IAP contribution to PSWS work package

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Verification of models against in-situ data

- Use spacecraft data to validate existing models of CME/CIR propagation at different points in the heliosphere
  - Shall probably be implemented as a series of case studies, selecting events where good data (STEREO + other spacecraft) are available.
- Model predictions can be compared to data of
  - Arrival time to spacecraft position (sheath of the CME)
  - Solar wind velocity, density, B-field etc. measured in-situ
  - CME propagation and density profile derived from remote radio observations (STEREO, WIND).
  - Magnetospheric response ?

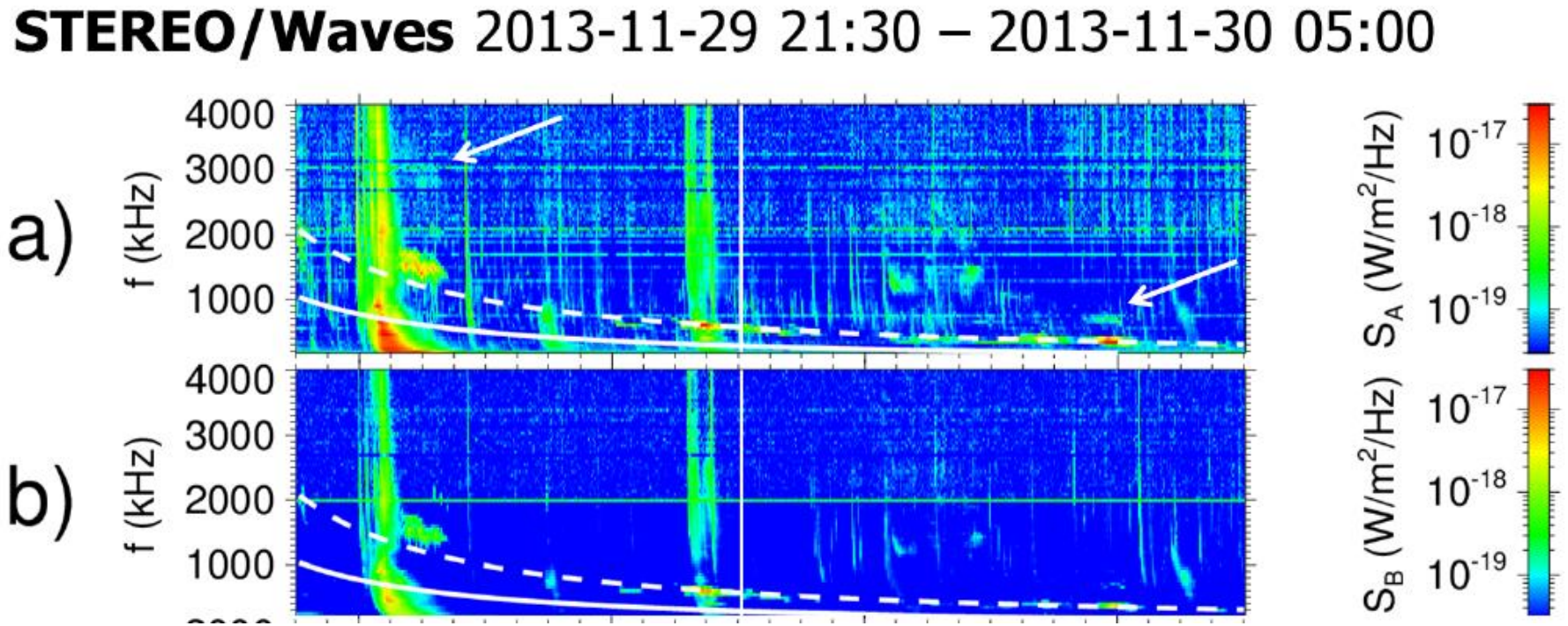
Data to be used

- STEREO – main dataset for context
  - Both in-situ, coronagraph and radio wave observations
  - Triangulation possible
- Near-earth spacecraft
  - Cluster, WIND, ACE
  - Earth is not the main target, but still can be used as an additional datapoint
- Cassini
  - In situ data – magnetic field, wave data (density)
- MESSENGER
  - Magnetic field
- Mars/Venus express, Rosetta, Juno
  - Possibly...

Example – radio wave / in situ tracking of CME

Example from Krupar et al., to be submitted soon:

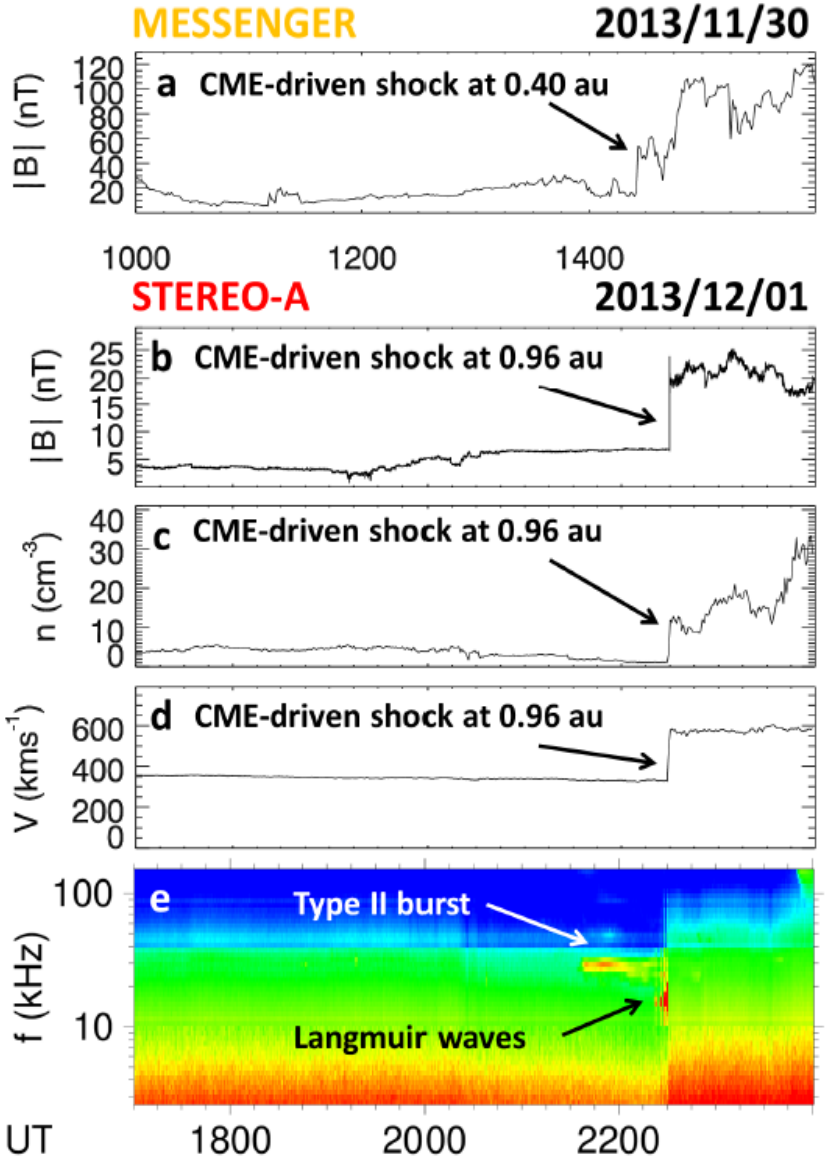
- Rare event of type II burst associated with a CME observed by STEREO.



In-situ data

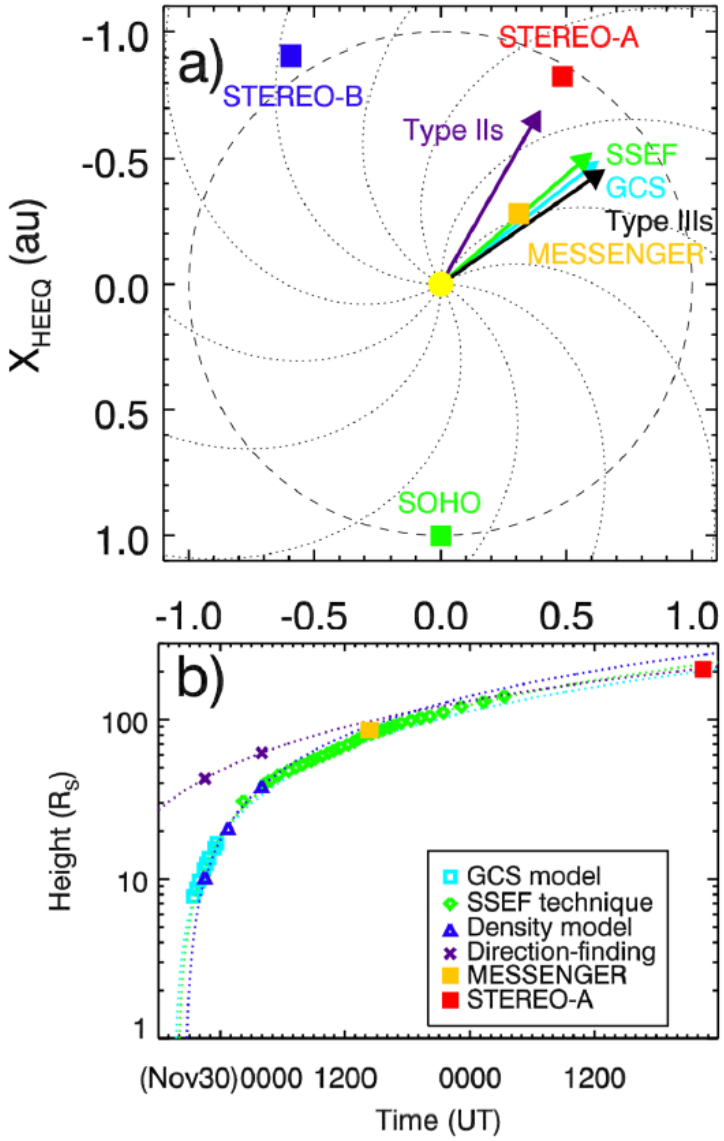
The CME driven shock was observed on

- **MESSENGER**
- **STEREO-A**
  - ❑ Full set of plasma parameters measured
  - ❑ In-situ wave spectrum confirming harmonic emission.
- Events like this (although not as nice) will be used for model validation by case studies



Comparison of models and observation

- Arrival times fit nicely with the GCS model (based on SOHO coronagraph).
- Density model is used to convert radio wave frequency to distance
- Direction and velocity of CME propagation can be checked by in-situ and radio measurements.



Plan for PSWS

- Existing spacecraft data at multiple points in the heliosphere can be effectively used to validate space weather models when applied to other planets.
- A database of suitable events with in-situ measurements shall be created. Good multi-spacecraft events are rare.
  - Covering both inner and outer heliosphere.
- Basic parameters characterizing model efficiency for different points in the solar system can be derived. Can be used to add empirical error bars on the predictions.
- We should decide what models to use and check....
  - What parameters to check (arrival time, n, v, ...)
  - We need to know what has been done not to duplicate work