HELCATS WP2: Automatic CME Identification

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T2.2 - Automatic cataloguing of STEREO/HI CMEs [Months: 1-36]

- **Investigate the possibility** of the automatic detection of CMEs in the heliosphere from STEREO/HI-1 images.
- Never been tried before.
- ROB has experience (**CACTus**) in doing this with LASCO and COR (recently has been done with SWAP).
- Parameters of the automatically-detected CMEs will be catalogued in an analogous manner to those detected manually.
- T2.3: comparison of both catalogues.

Deliverables

- D2.1: Catalogue of observational parameters of HI-1 manually identified CMEs (month 36, but 1st release month 9)
- D2.2: Report on the feasibility of automatic identification of CMEs in HI-1 data (month 12)
- D2.3: Report on the inter-comparison of the manual and automated CME catalogues (month 18)
- D2.4: Report in which the manual and automated HI CME catalogues are compared to pre-existing coronagraph CME catalogues (month 24)

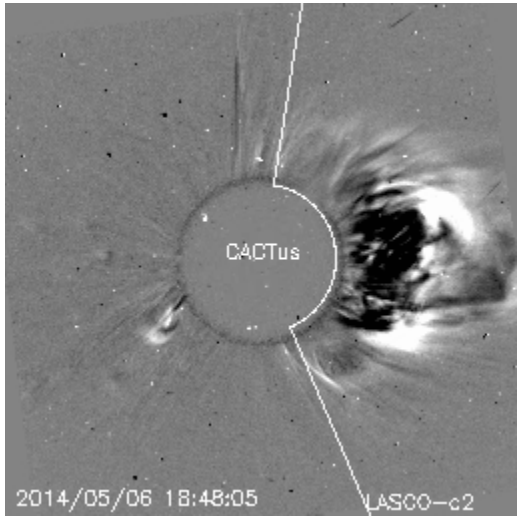
How to proceed?

- Study the methods out there
  - Tappin et al., 2012: AICMED
    - Operates along the same lines as CACTus
    - Hough Transform on elongation-time J-maps to extract straight lines from the data set.
    - The proportion of false identification was high (71%).
    - SMEI data are too noisy for the tool to be completely automated.

How to proceed?

- CACTus for HI
  - CMEs are more difficult to catch than in normal coronagraphs.
  - Pre-processing of the images.
  - Geometry, not the same as with normal sun-centered coronagraphs:
    - Conversion of elongation to radial distance
    - De-projection of the images

CACTus needs polar maps



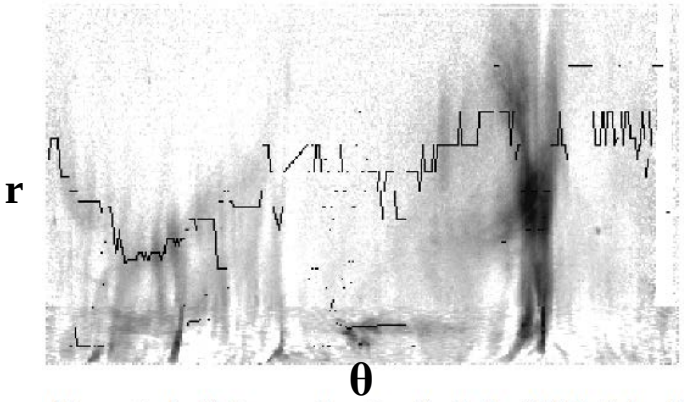
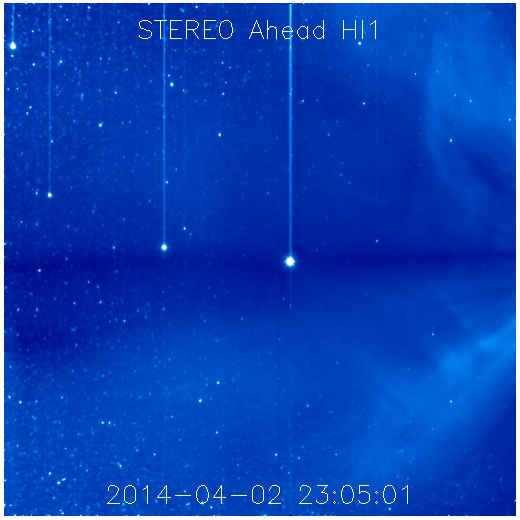


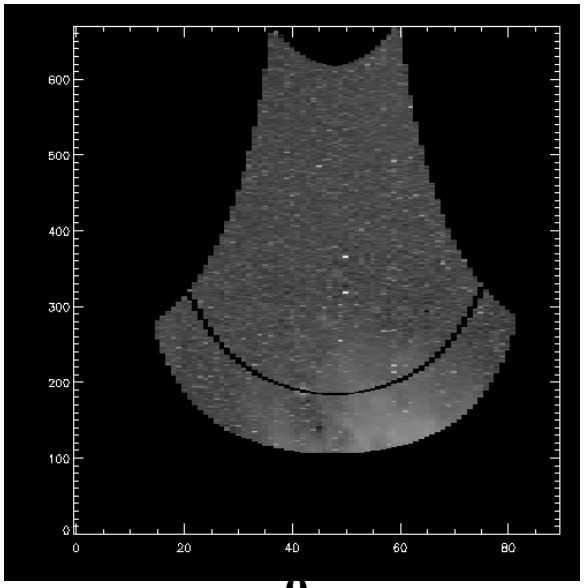
Figure 5. $[r, \theta]$ image showing the halo CME of April 29. The overplotted, dark, broken line is the detected CME front. Note that different parts of the CME propagating at different speeds are correctly tracked.

- Almost all solar imaging instruments, including coronagraphs, use **gnomonic or tan** projection.
- This representation is not adequate for HI, because of their wide-angle optics and the resultant distortion at the edge of the field of view.
- Azimuthal perspective (**AZP**) projection can be used for HI.

Eyles et al., SolPhys, 2009

CACTus needs polar maps



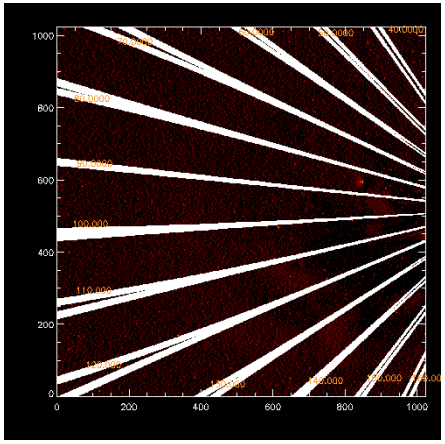


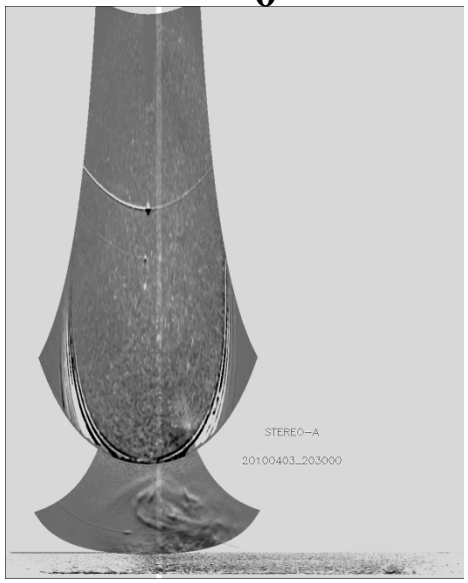
ε

θ

Manually

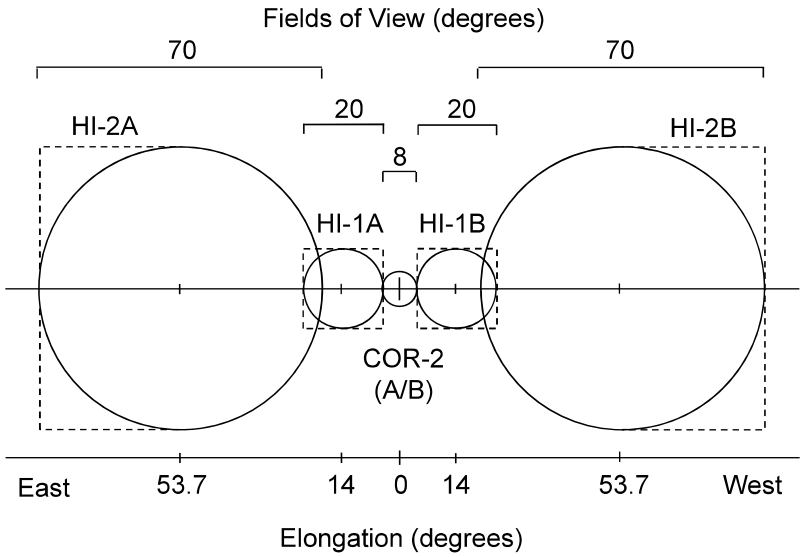
Fov2pos.pro
pix2coord.pro
drawcoordgrid.pro

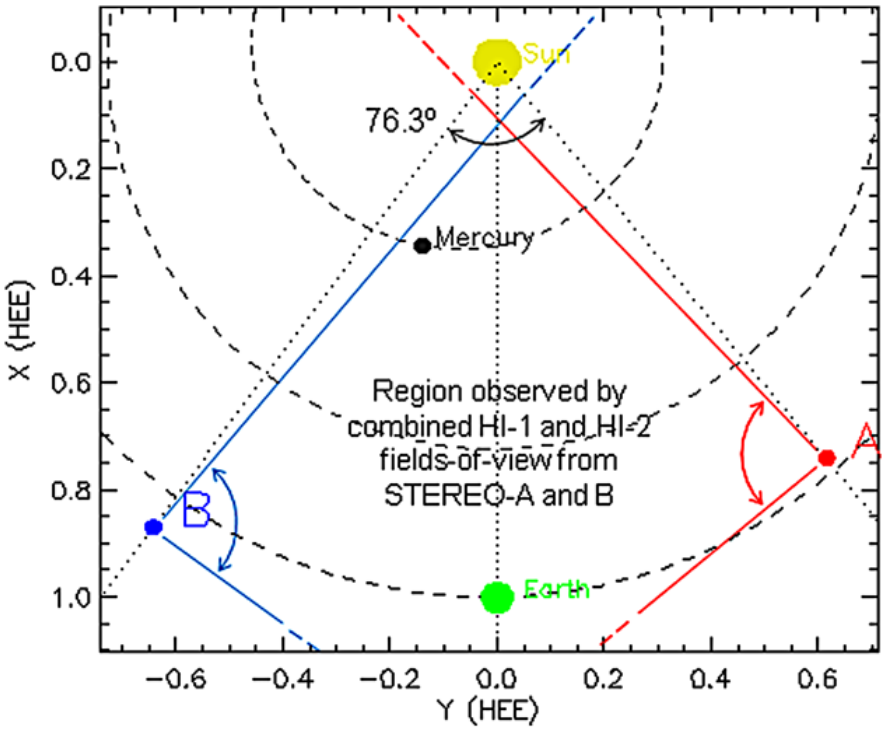




Satplot (cylindrical)

HI instrument – PoS vs. COR PoS





Eyles et al., SolPhys, 2009

- Plane of the sky of HI and COR are not the same
- Correction may be needed if we want continuous tracking and ID the same events

More topics to consider

- Conversion of elongation to radial distance
- Star and planet removal
- Use level-2 bg subtracted images, or level 1 running differences
- Do we need more complex processing methods? (e.g. C. DeForest)

Outlook

- The automatic CME identification in HI data will be done by adapting CACTus.
- The preparation for adapting CACTus to HI has been started.
- Some topics with respect to the treatment of the data need to be clarified, but the future looks bright.