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HELCATS WP7 Overview/Type II

Bob Forsyth on behalf of Jonathan Eastwood

HELCATS kick-off meeting 14 May 2014, RAL

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Work Package 7

Assessing the complementary nature of radio measurements of solar wind transients

- *Duration*: Months 10 – 36
- *Participants*: Imperial, ROB, STFC
- *Work package leader*: Jonathan Eastwood (Imperial)

- *Objectives*:
  - To identify and analyse potentially-geoeffective solar wind events that are observed by both HI and IPS, and use IPS to augment the HI observations.
  - To identify and analyse solar wind transients that are observed by both HI and in radio, and add value to the HI data by establishing/cataloguing the relationships between them.

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Motivation

- Recognising that radio observations are associated with heliospheric transients, this work package links **Inter-Planetary Scintillation** and **Type II radio emission** to the established Heliospheric Imager observed events.

- **IPS**: Solar wind density; solar wind speed can be retrieved if signals from the same radio source are received at spatially-separated receiver sites (*see next talk by Mario Bisi*)

- **Type II radio emission**: generated at shocks driven by coronal mass ejections, frequency corresponds to (harmonics) of the local plasma frequency, which is a function of density. Coordinated analysis of HI data and radio burst observations has been performed only on a case-by-case basis (e.g. Harrison et al., 2012)

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Tasks and deliverables

- **T7.1** - Identifying and analysing potentially-geoeffective solar wind events that are observed by both HI and IPS [Months: 10-36] STFC
- **T7.2** - Identifying and analysing solar wind transients that are observed by both HI and in Type II radio burst emission [Months: 10-36] IMPERIAL, ROB

- **D7.1** : Catalogues of EISCAT and LOFAR IPS data events and of S/WAVES events, both extending throughout the STEREO HI Mission timeline [month 27]
- **D7.2** : Report of initial comparison between IPS events and HI events. [month 30]
- **D7.3** : Report of initial comparison between solar radio-burst events and HI events. [month 30]

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Task 7.2

Identifying and analysing solar wind transients that are observed by both HI and in Type II radio burst emission

- Combining STEREO solar radio-burst, coronagraph and HI observations enables unique study of the propagation of shock waves and their drivers (CMEs), as well as interaction of fast CMEs, all the way from the low corona to 1 AU.

- Solar radio-burst observations cover a broad frequency domain corresponding to different distances from the Sun.

- Key advantages of space-based radio measurements
  - effectiveness in tracking CMEs between coronagraph and HI FOV
  - analysis of events where fast CMEs interact.

- Will also leverage team participation in ground-based radio observations, (e.g. CALLISTO) that extend the data down to the low corona,

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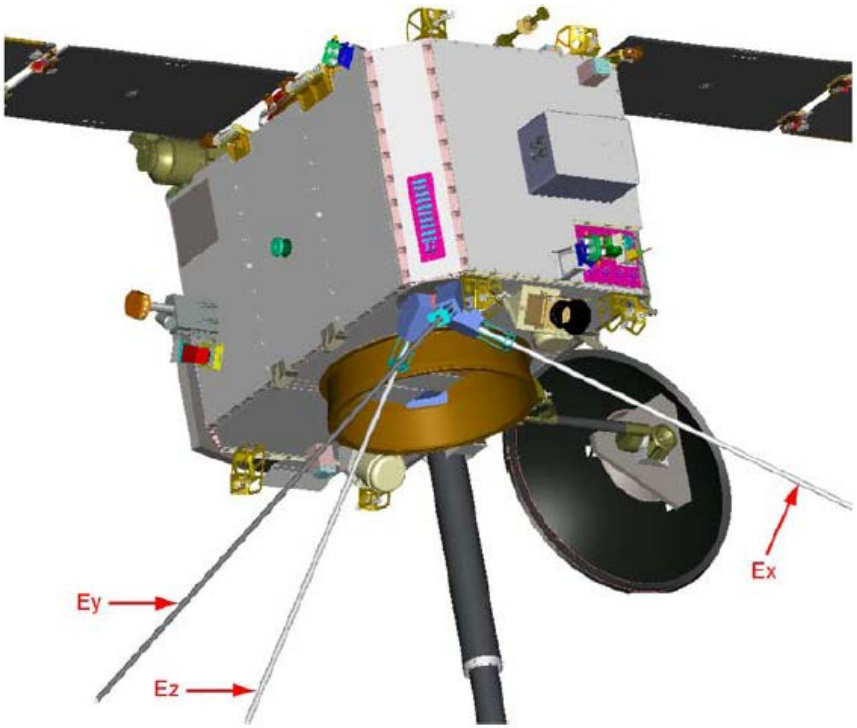
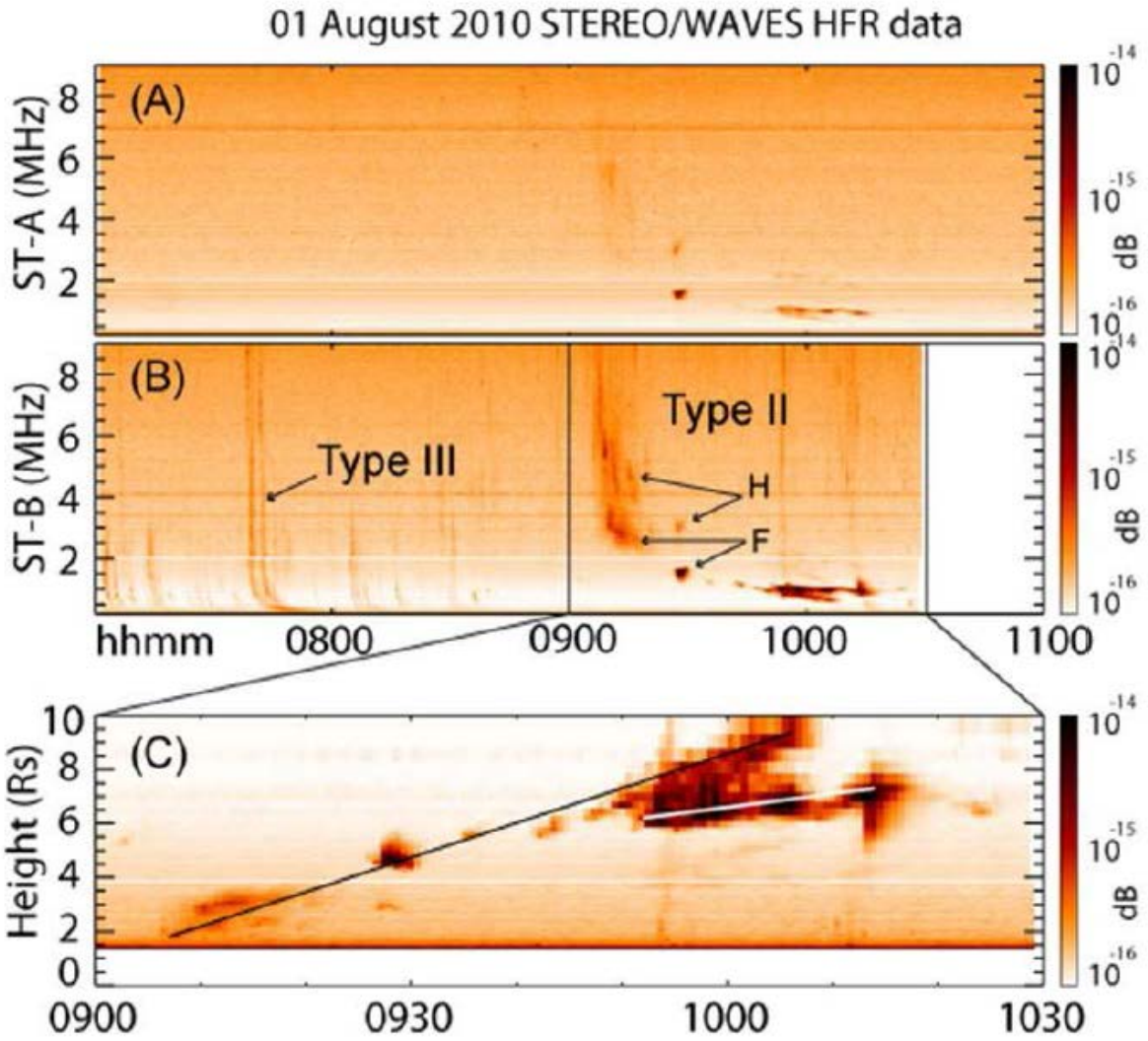
S/WAVES (Bougeret et al., 2008, SSR)



- 3 orthogonal monopole electric antennas
- High frequency receiver 125 kHz – 16.025 MHz
- Low frequency receiver 2.5 kHz – 125 kHz
- Type II emission at fundamental and harmonics of plasma frequency
- $f = 8.98 \times 10^3 (n_e)^{1/2}$
- Use model to convert density to radial distance
- HFR frequency range – height of 10 Rs – lower boundary condition for the J-map analysis

Example of Type II emission



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Activities in Task 7.2

- Developing a joint catalogue of CMEs observed in HI, and S/WAVES and Wind/WAVES data.
- Extending the catalogue with ground-based radio observations to examine more closely the source region of each CME.
- Constructing height-time statistics, and systematically examining usefulness of radio data in constraining modelling of CME lift-off and its impact on CME forecasting.
- Determining the number of interacting CME events and exploring how radio data can be used to decipher event kinematics and improve forecasting.

Instruments used: STEREO/SECCHI and SWAVES; WIND/WAVES

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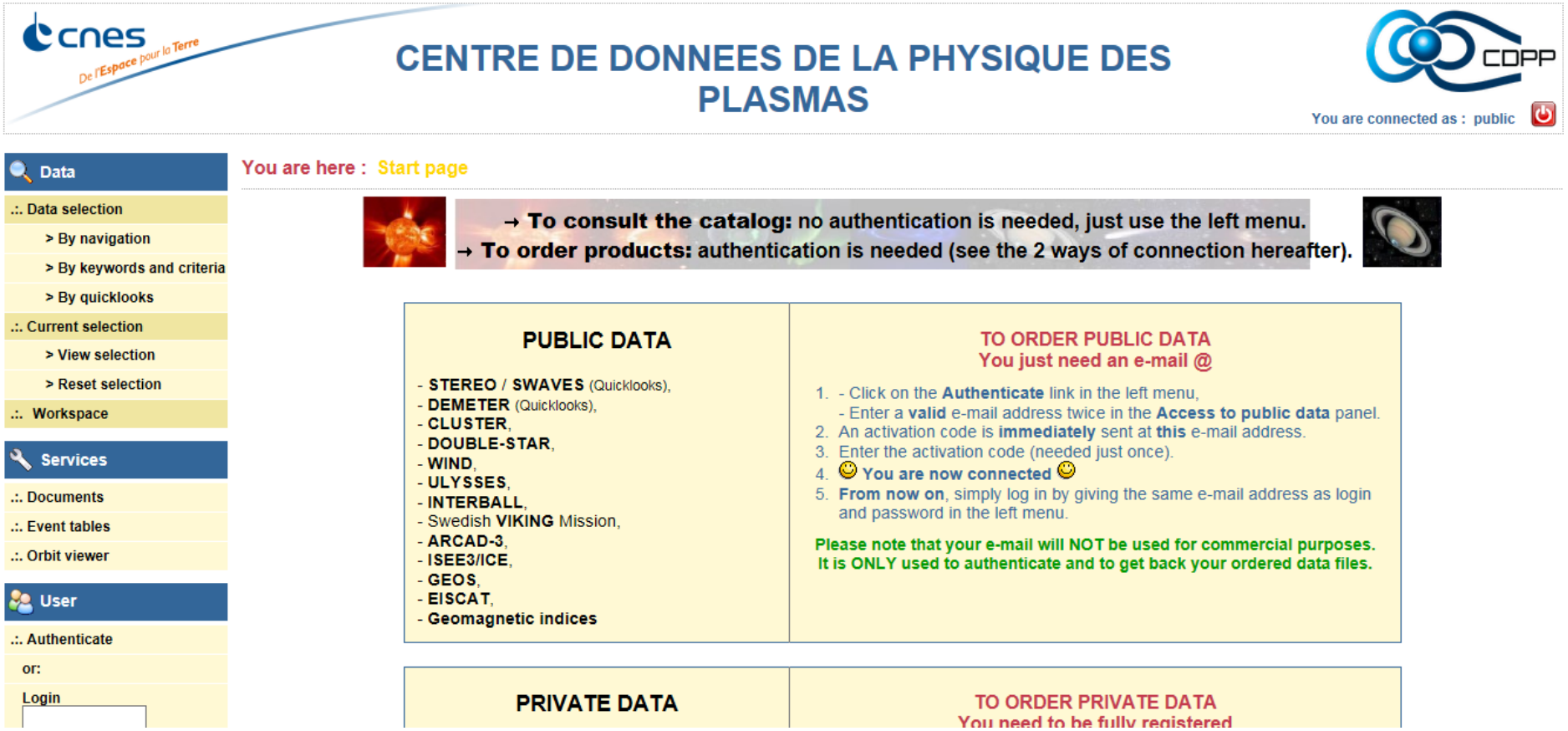
Accessing S/WAVES data



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Quicklook plot browsing

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Quicklooks

Select quicklooks by ticking the 'Select' checkbox at the bottom of each image. When finished, click on the 'Create order' button to order the corresponding data objects. The link displays the related information about a particular quicklook. The symbol allows direct order of the corresponding data object in your workspace (when direct order is available).

Show attributes for all quicklooks:
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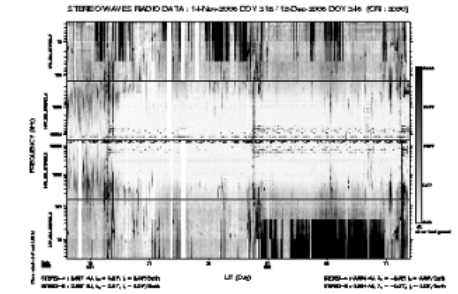
Create order



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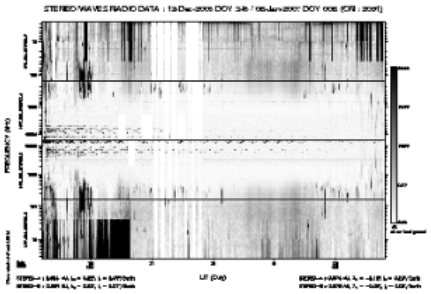

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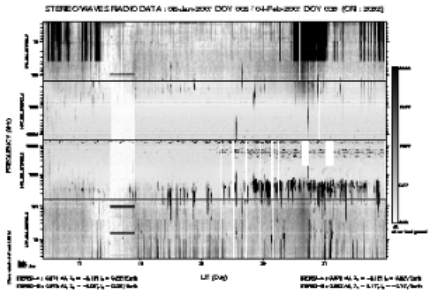

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Work plan for Task 7.2

- Start month 10
- Initial construction of S/WAVES catalogue, in the context of initial work on the HI catalogue
- Initial construction of CALLISTO catalogue, in context of initial work on the HI catalogue
- Identification of events for case study and detailed analysis
- Analysis of case studies
- Timing analysis of all events?