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Assessing the complementary nature of radio measurements of solar wind transients: HELCATS WP7

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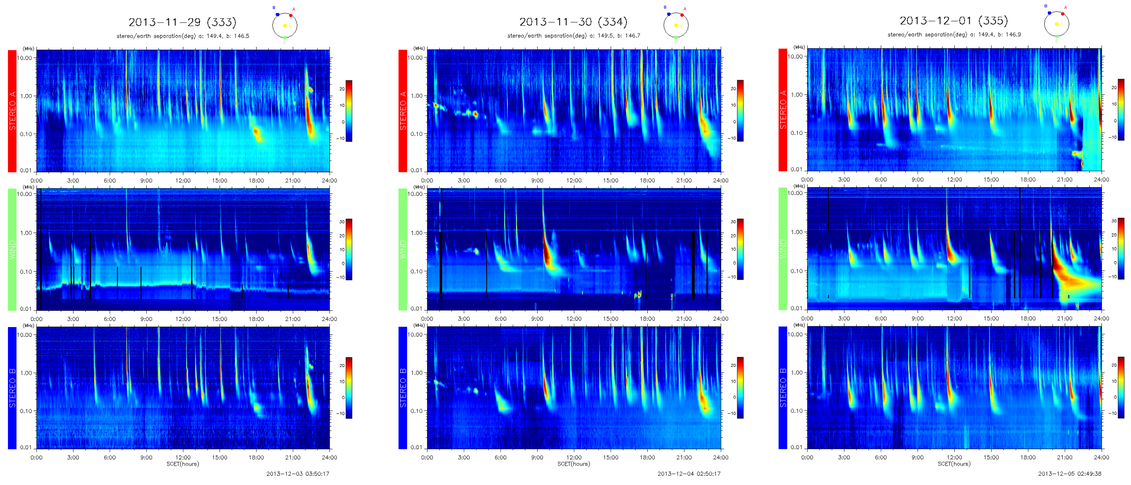
Summary

- **HELCATS adds value to the STEREO heliospheric imaging observations by (1) cataloguing phenomena (coronal mass ejections and stream interaction regions), (2) producing derived 'metadata' products, (3) applying computer modelling techniques and (4) comparing with other datasets.**
- **HELCATS work package 7: assess the potential for combining white-light imaging of the inner heliosphere with ground- and space-based *radio data*, in particular Interplanetary Scintillation (IPS) and Type II radio bursts.**
- **WP7 has just started! Here we present an initial illustrative case study on the utility of Type II radio emission, demonstrating the types of analysis that can be performed in the context of HELCATS.**
- **For info on *IPS*, see separate talk by *Bisi et al.* and for info on *Direction Finding* see talk by *Magdalenic et al.***

Case study: 29 November 2013 – 1 December 2013



3 days of data from STEREO and Wind.

- **Type III storm + Type II emission**
- STEREO/Waves/HFR = a dual-channel receiver (connected to two antennas at one time) HFR1 low frequency, HFR2 high frequency
- From three quasi-instantaneously acquired measurements of HFR1 we can build the correlation matrix P that yields Direction Finding (DF) information.

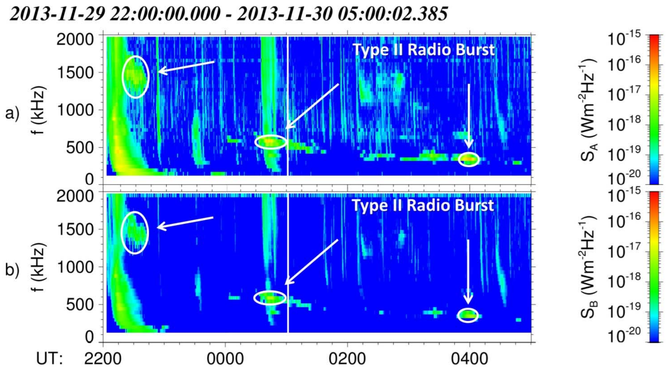
HFR1	HFR2
125 kHz – 1975 kHz	2025 kHz – 16.025 MHz
50 R_S – 5 R_S	5 R_S – 2 R_S
Three monopole mode	Monopole and Dipole Mode
DF capability	No DF capability

Type II radio emission

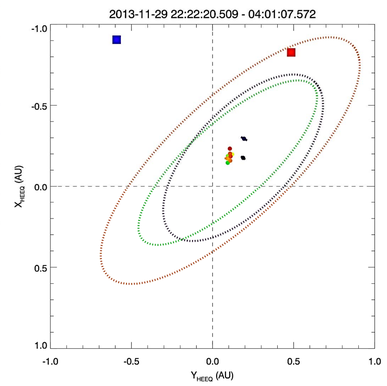
- Three discrete bursts labelled
- Can use frequency and time difference with a density model to determine the source altitude
- Two estimates of radial source speed: ~500 km/s

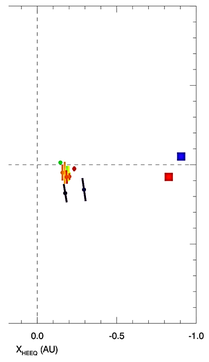
Direction finding

- Using the SVD method of Krupar et al., can localise the emission at different frequencies: potential to compare with remote imaging.

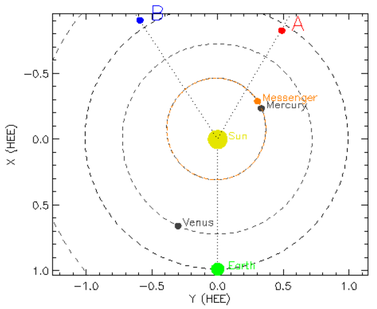


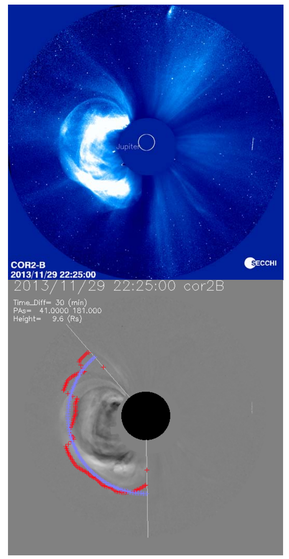
Interval	Date	Time	Frequency	Distance F	Speed
1	2013-11-29	22:30	1,500 kHz	6.4 R_S	*
2	2013-11-30	00:45	600 kHz	12.1 R_S	500 km/s
3	2013-11-30	04:00	300 kHz	20.9 R_S	530 km/s





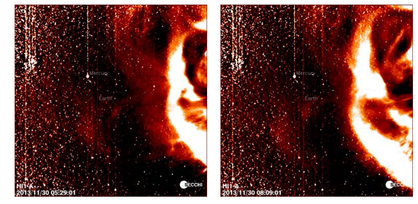
Context: remote sensing and in situ





Coronagraph

- CME liftoff at ~20:00 on 29/11/2013
- Directed towards STEREO-A, imaged by STEREO-B in e.g. COR2
- Modelling: here used SEEDS (Solar Eruptive Event Detection System from George Mason University)



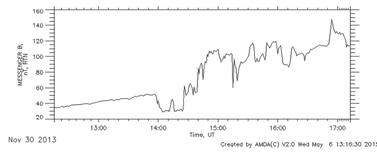
Heliospheric Imager

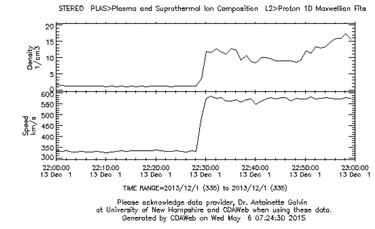
- Imaged by HI-1 in STEREO A
- STEREO B HI: not in field of view

In situ measurements:

MESSENGER

- MESSENGER at Mercury was radially aligned with STEREO-A
- MESSENGER was in the solar wind and detected the shock (magnetic field only)





STEREO-A

- STEREO-A also measured the shock arrival
- Reached STEREO-A in ~50 hours
- Average speed: ~ 830 km/s

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