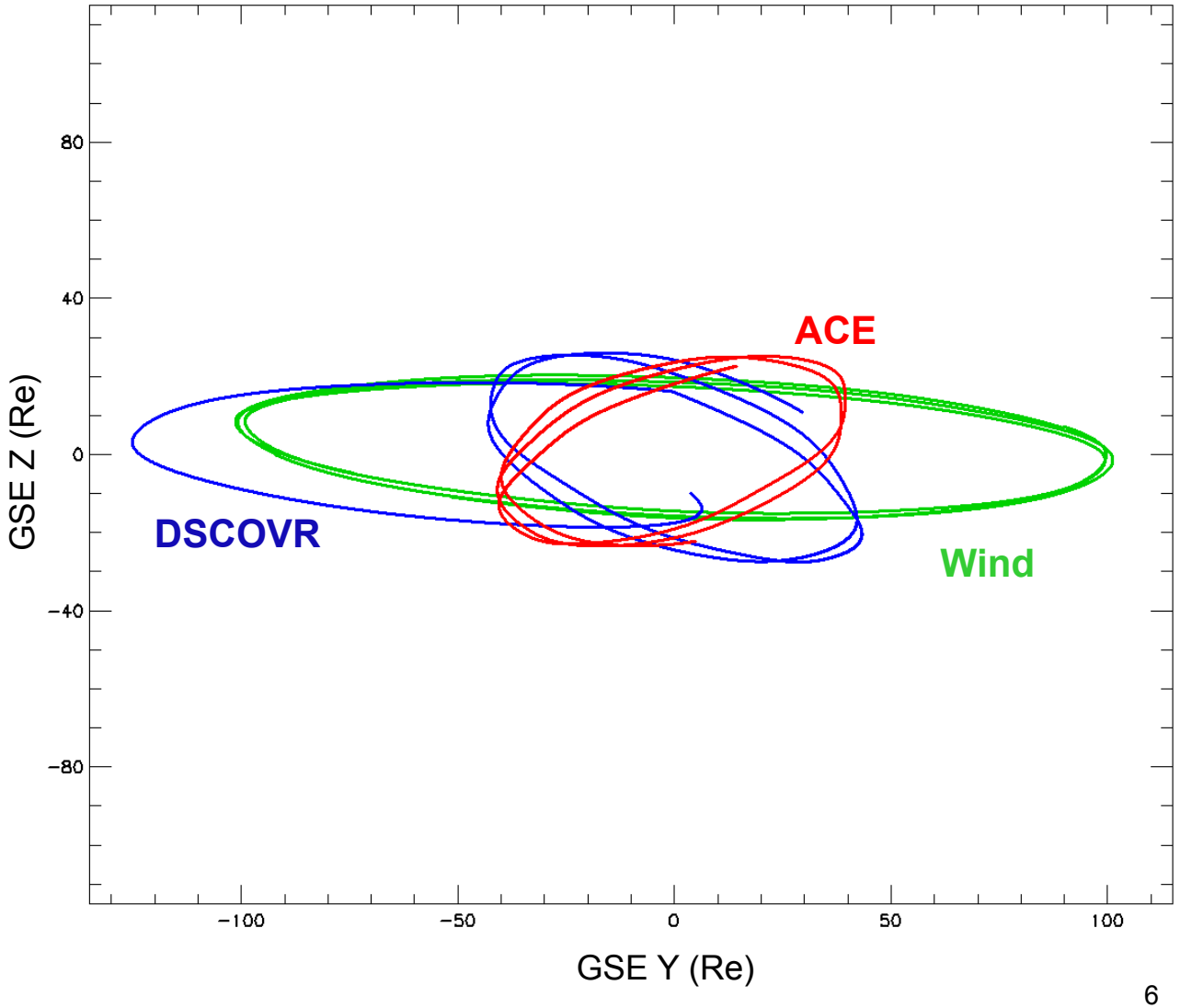
ACE – DSCOVR:

June 8 – 19, 2015
Sept 1 – 18, 2015
Nov 27 – Dec 13, 2015
Feb 24 – Mar 10, 2016

Wind – DSCOVR:

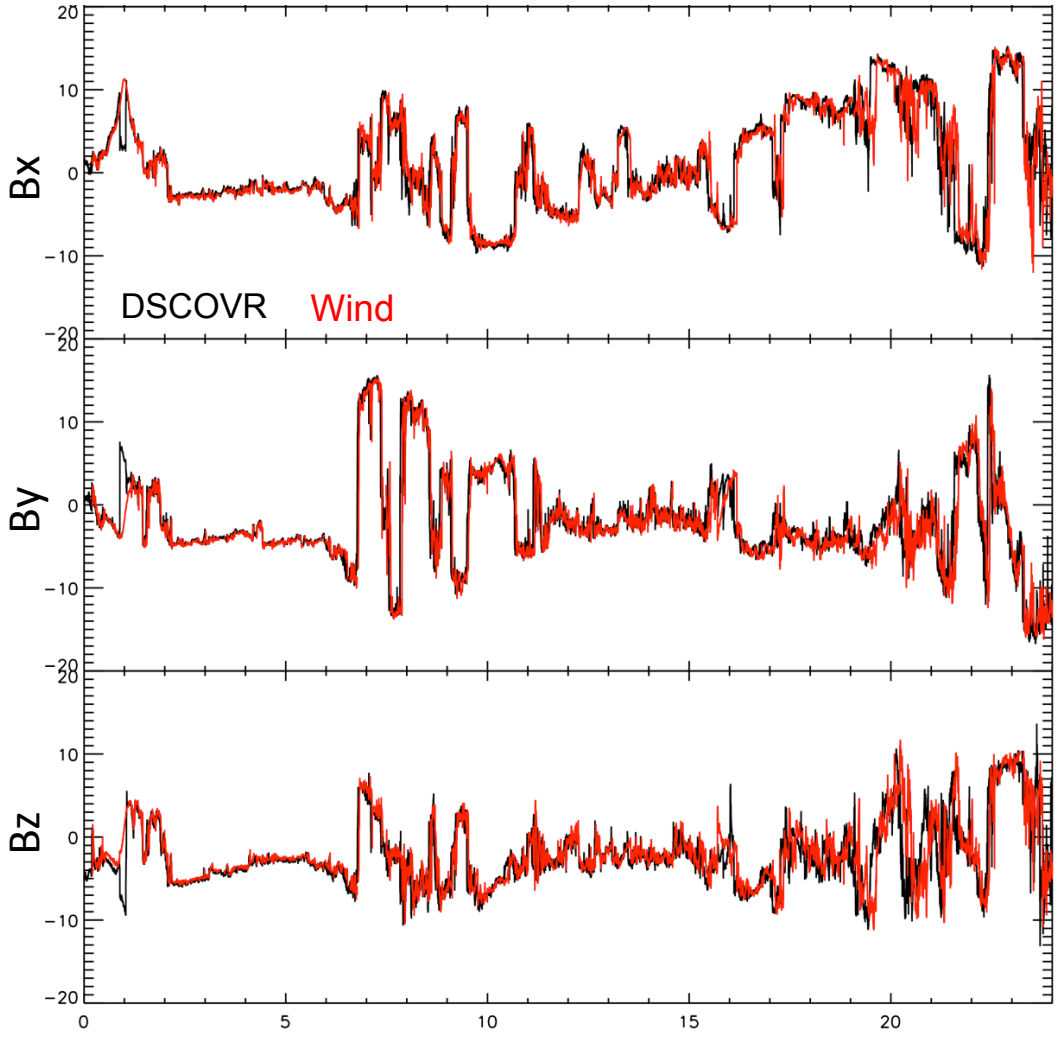
May 12, 2015
July 4 – 20, 2015
Oct 6 – 23, 2015
Dec 29, 2015 –
- Jan 3, 2016
Mar 23 – Apr 6, 2016

DSCOVR, ACE and Wind Orbits



Wind-DSCOVR Comparison

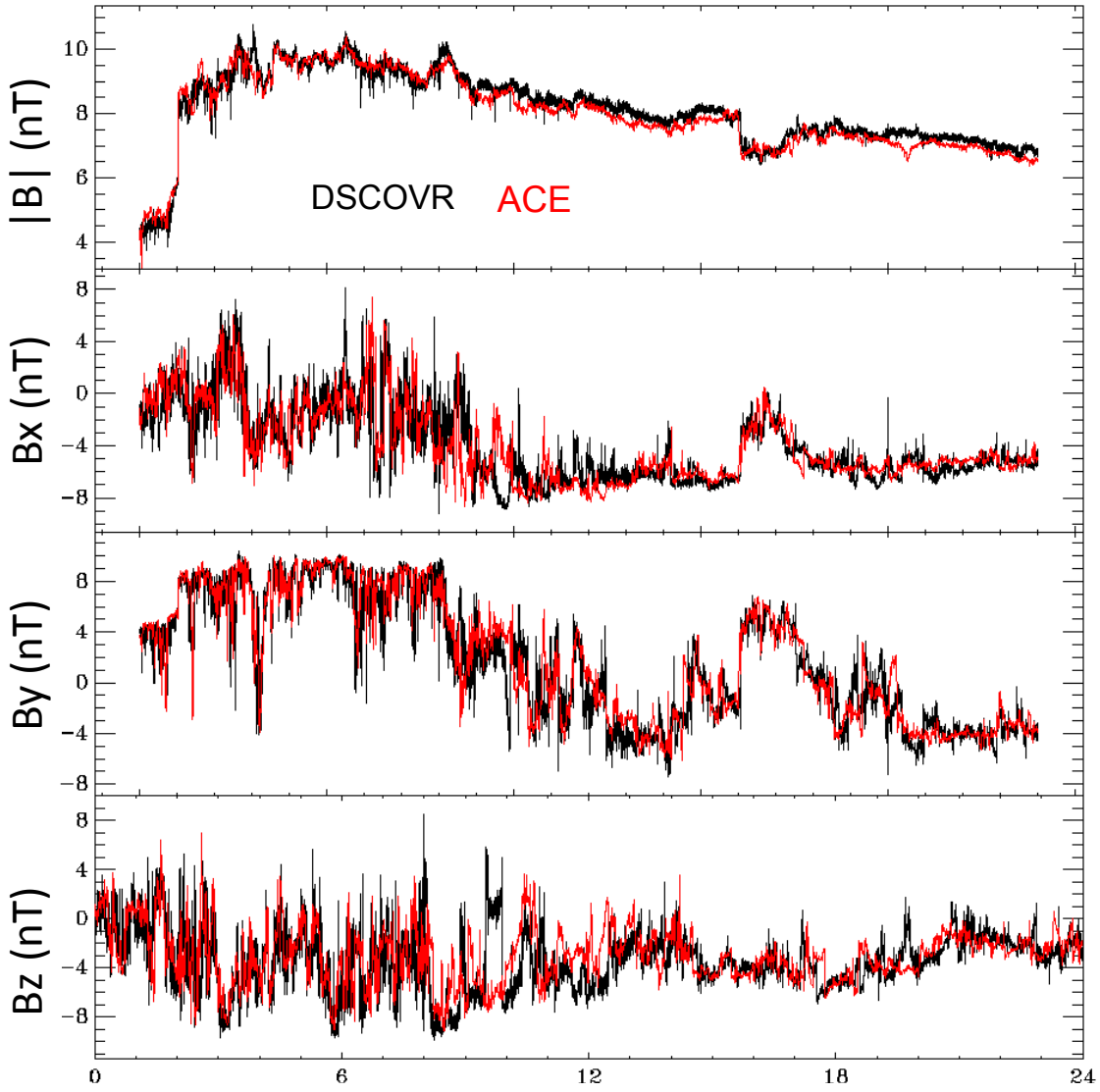
Comparison with Wind spacecraft measurements show good agreement. DSCOVR data is in black. The time shifted Wind data (to allow for solar wind propagation) is plotted in red. Small deviations are consistent with spacecraft separation.



ACE-DSCOVR Comparison

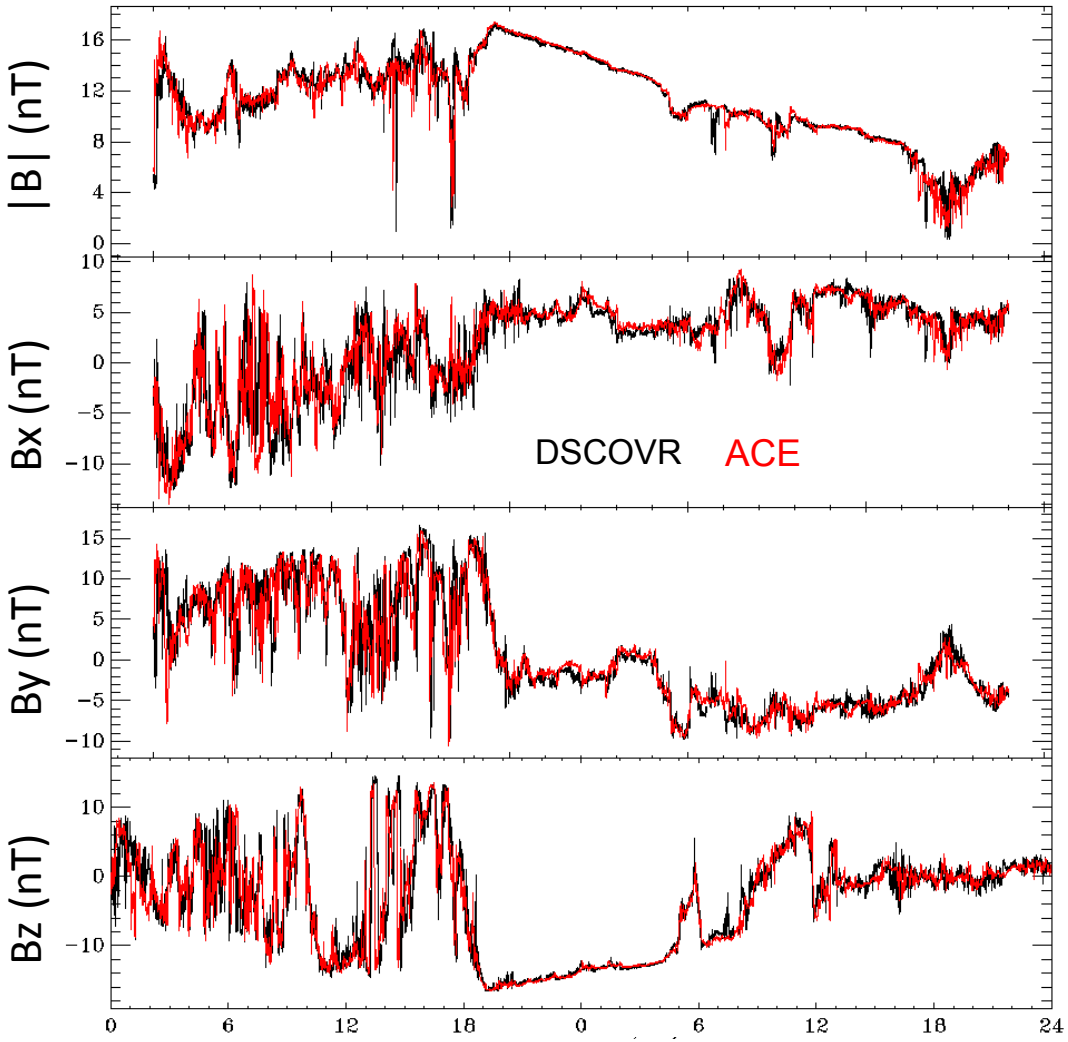
Comparison with ACE spacecraft measurements also show good agreement. DSCOVR data is in black. The ACE data in red is not time shifted. Small deviations are consistent with spacecraft separation.

Interplanetary shock jump conditions at the beginning of the day agree as measured by the two spacecraft.



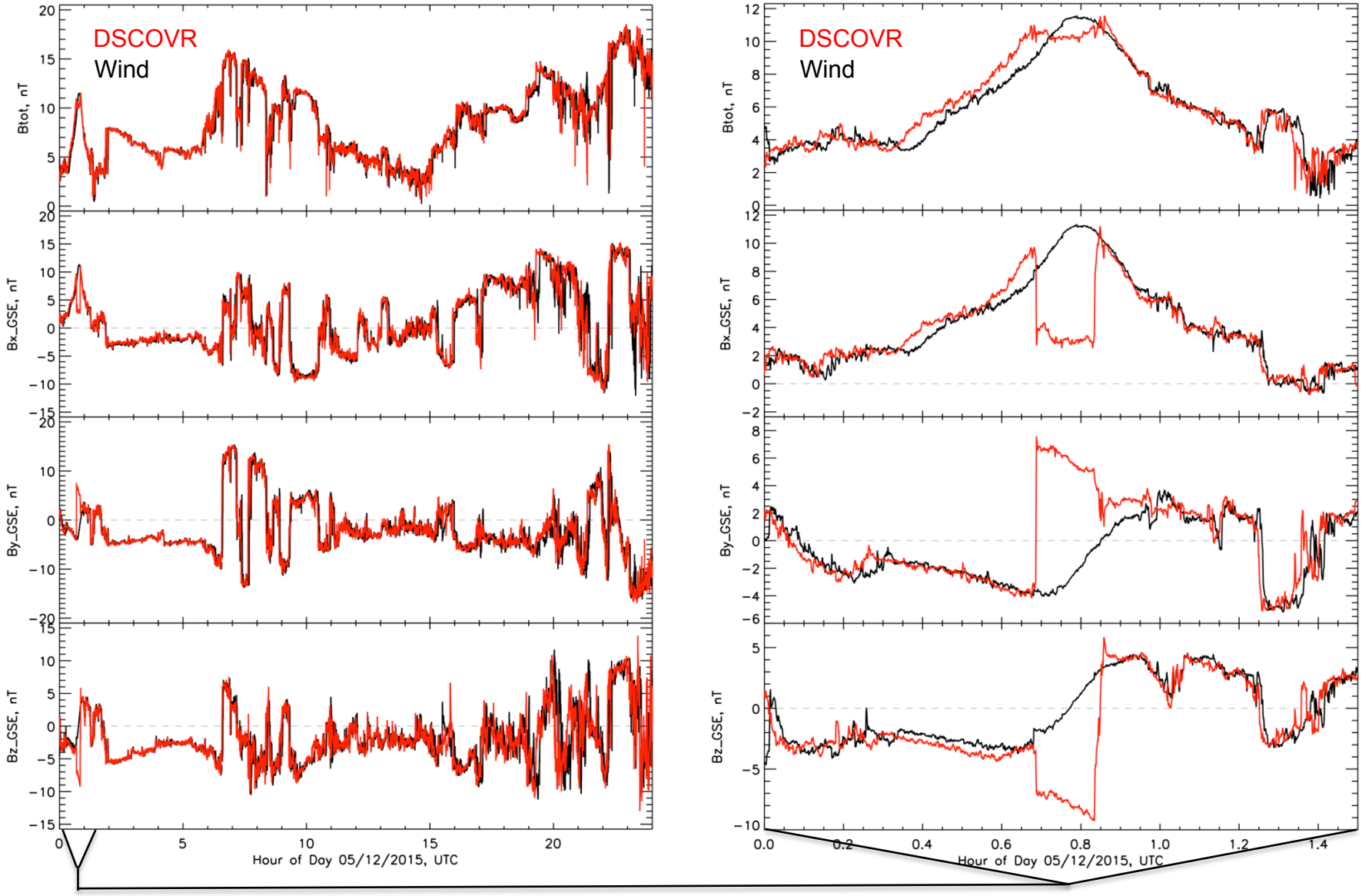
ACE-DSCOVR Comparison (2)

The 2015 Dec 31 – 2016 Jan 1 ICME was measured by both spacecraft with identical values.

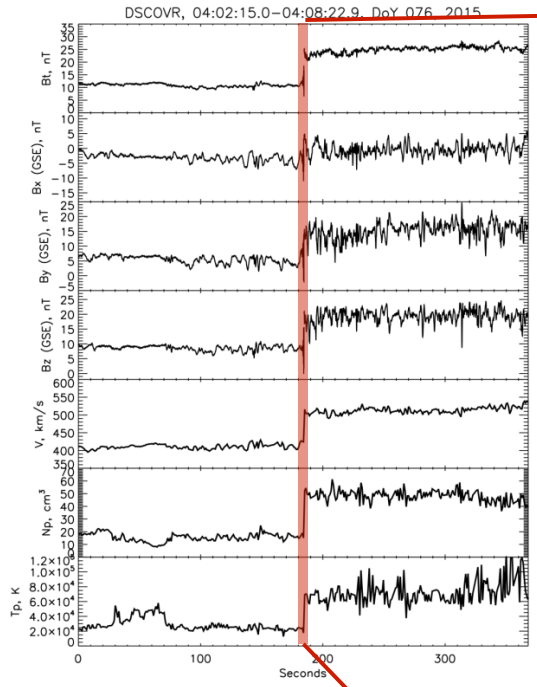


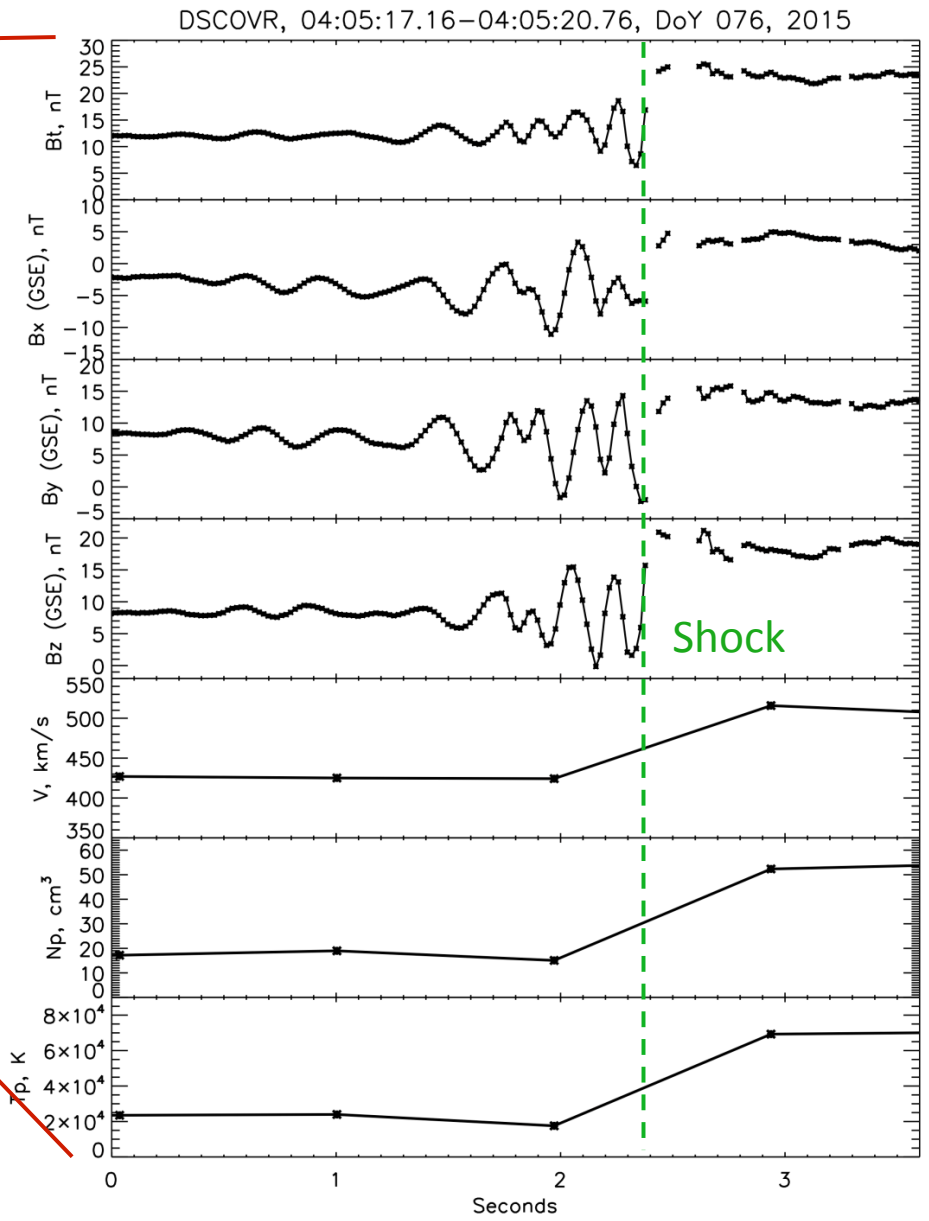
DSCOVR Science: Small Structures

- DSCOVR and Wind separated by < 10 Re perpendicular to SW



High Time Resolution Data

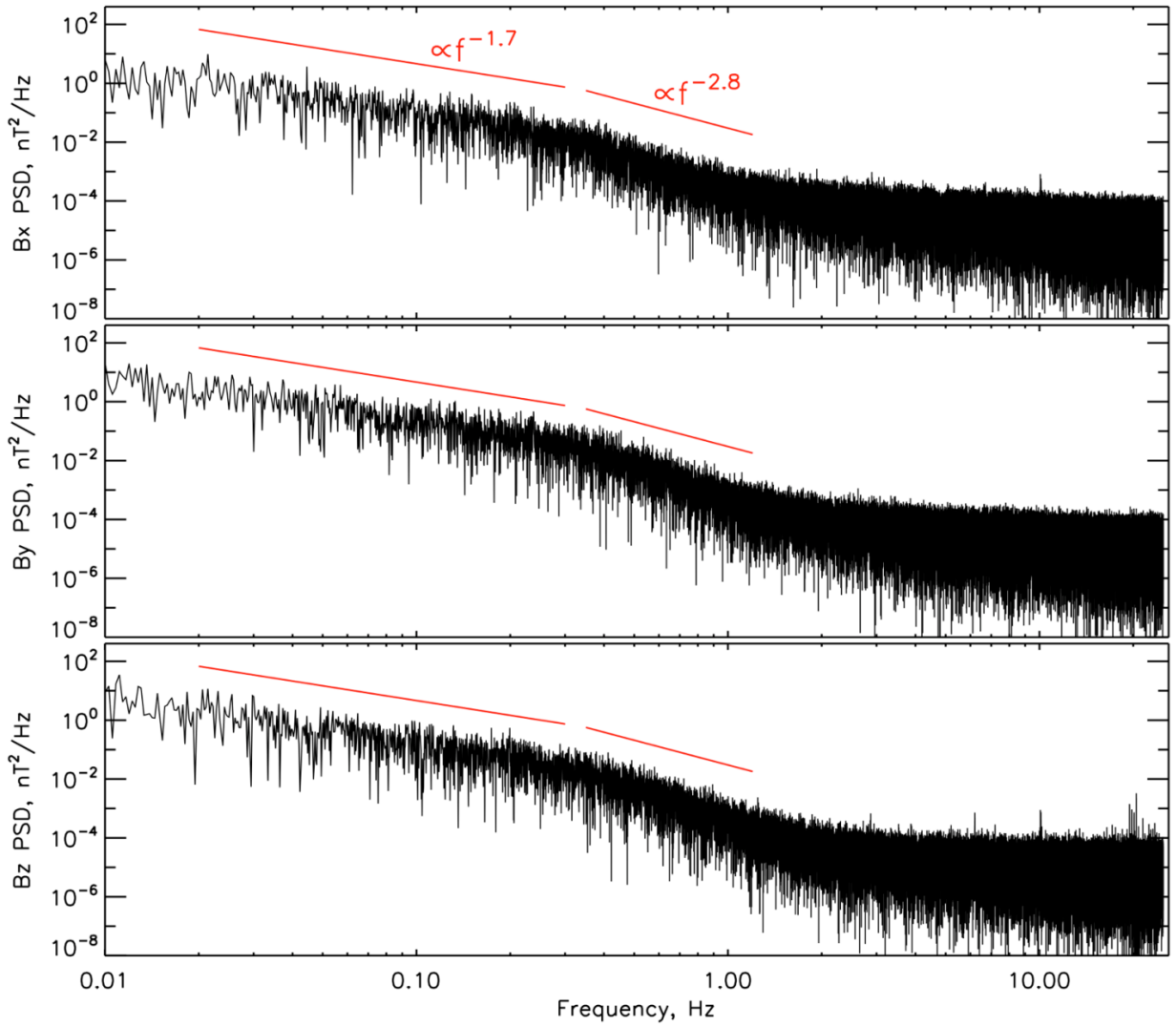




Large amplitude waves upstream of shock

Magnetic Power Spectrum

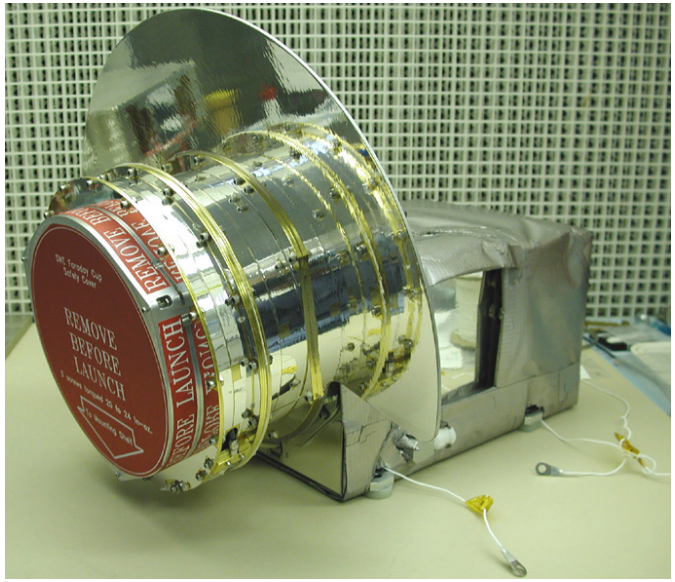
- Inertial and dissipation ranges of magnetic turbulence

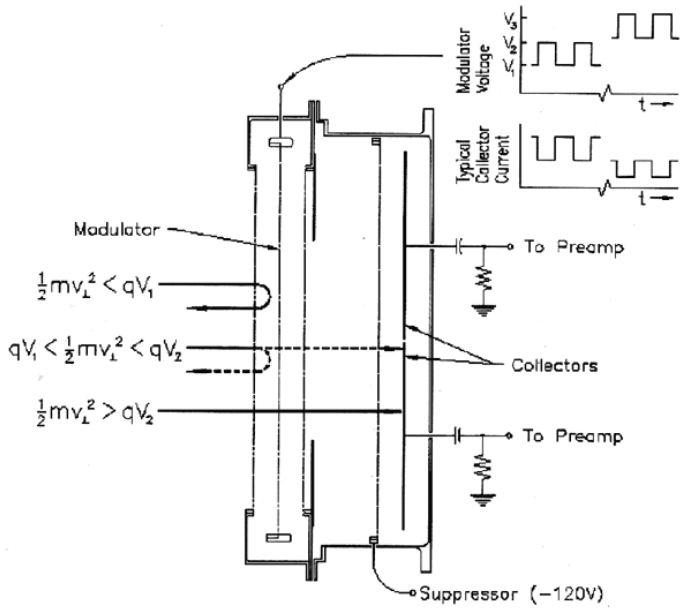


DSCOVR Faraday Cup - SAO/MIT/GSFC

The Faraday Cup is a retarding potential particle detector that provides high time resolution solar wind proton bulk properties (wind speed, density and temperature)

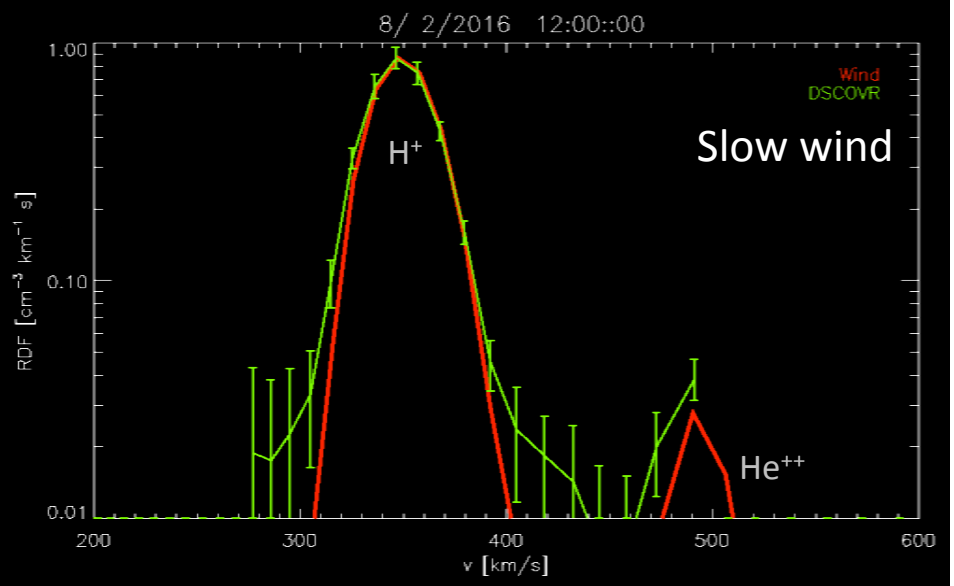
Robust instrument – Can operate through high energy particle storms that commonly accompany critical space weather events

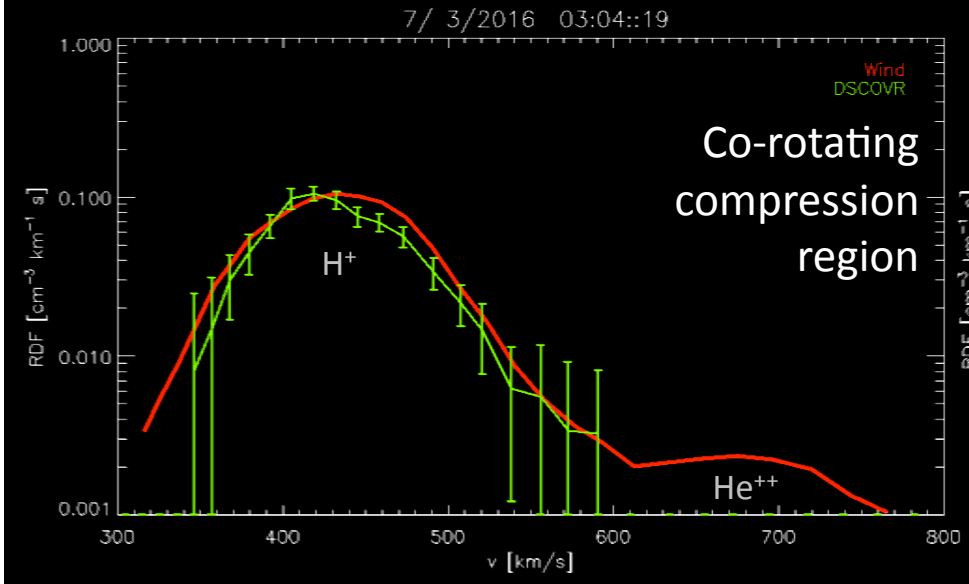


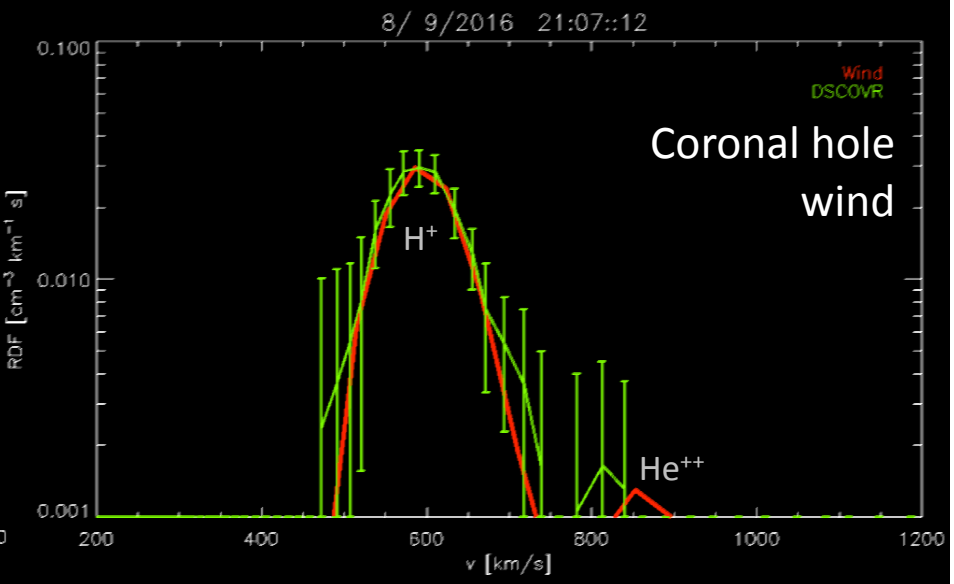


FC Data Quality

"flyback" noise eliminated and low-energy range extended

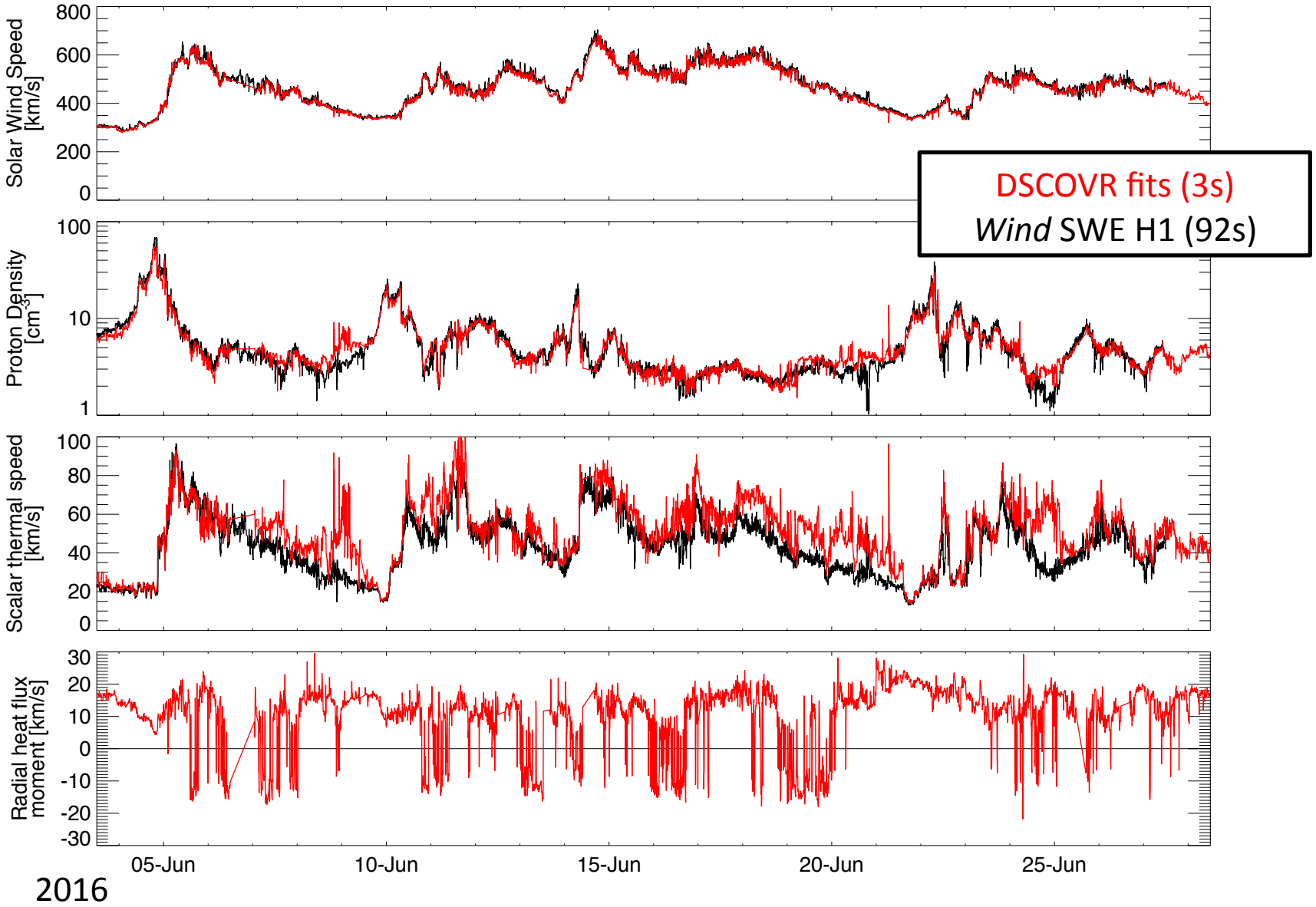




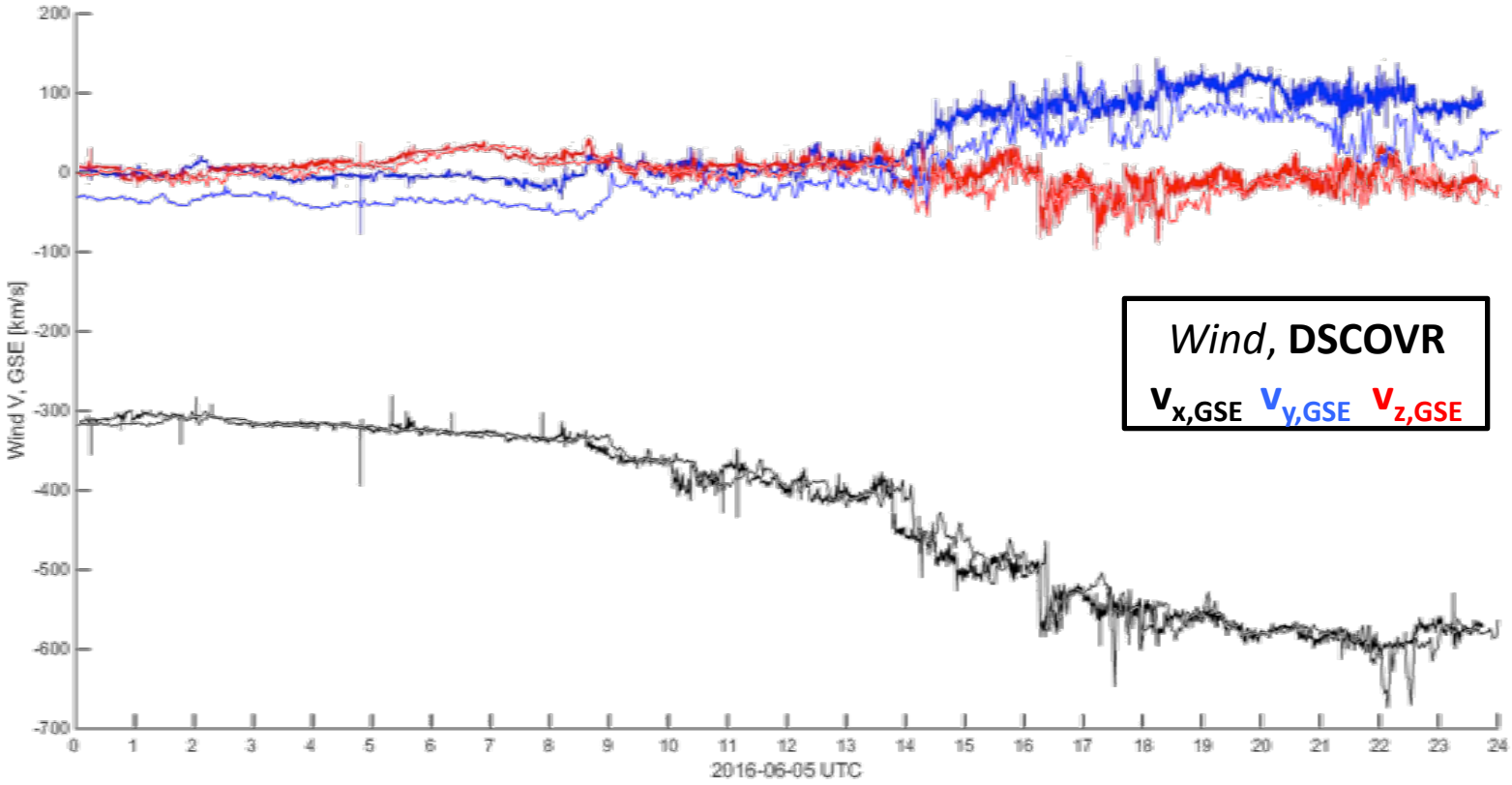


Wind SWE data (not fits)

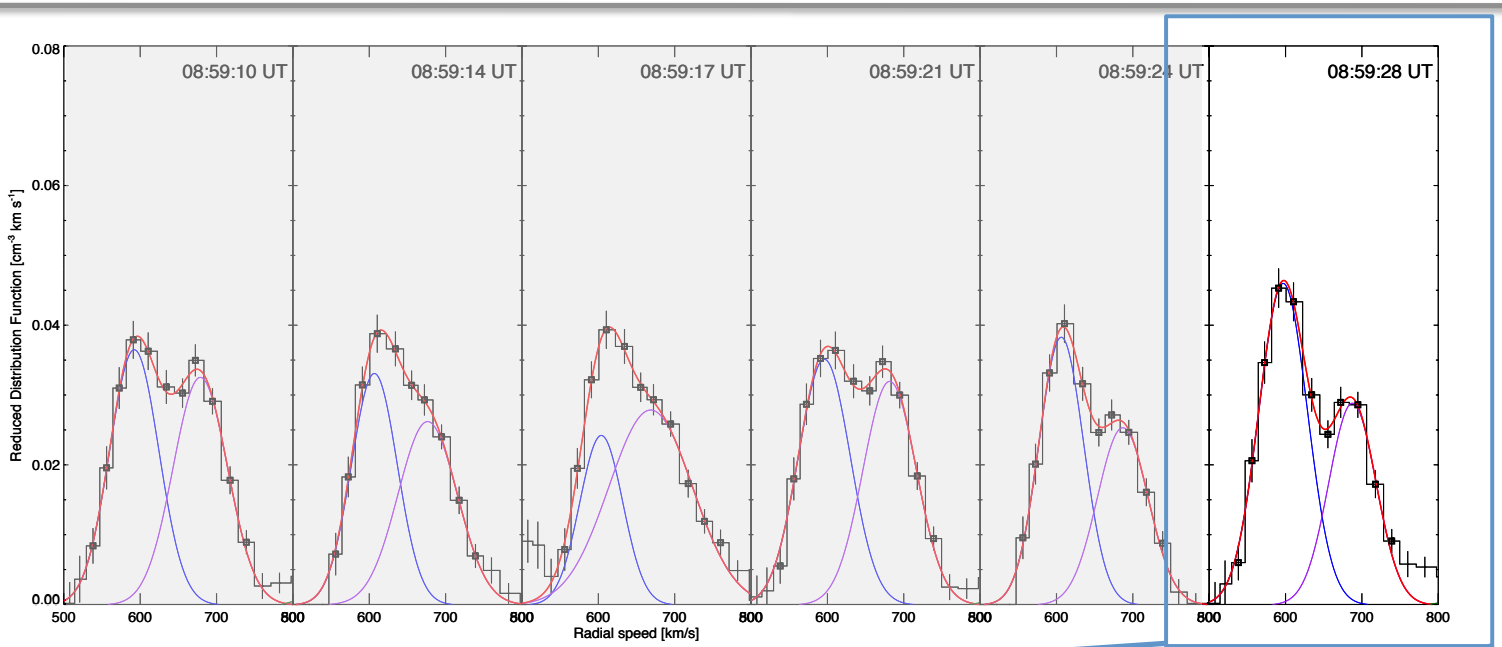
DSCOVR – Wind Comparison



Non-radial velocity components



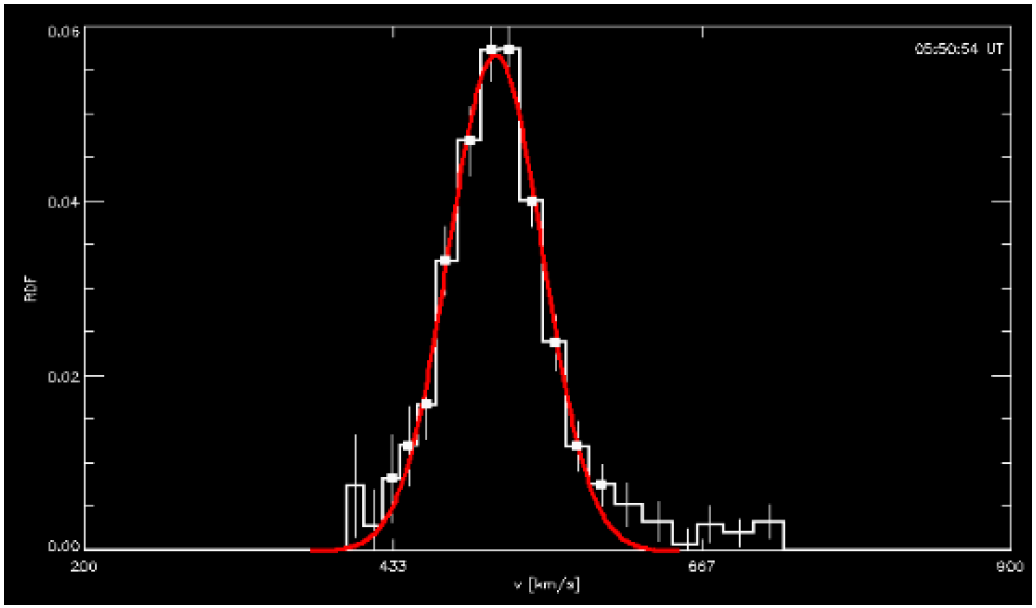
Counter Streaming Proton Beams



Type of peak analysis	Speed, v (km/s)			Density, n (cm^{-3})			Effective thermal speed, w (km/s) (i.e. Temperature)			
Two-peak fit Best known values	u_1	u_2	**u_{eff}**	n_1	n_2	**n_{tot}**	w_1	w_2	Δv_{1-2}	**w_{eff}**
	622	634	**631**	*3.7*	*2.2*	**5.9**	*45*	*44*	*91*	**63**
MOMENTS *DSCOVR realtime*	**634**			**5.7**			**52**			
Single peak fit *like Wind NRT keys*	**622***			**6.4***			**93***			
ACE realtime	550-590*			3.0-5.3*			31-40* (*flagged for poor quality)			

Typical Solar Wind Conditions

A more typical, equilibrium-like measurement from July 12, 2016



Type of peak analysis	Speed, v (km/s)			Density, n (cm^{-3})			Effective thermal speed, w (km/s) (i.e. Temperature)			
Two-peak fit	u_1	u_2	$\mathbf{u_{eff}}$	n_1	n_2	$\mathbf{n_{tot}}$	w_1	w_2	$\Delta v_{1\text{-}2}$	$\mathbf{w_{eff}}$
Best known values	511	-	**511**	*5.1*	-	**5.1**	*50*	-	-	**50**
MOMENTS *DSCOVR realtime*	**511**			**5.2**			**49**			
Single peak fit *like Wind NRT keys*	**510**			**5.1**			**50**			
ACE realtime	460-512			2.8-4.8			36-48			

Conclusions

- DSCOVR became the NOAA operational L1 solar wind monitor on July 27, 2016 at 16:00 UTC
- DSCOVR is providing interplanetary magnetic field and solar wind proton key parameters to NOAA SWPC.
- Archived data is available through NOAA's National Centers for Environmental Information (NCEI) [previously NGDC]
- Reprocessed, science data will be available through CDAWeb starting in December, 2016.