

The background of the slide is a composite image. On the left, a large, textured orange-red sphere represents the Sun. To its right, a yellow and black spacecraft is shown in the solar wind. Below the Sun, a blue and green curved surface represents the Earth's magnetosphere, with yellow and white lines indicating magnetic field lines. Several other spacecraft are depicted: one near the top, one near the magnetosphere, and one near the Earth on the right. The Earth itself is visible in the bottom right corner, with the Moon in the far right.

Visualizations of the HI CME catalogue and solar wind magnetic field data

HELCATS open workshop May 2015

**Christian Möstl¹, Peter Boakes¹, Alexey Isavnin², Emilia
Kilpua², Jackie Davies³, Simon Good⁴, Bob Forsyth⁴, Volker
Bothmer⁵**

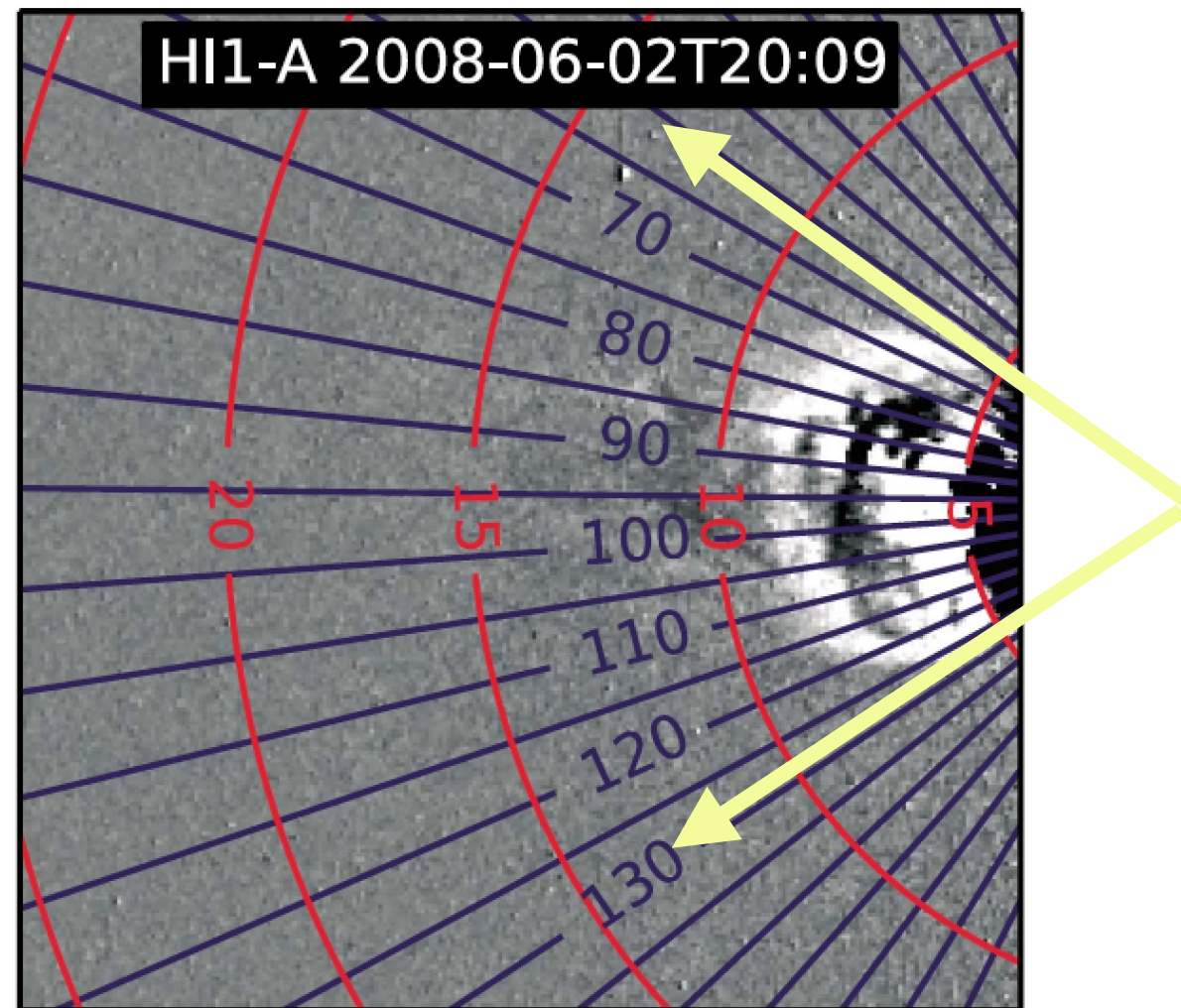
**¹University of Graz, Austria ²University of Helsinki, Finland
³RAL, UK ⁴Imperial College, London, UK ⁵University of
Göttingen, Germany**

christian.moestl@uni-graz.at

CMEs from prel. HI catalogue

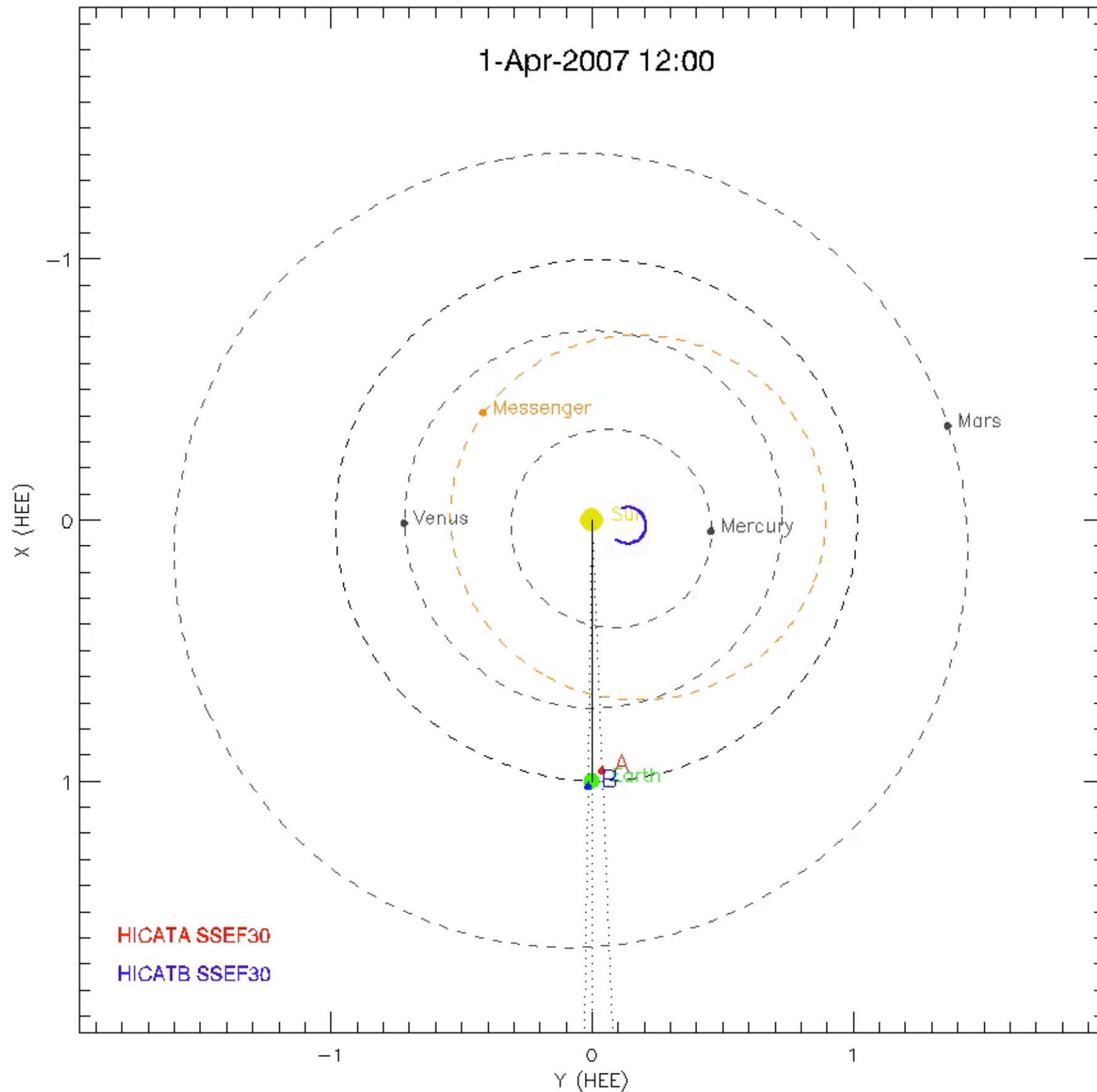


Barnard et al. 2014
Space Weather



- we select those CMEs which propagate with any part in the solar equatorial plane, as a proxy for the plane containing the planets (within a few degrees)
- tracks measured along central PAs
- SSEF model gives constant direction+speed, arrival time+speed
- results in **596 CMEs for STEREO-A HI** and **501 CMEs for STEREO-B HI**
- covers April 2007 – June 2013

HELCATS visualization of CME fronts

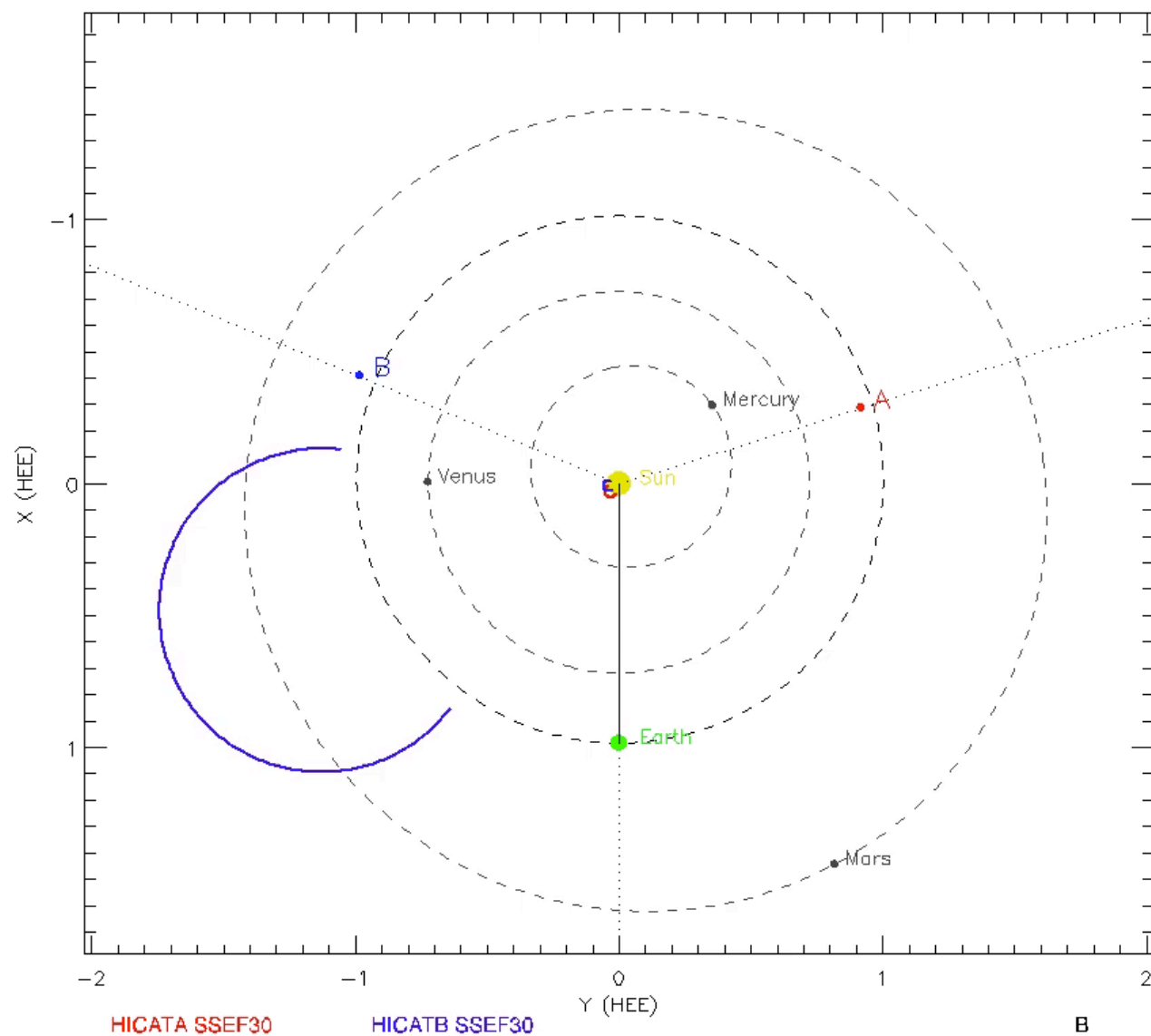


Arrival time prediction



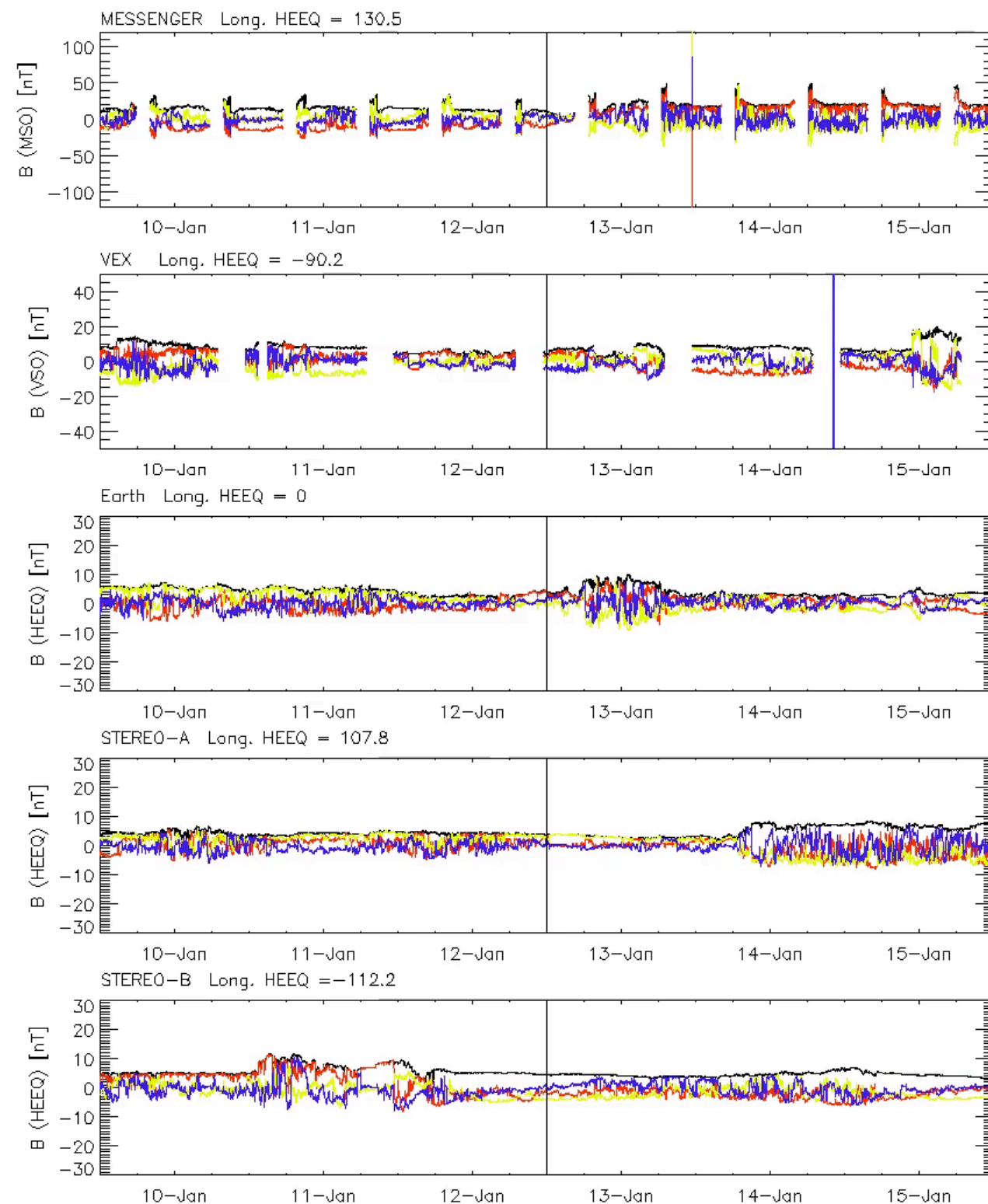
HELCATS in situ magnetic field visualization

12-Jan-2012 12:00

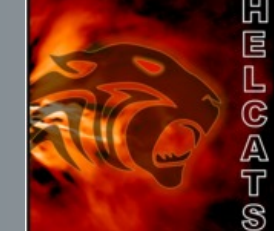


Plotted CMEs extend over PAs 90/270 and SSEF was successful.

by C. Moestl & P. Boakes (Graz), A. Isavnin & E. Kilpua (Helsinki)

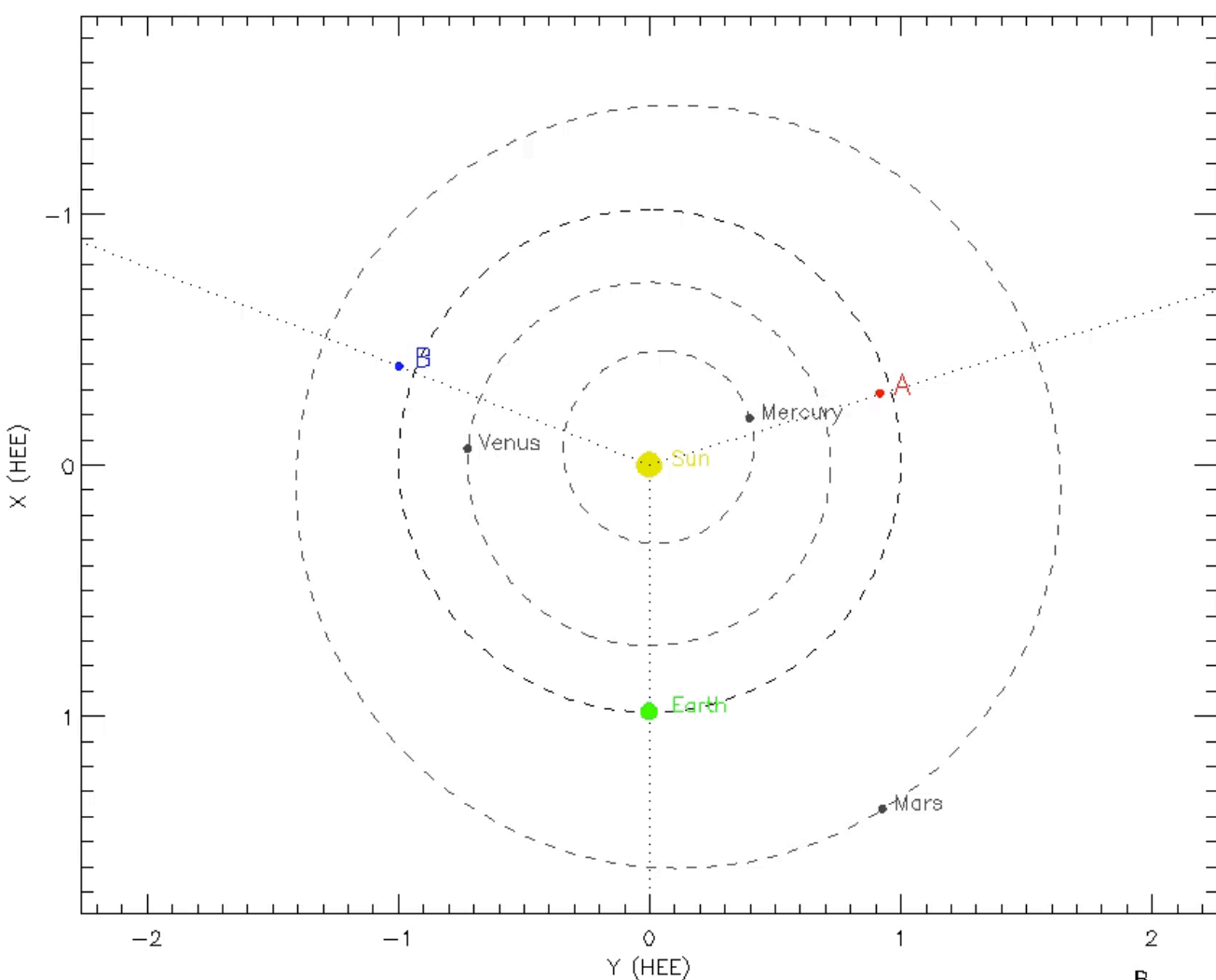


ICME catalogue



HELCATS in situ magnetic field visualization

4-Jan-2012 12:00

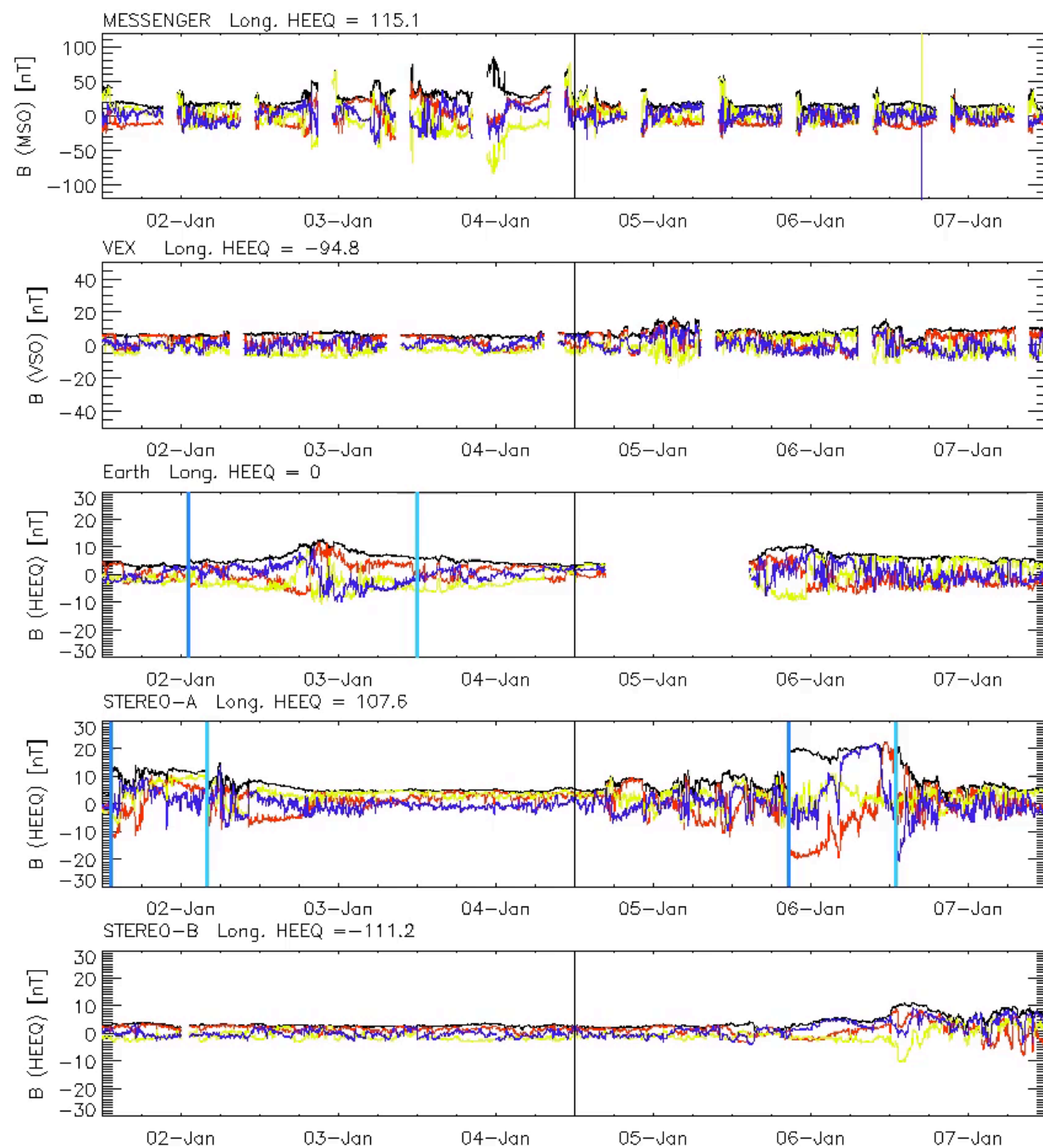


ICMEs: Good/Isavnin NASA Jian

HI CMEs extend over PAs 90/270 and SSEF was successful.

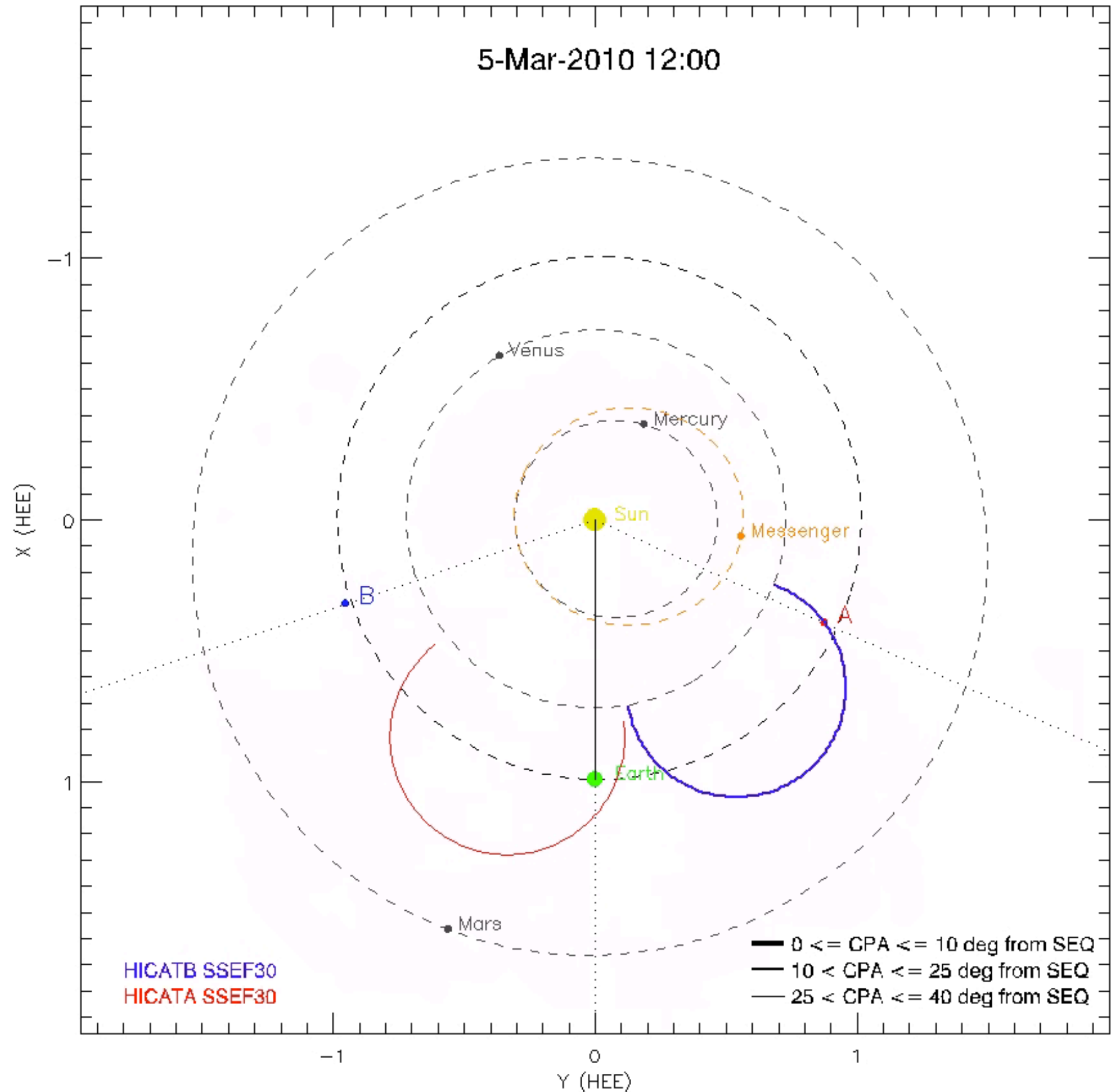
by C. Moestl & P. Boakes (Graz), A. Isavnin & E. Kilpua (Helsinki)

B
Bx
By
Bz



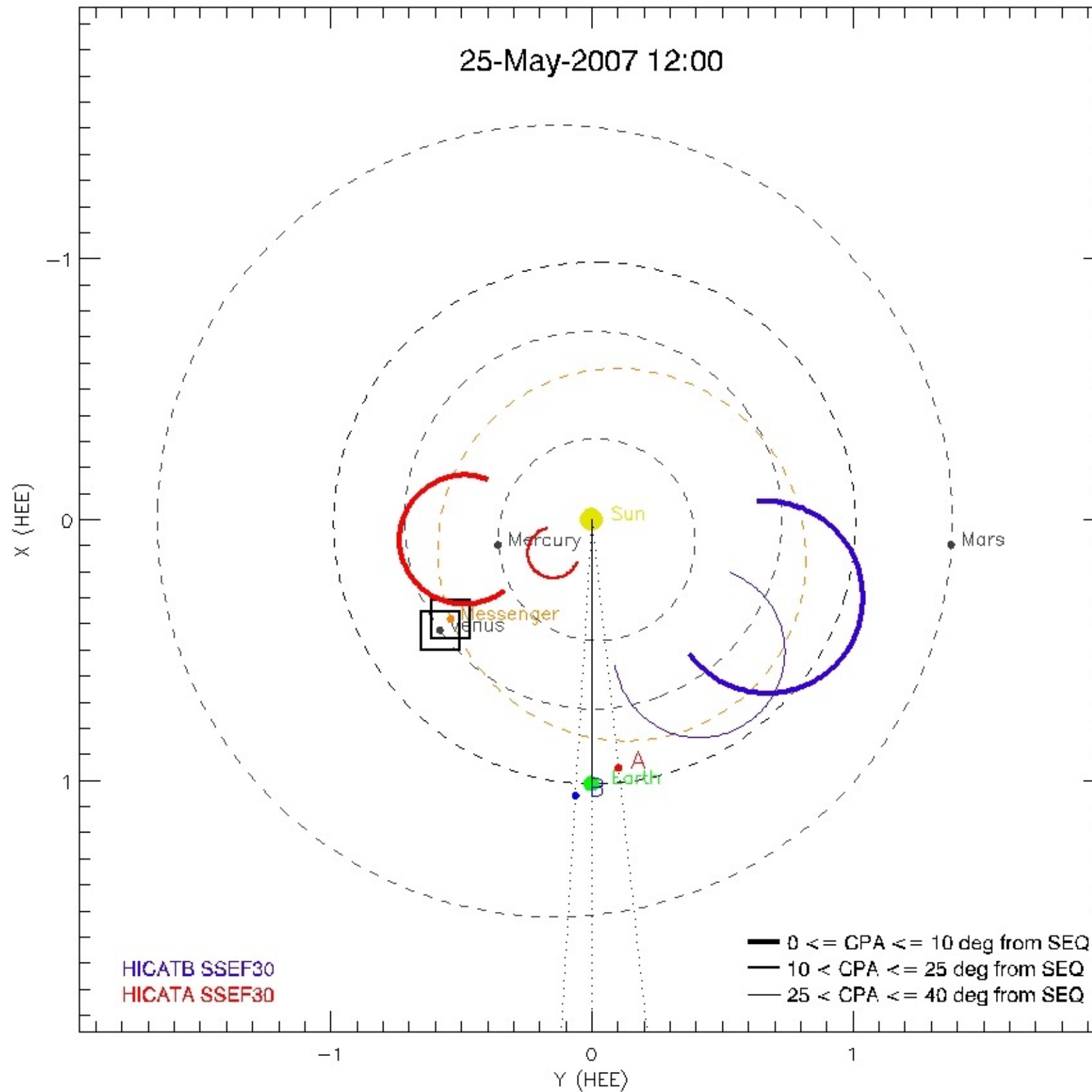
HELcats visualization of CME fronts

- ☐ ICME detections
s/c is inside
at current time
- + Low corona events
+/- 6 hours of frame
until Dec 2011



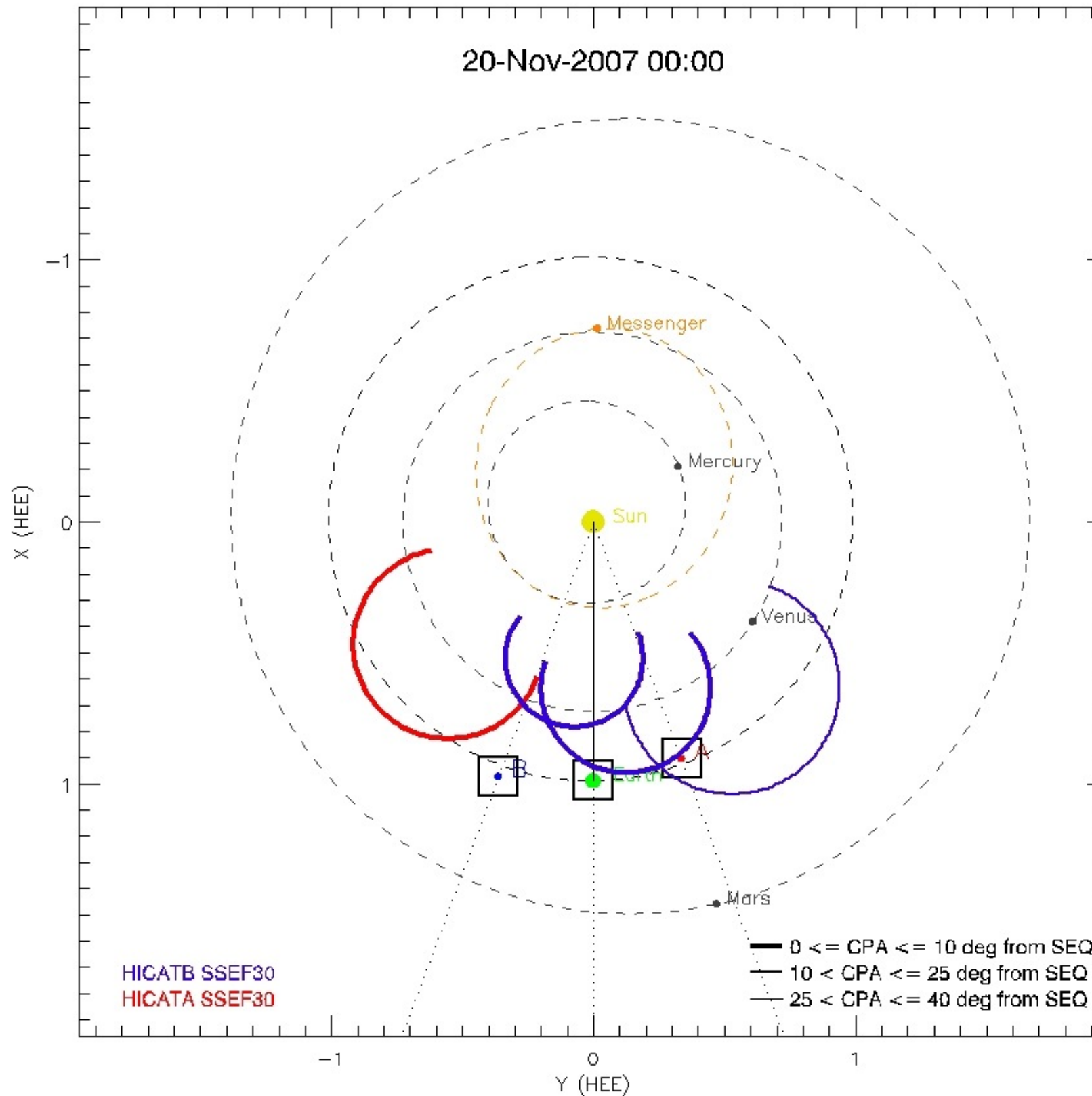
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STEREO events



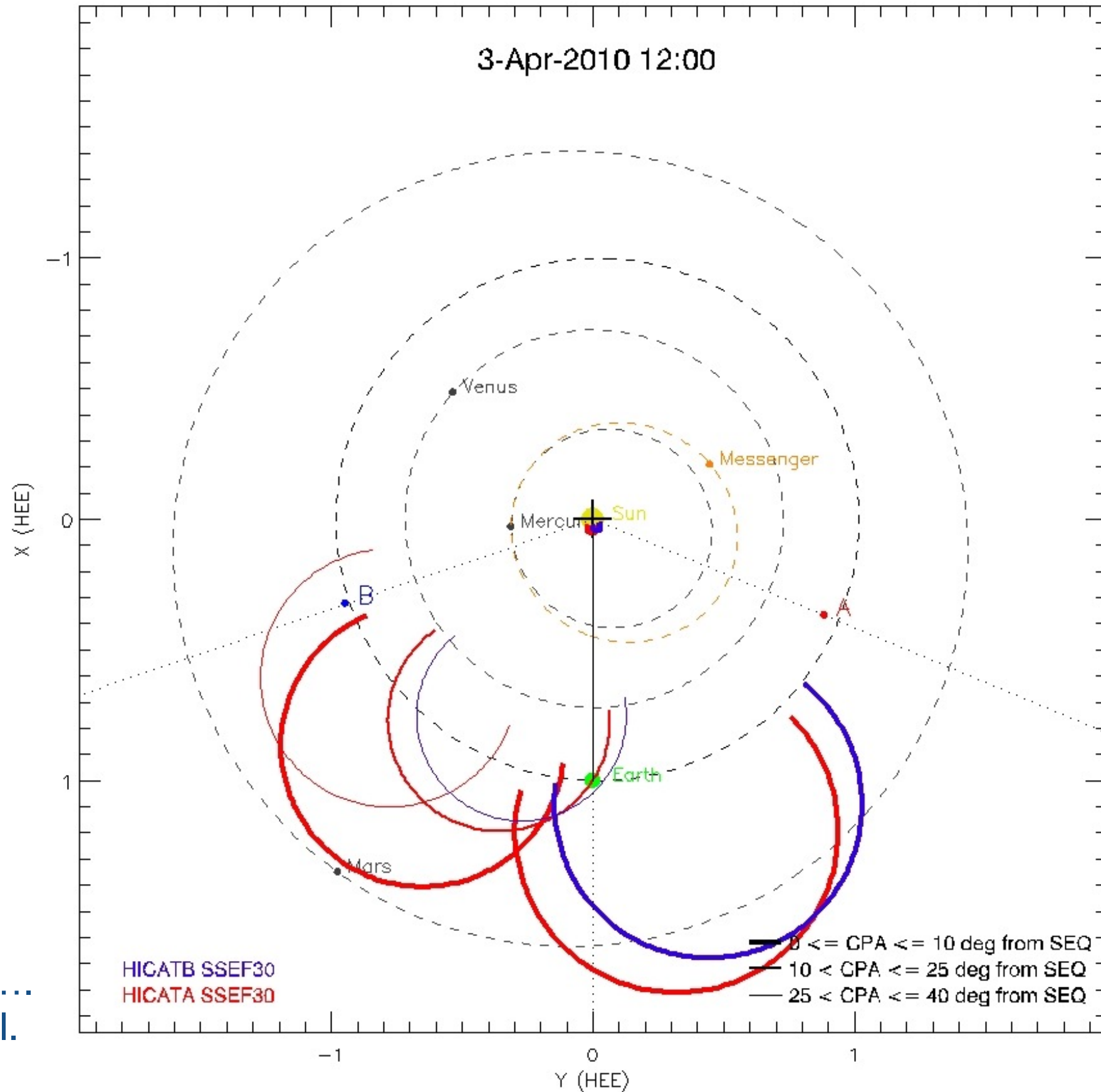
Rouillard et al. 2009 JGR

STEREO events



Farrugia et al. 2011 JASTP

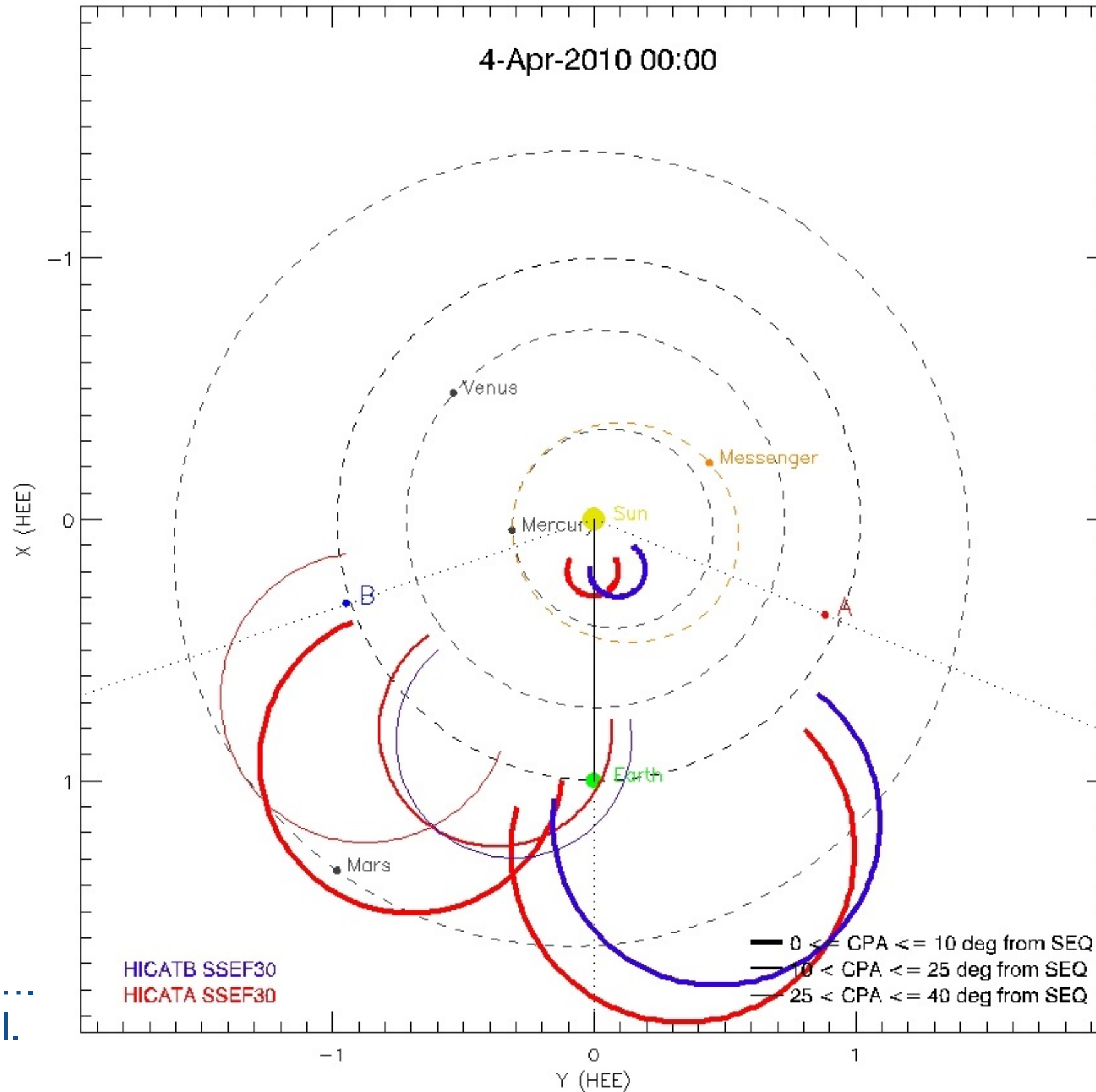
HELcats visualization of CME fronts



many studies....
e.g. Möstl et al.
2010 GRL

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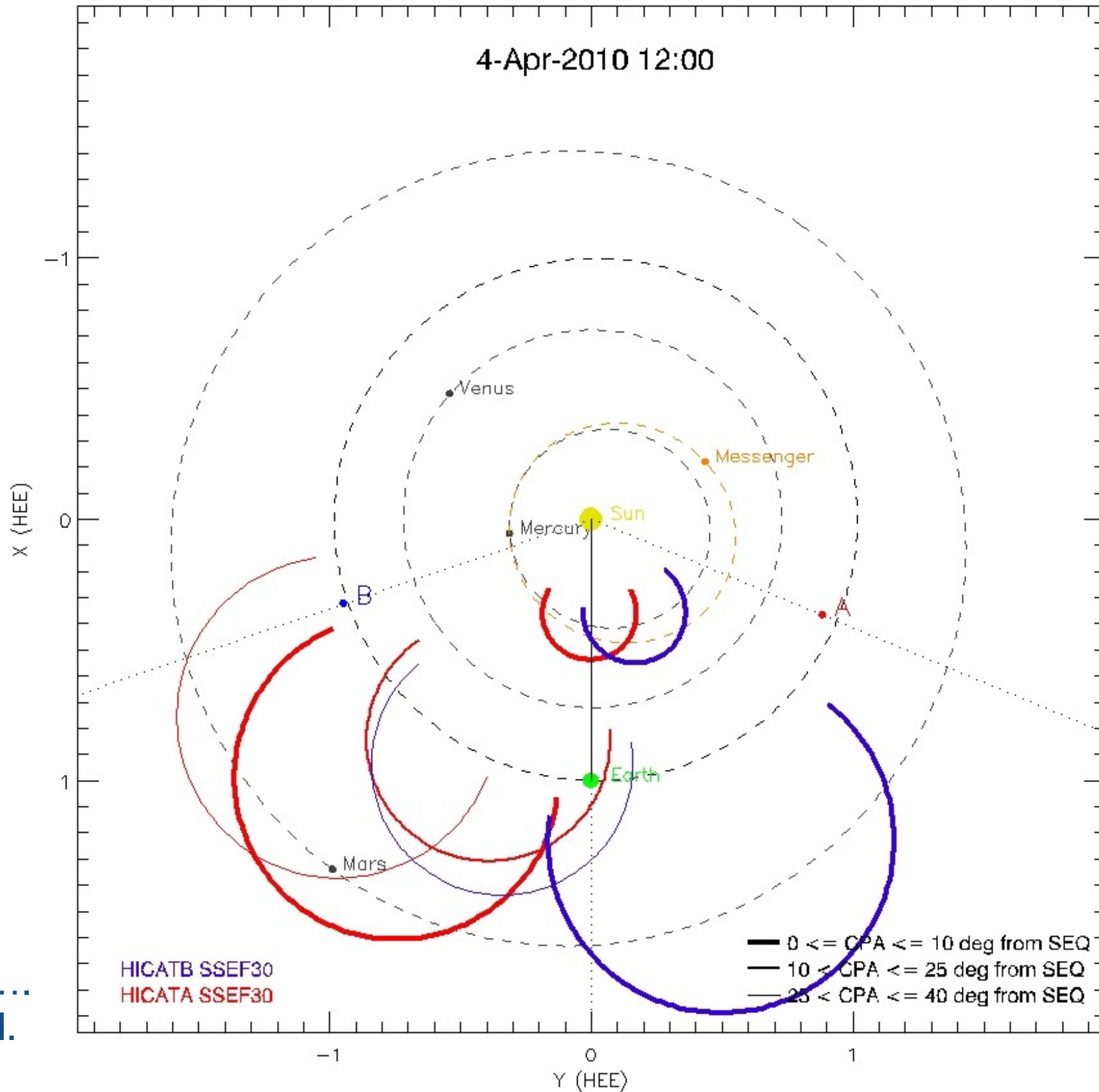
HELcats visualization of CME fronts



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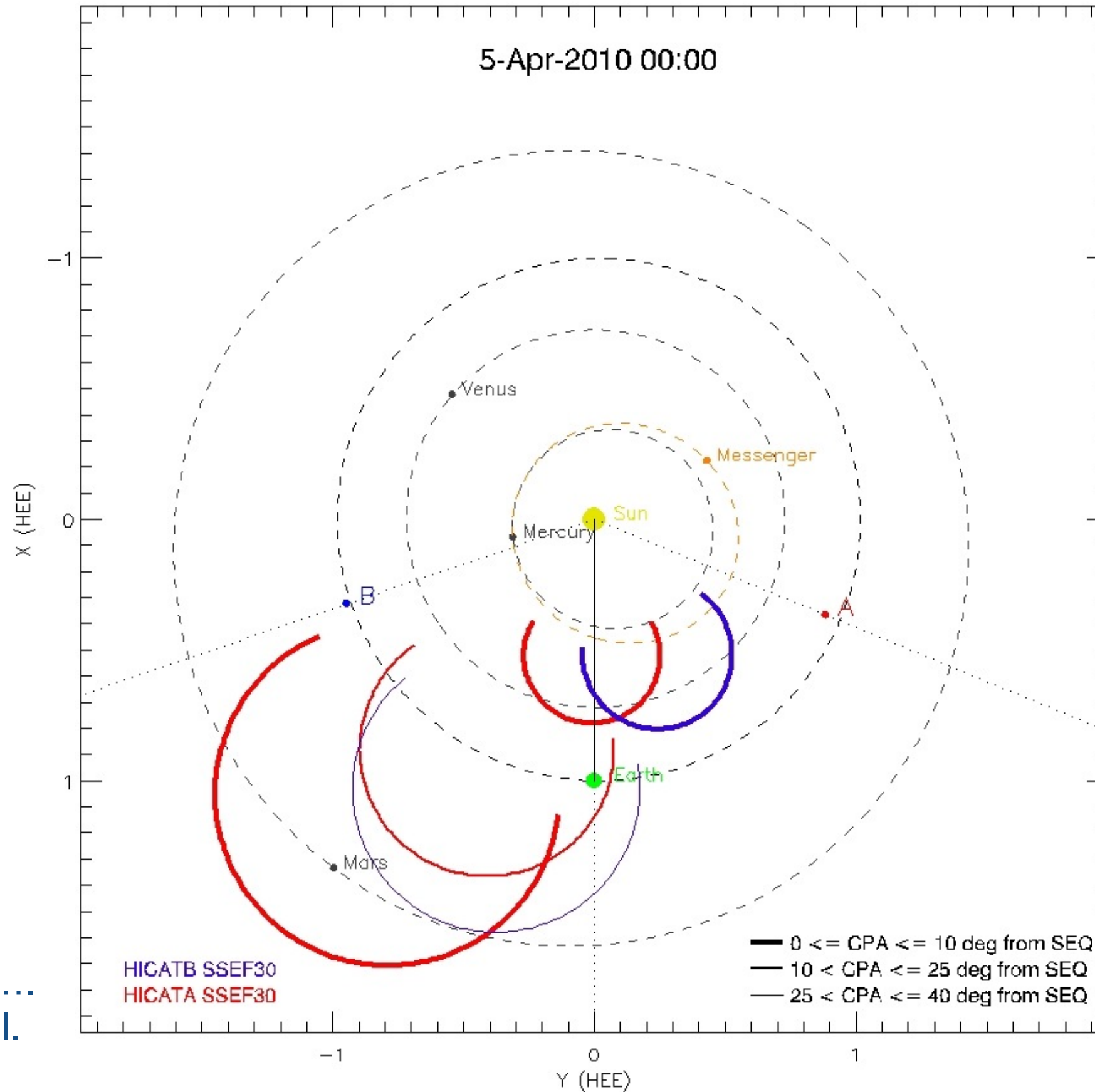
HELcats visualization of CME fronts



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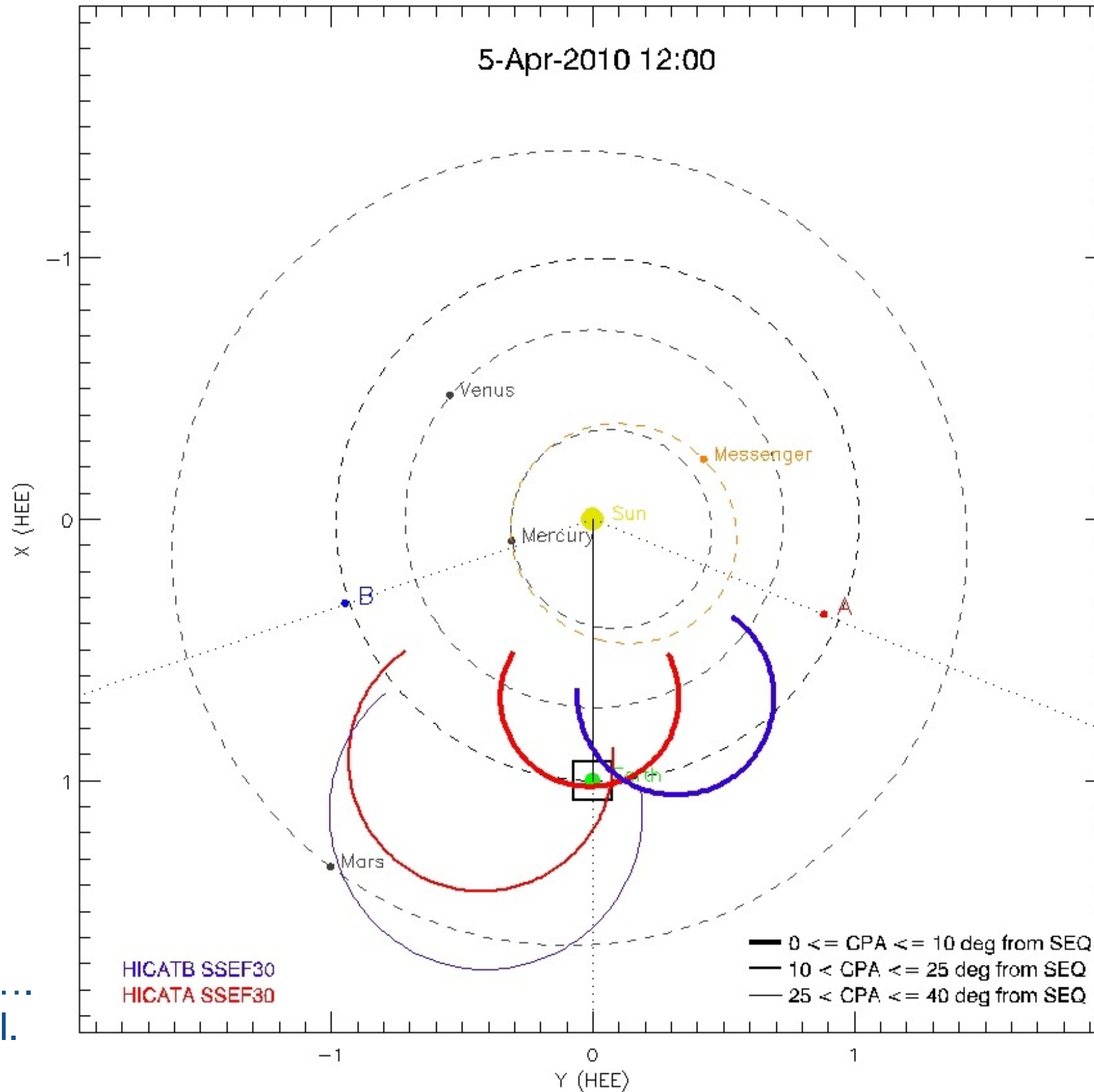
HELcats visualization of CME fronts



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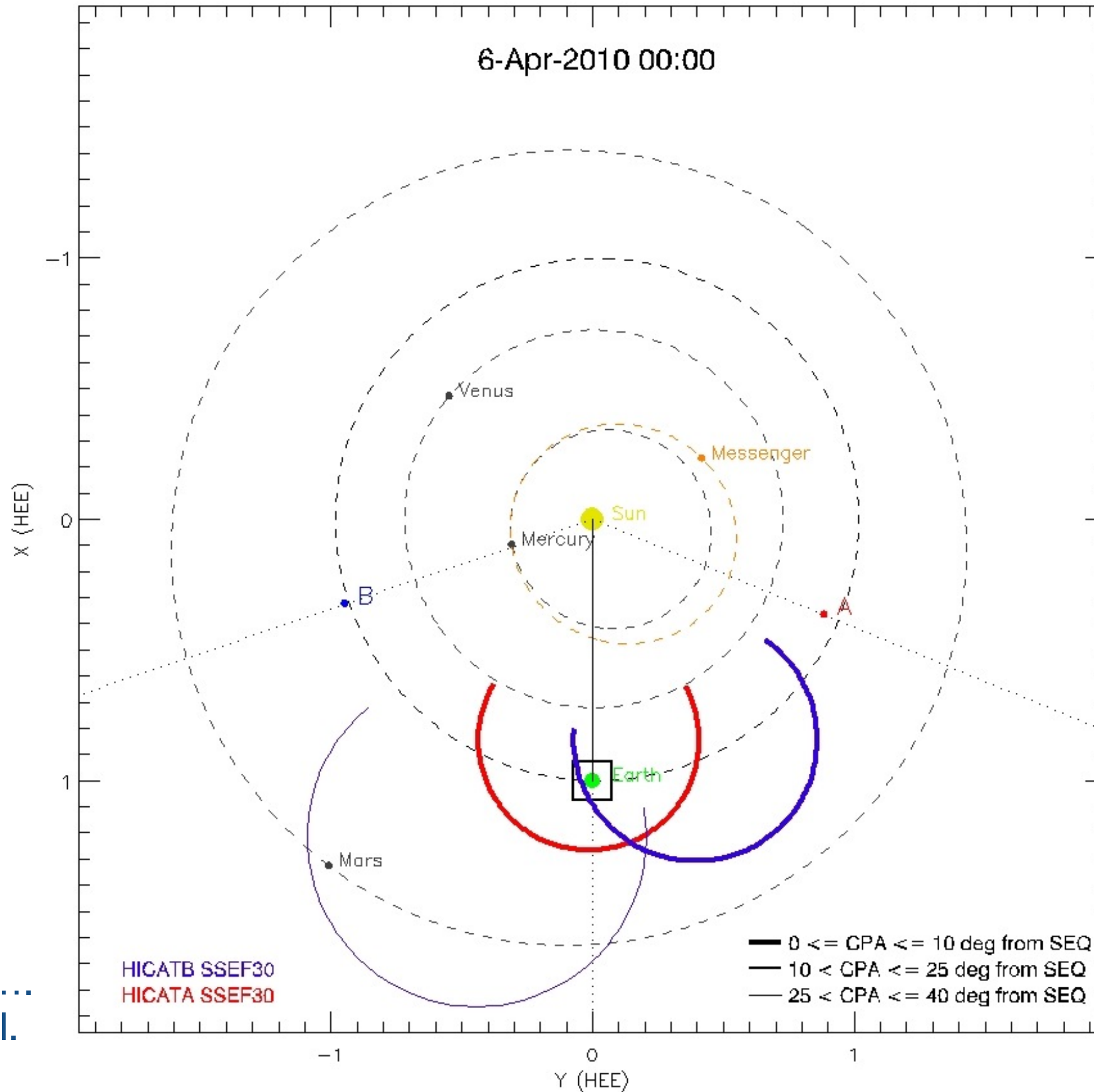
HELcats visualization of CME fronts



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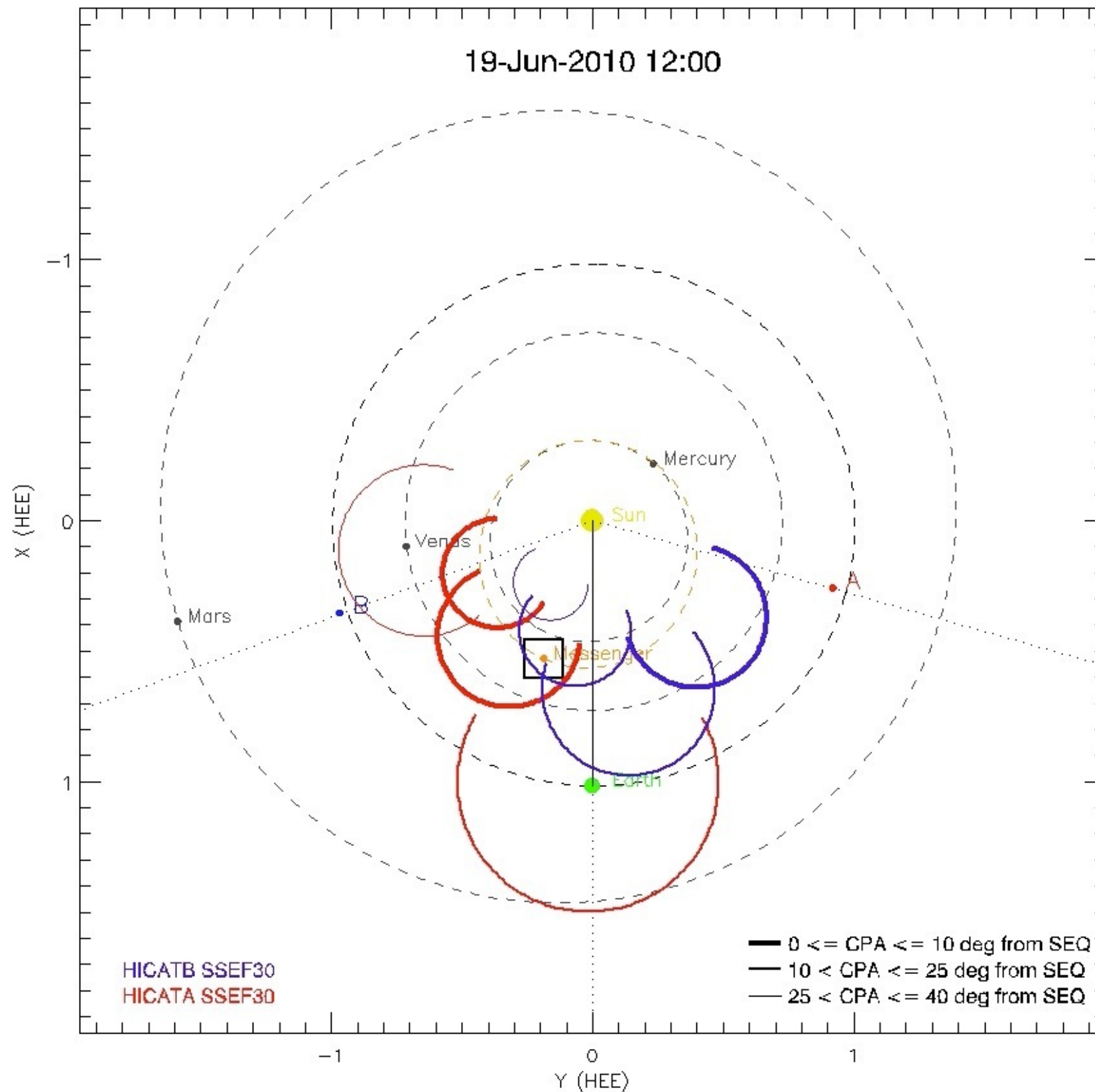
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STEREO events

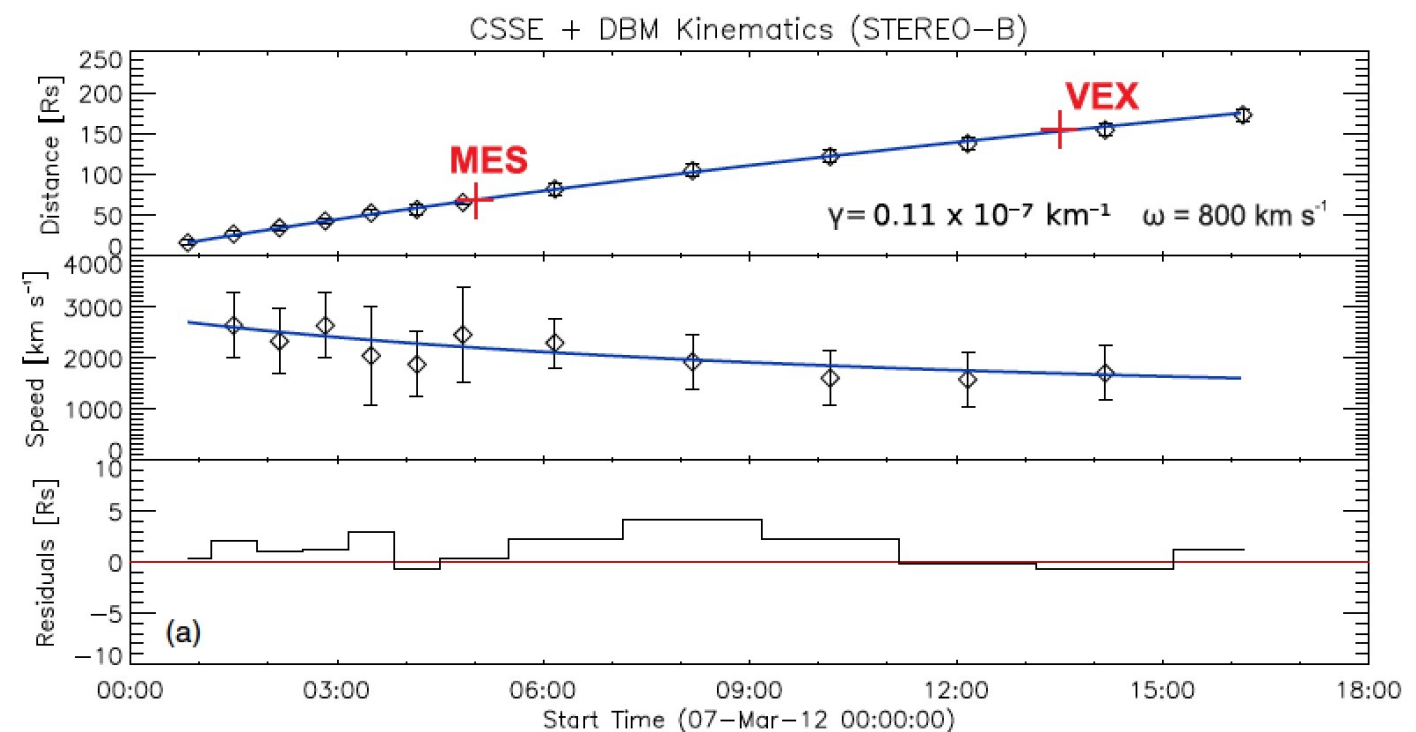
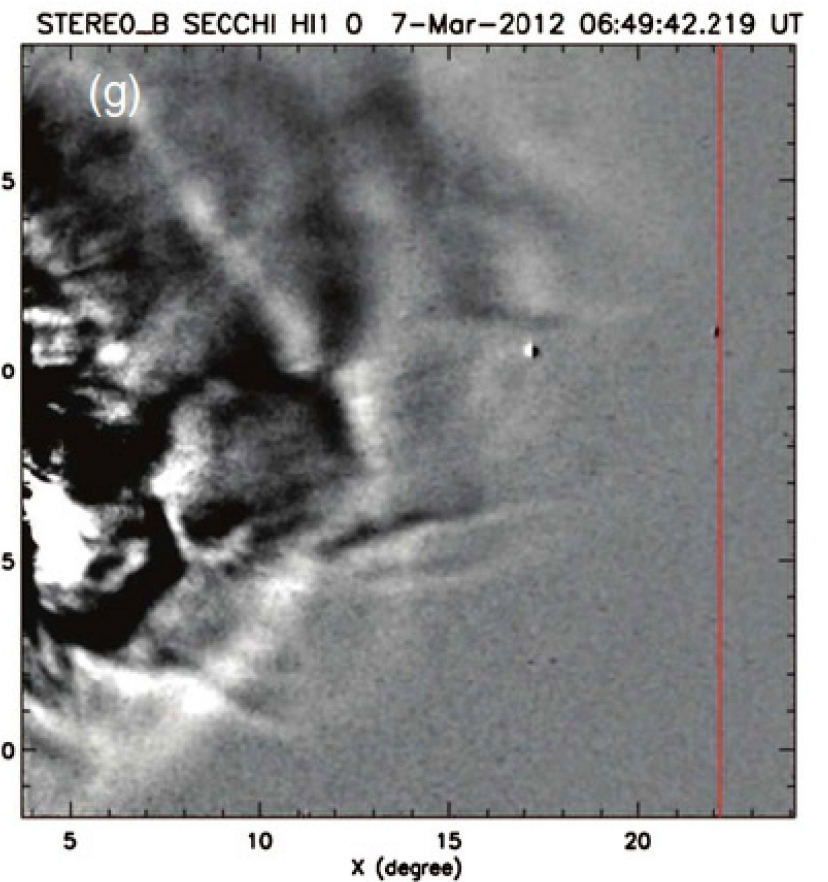
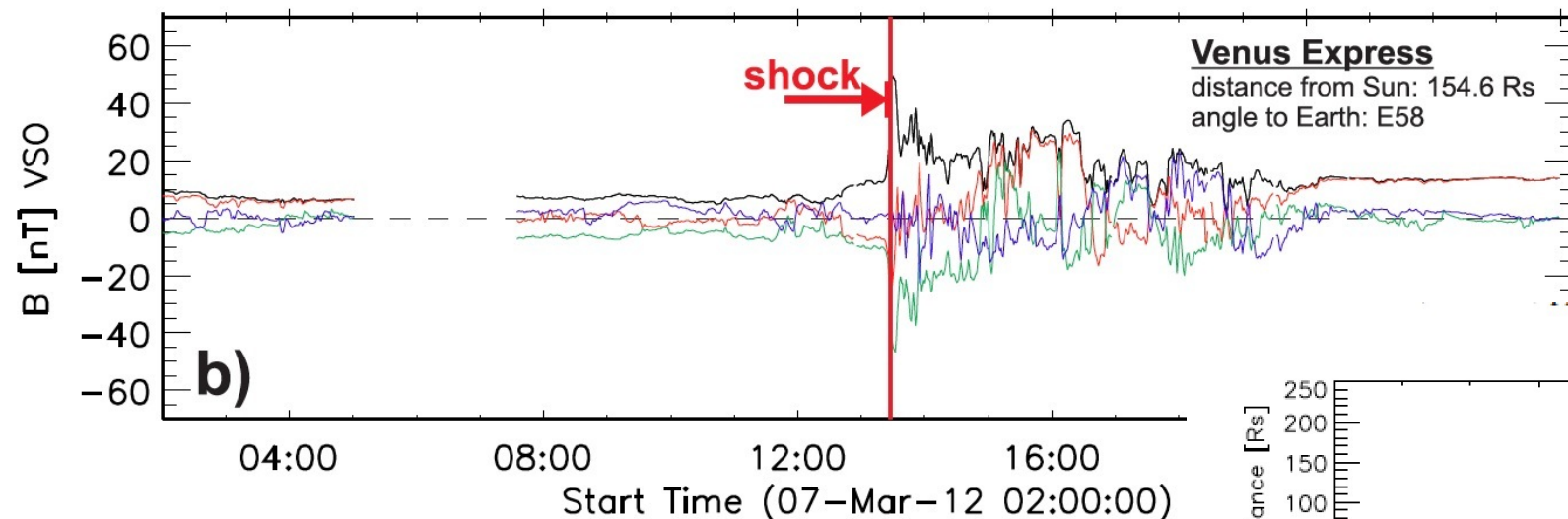
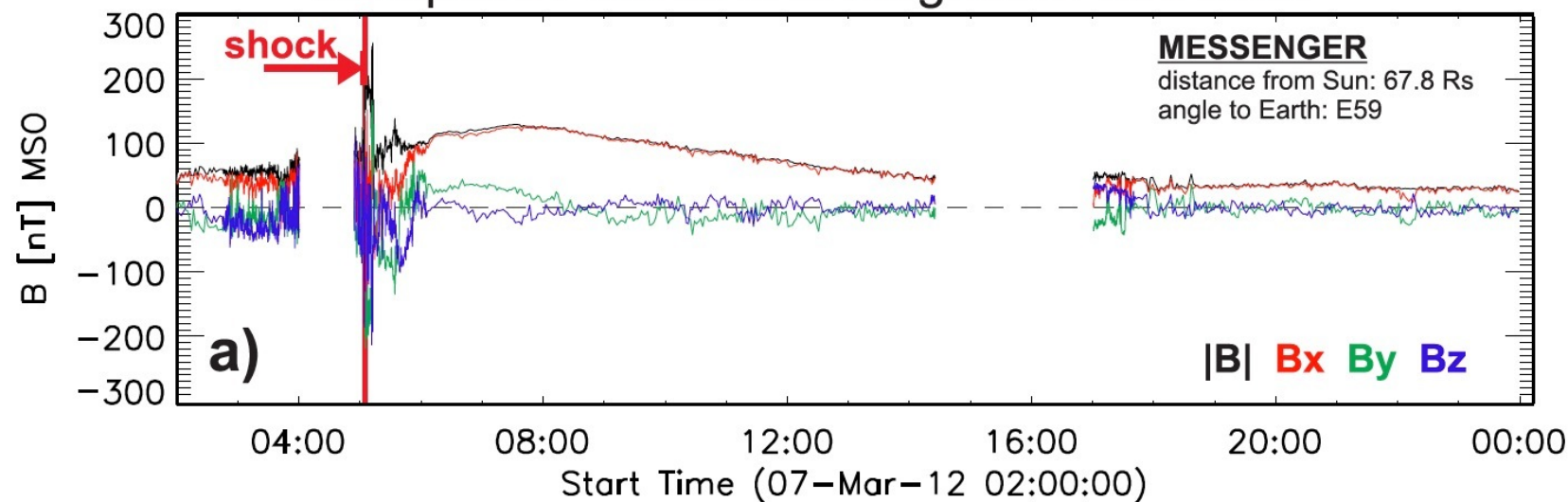


new science?

Multipoint lineups



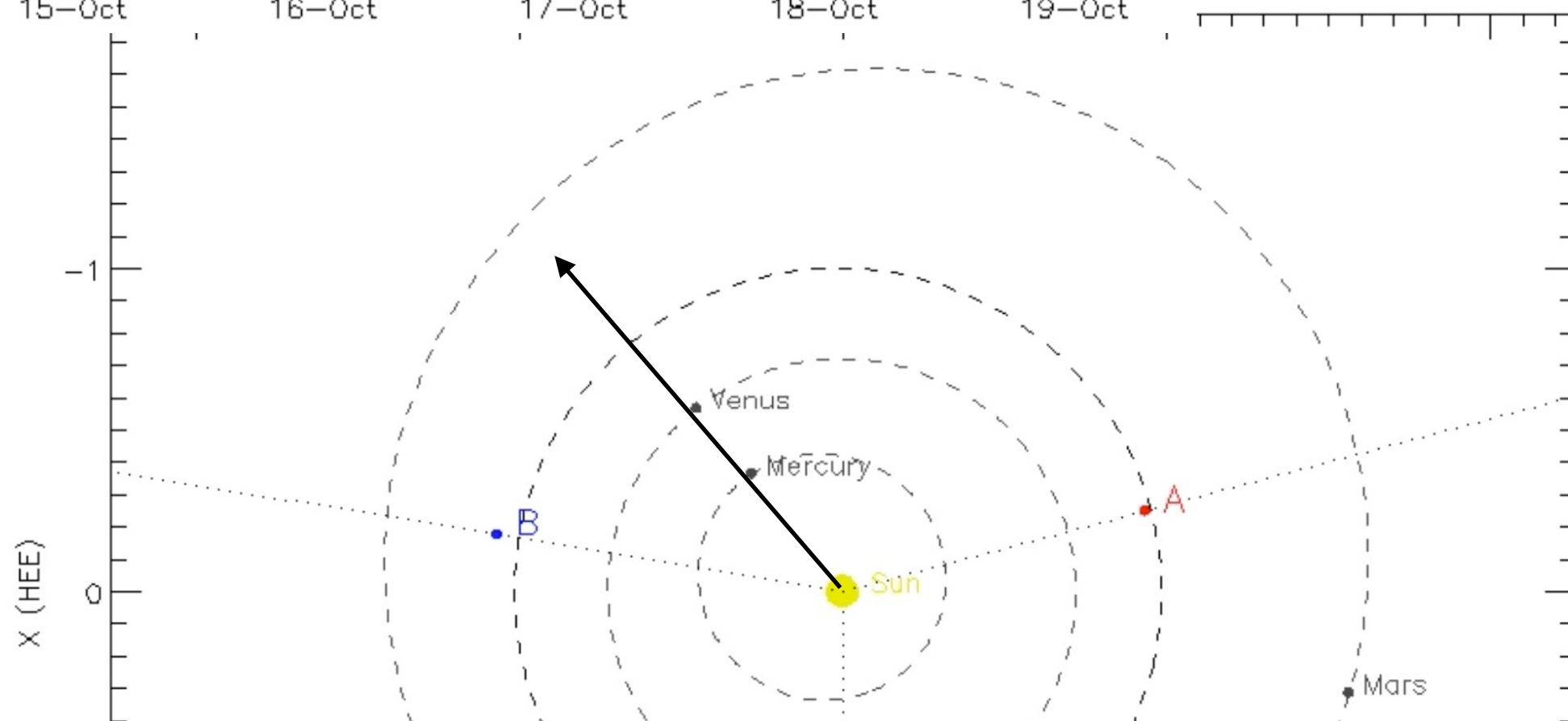
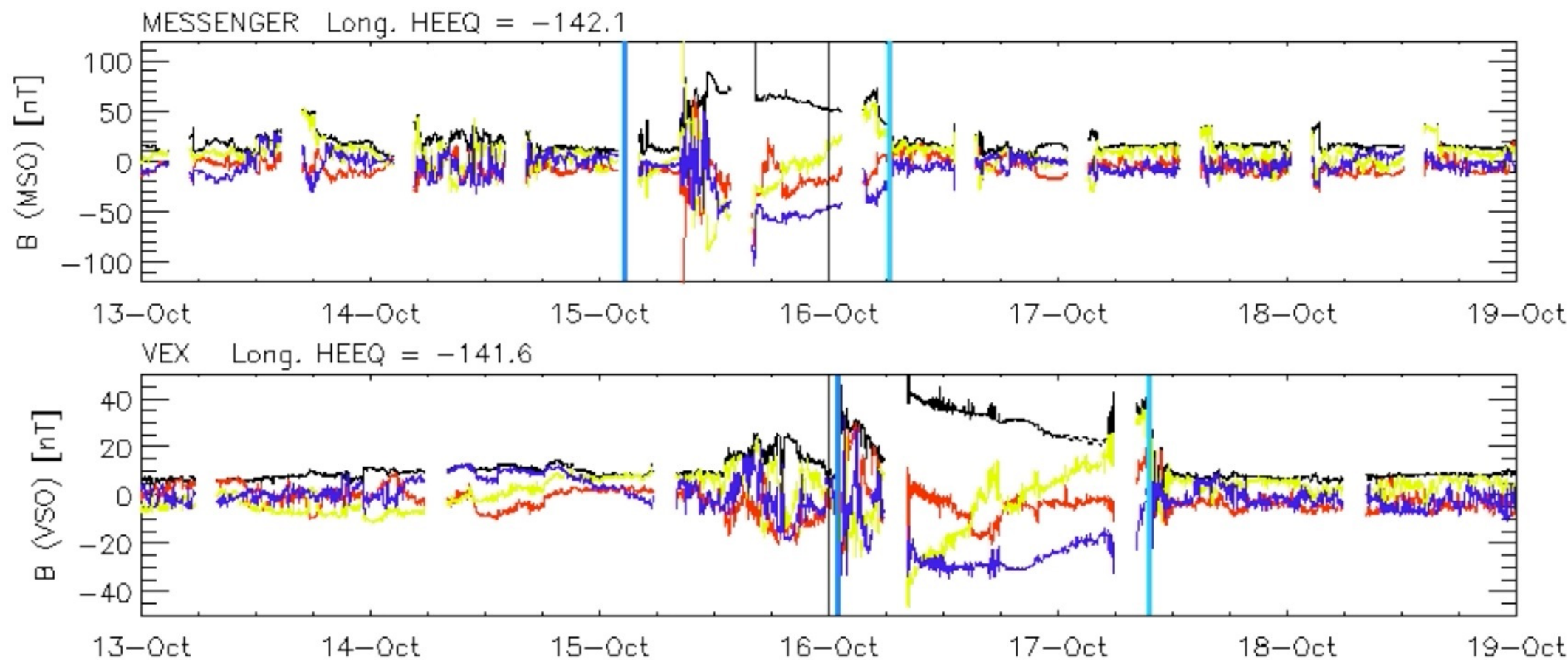
Multipoint Plasma and Magnetic Field Data



How do CMEs propagate?

Rollett et al. 2014 ApJL

Multipoint lineups

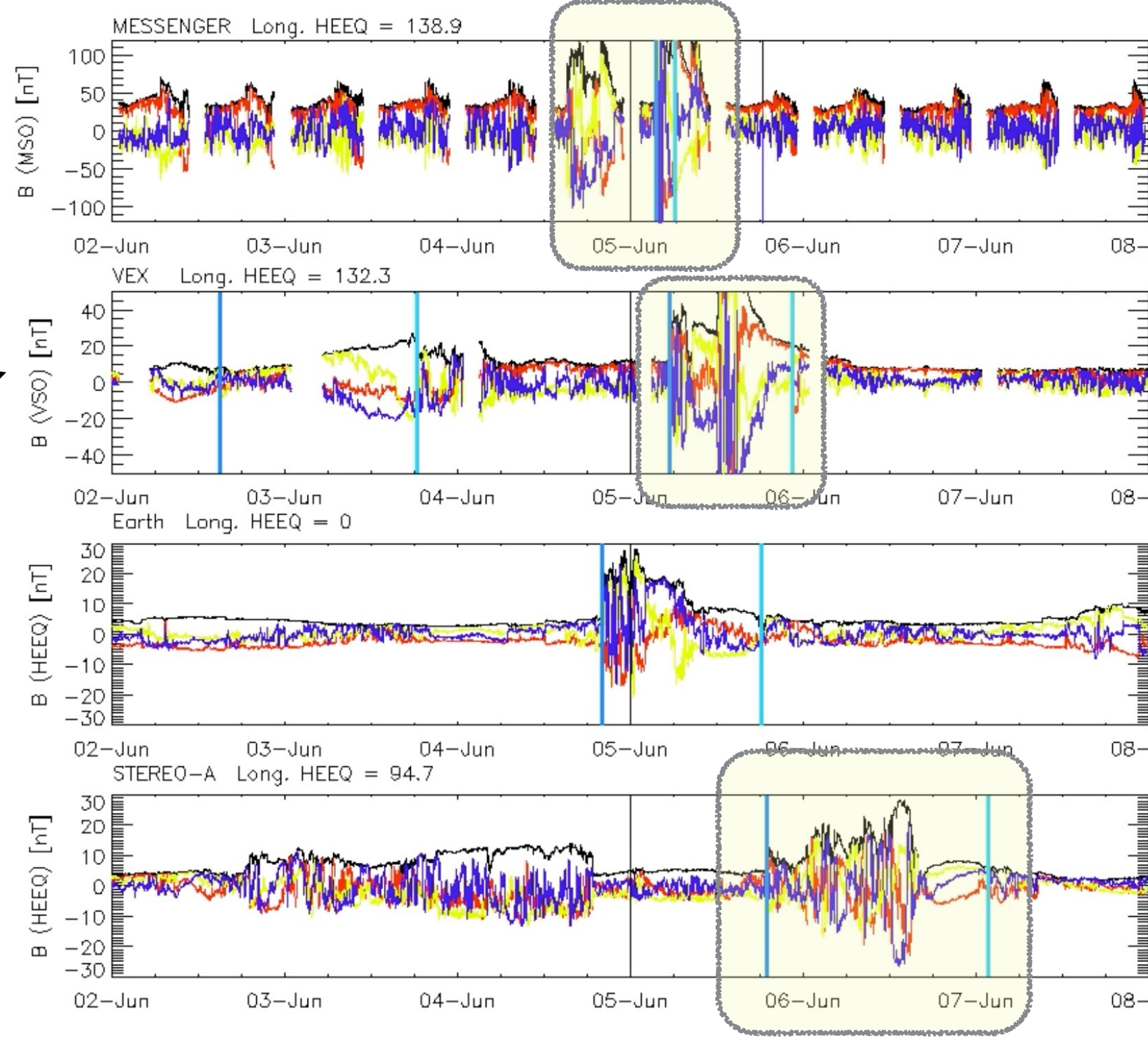
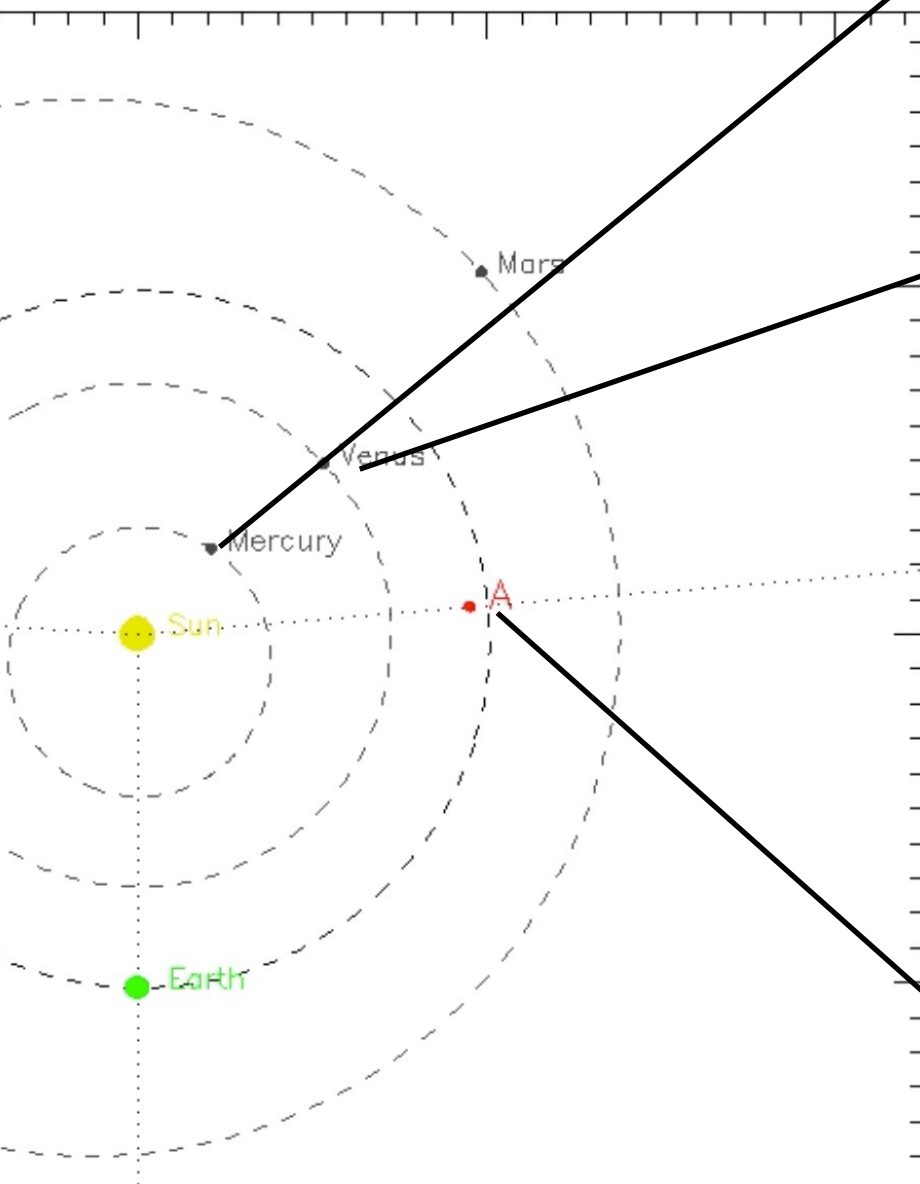


Do CME flux ropes rotate?
e.g.
Vourlidas et al. 2011
Isavnin et al. 2014

Multipoint lineups



2011 00:00

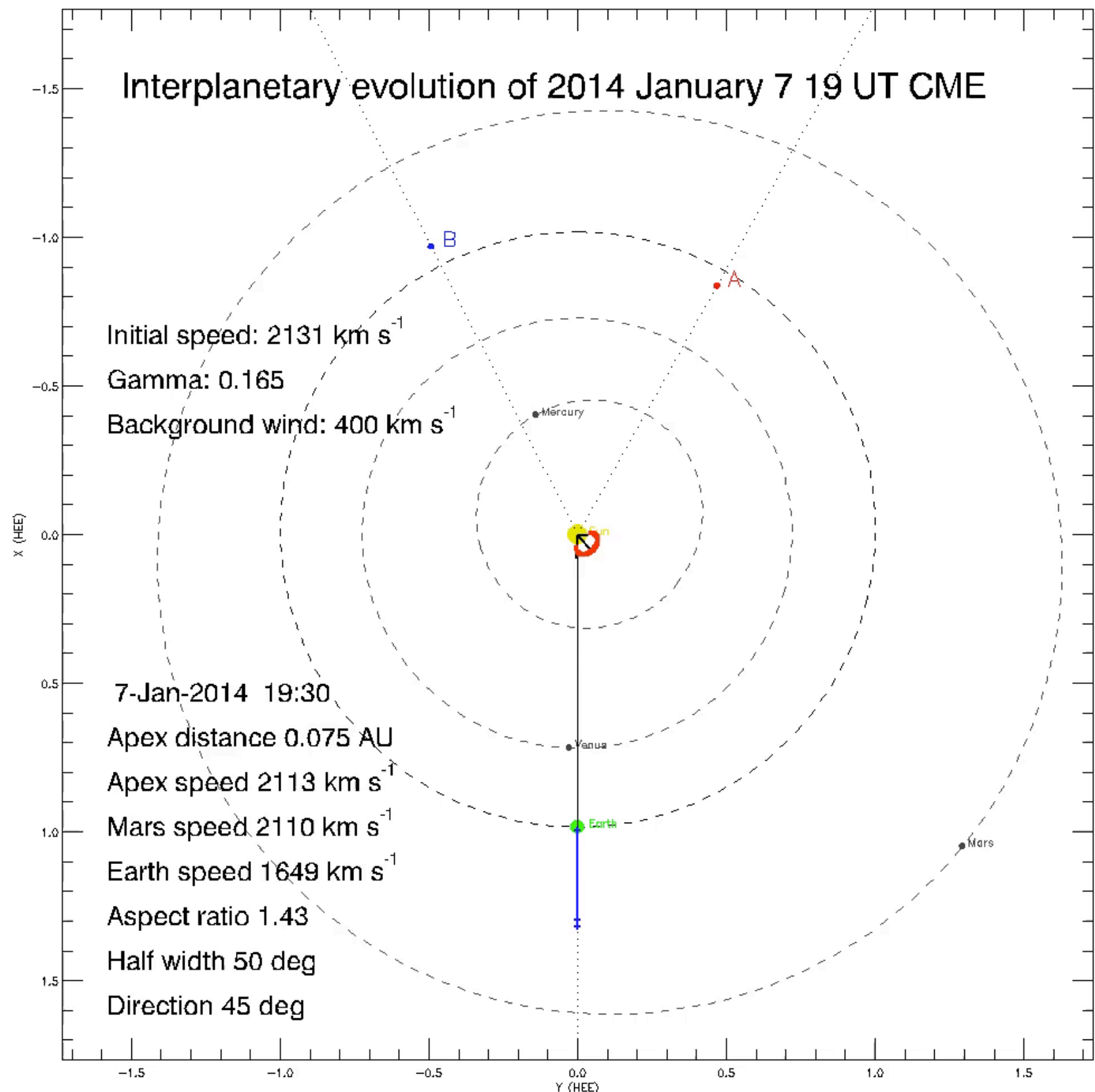


is CME-CME interaction inelastic, super-elastic, super in-elastic ? e.g. Temmer et al. 2012 ApJ

Ellipse evolution (ElEvo) model



- Möstl et al.
2015 Nat. Comm.
out Wed May 27
- use CME initial speed and direction
- ElEvo has 4 free parameters all constant
 - drag
 - background wind
 - width
 - aspect ratio
- **optimized aspect ratio of shock: 1.4 ± 0.4**
- consistent with Janvier et al. 2015 : 1.3



Summary



- Visualizations are very useful for browsing the HI CME catalogue and in situ data and to independently verify results.
- These movies will be updated with the new HI catalogue.
- Will also be made publicly available online with the products.
- **Current versions can be obtained by just asking me!**