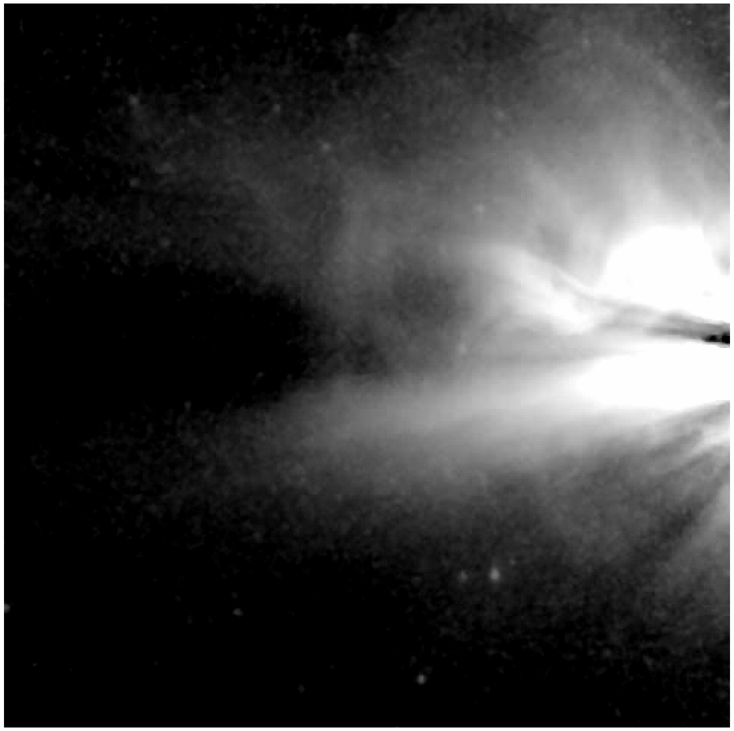
STEREO – Heliospheric Imagers

- HI status and operation *nominal*
  - Instrument paper – Eyles et al., 2009, Solar Phys. 254, 387
  - First light and review of first 2 years – Harrison et al., 2008, Solar Phys. 247, 171 & Harrison et al., 2009, Solar Phys. 256, 219
  - Calibration and performance – Brown et al., 2009, Solar Phys. 254, 185; Bewsher et al., 2010, submittec to Solar Phys.

00:09 UT, 15 February 2008



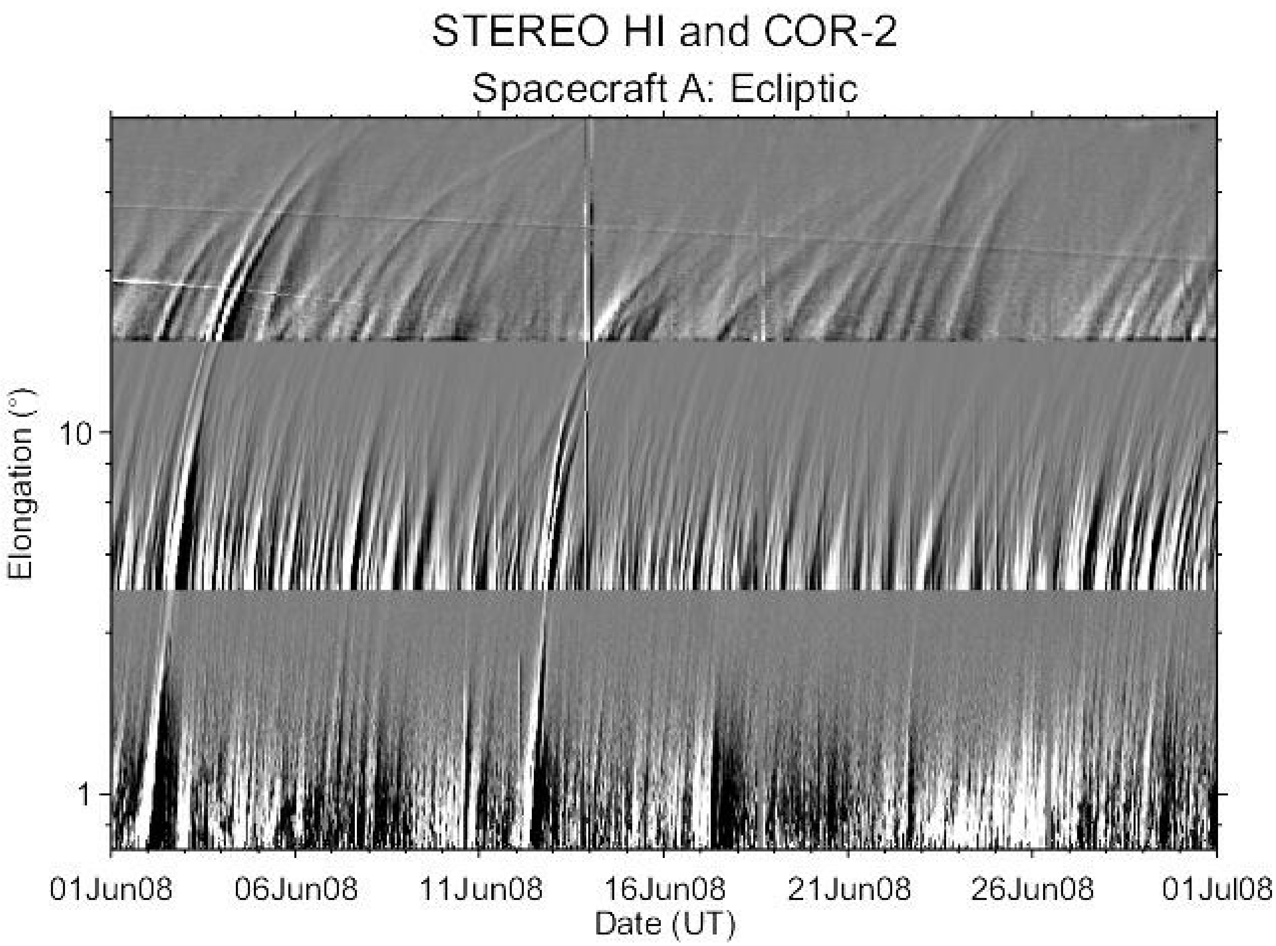
STEREO – Heliospheric Imagers

- Products: Images and movies, J-plots, c-maps
    - see http://www.sstd.rl.ac.uk/stereo/

- Exploitation – 67 publications known to the PI team
    - Includes 19 distinct institutes
    - Encompasses CME onsets, CME propagation and impacts at Earth and on other solar system bodies, cometary impacts, asteroids, stellar variability, CIRs, streamer ‘blobs’, dust…

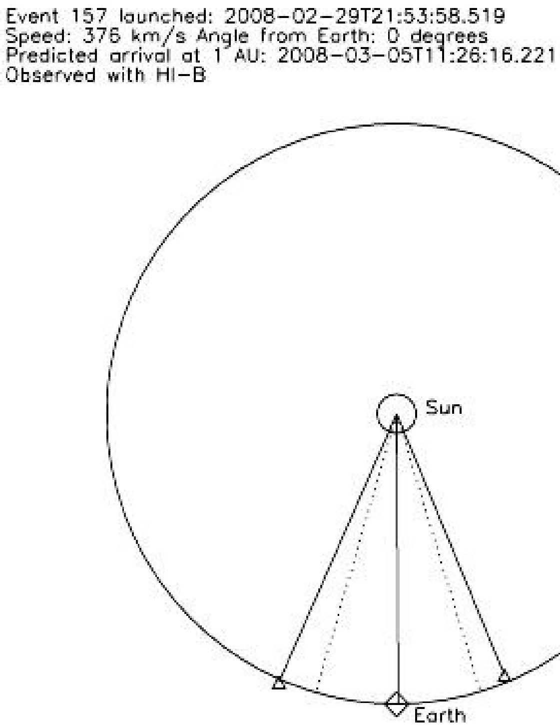
STEREO – Heliospheric Imagers – ‘Products’

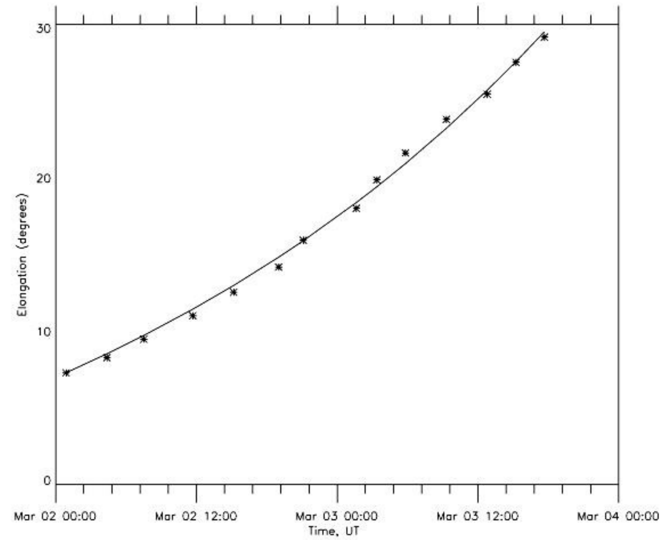
- J-plots – Fitting elongation-time profiles to determine both speed and direction with respect to the Sun-Earth line (see Davies et al., 2009)

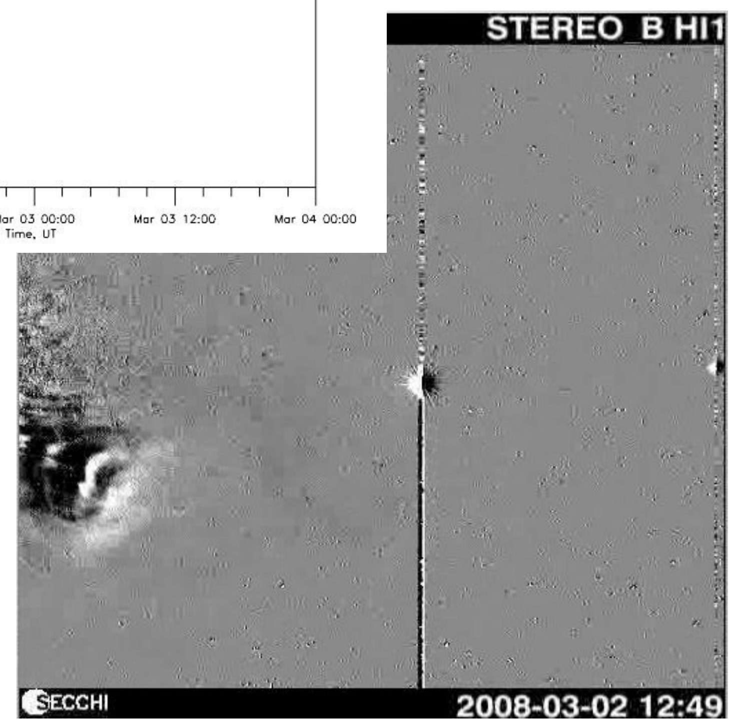


STEREO – Heliospheric Imagers

- 109 HI ICMEs catalogued for 2007 and 2008 (see HI web site) – J-plot technique used to study the passage of CMEs in 3D (Harrison et al., in prep)



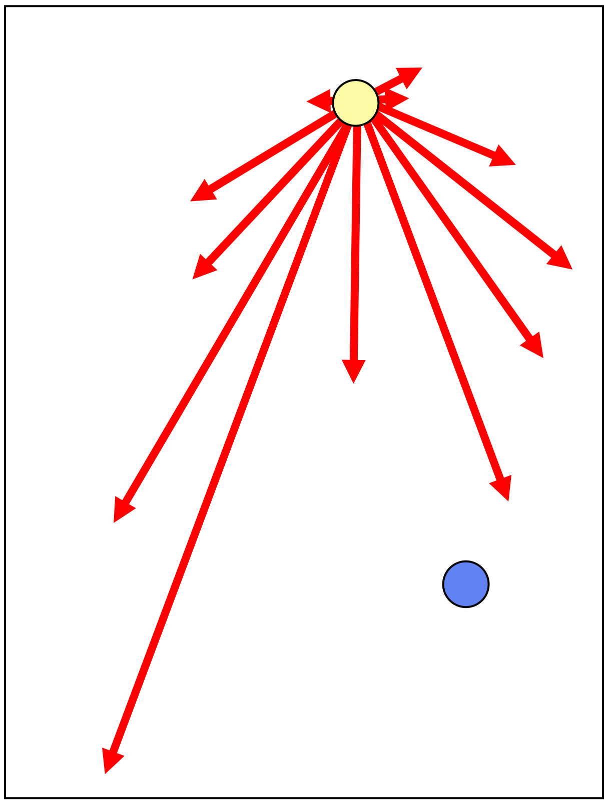


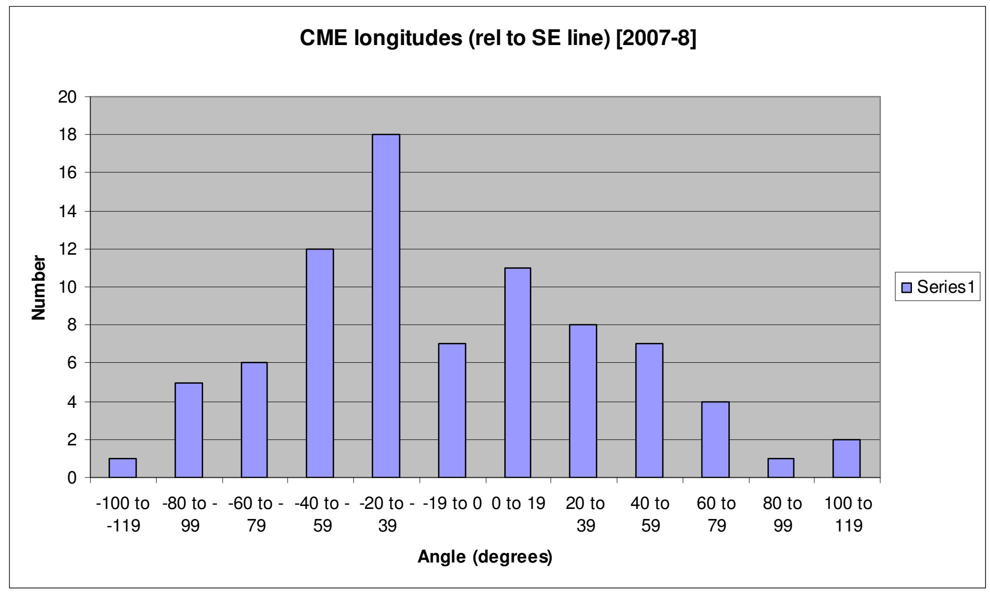


Example product-set for 29 Feb 2008 ICME from event list – J-plot analysis appears to show Earth-impact - 12 similar impacts identified for 2008

STEREO – Heliospheric Imagers

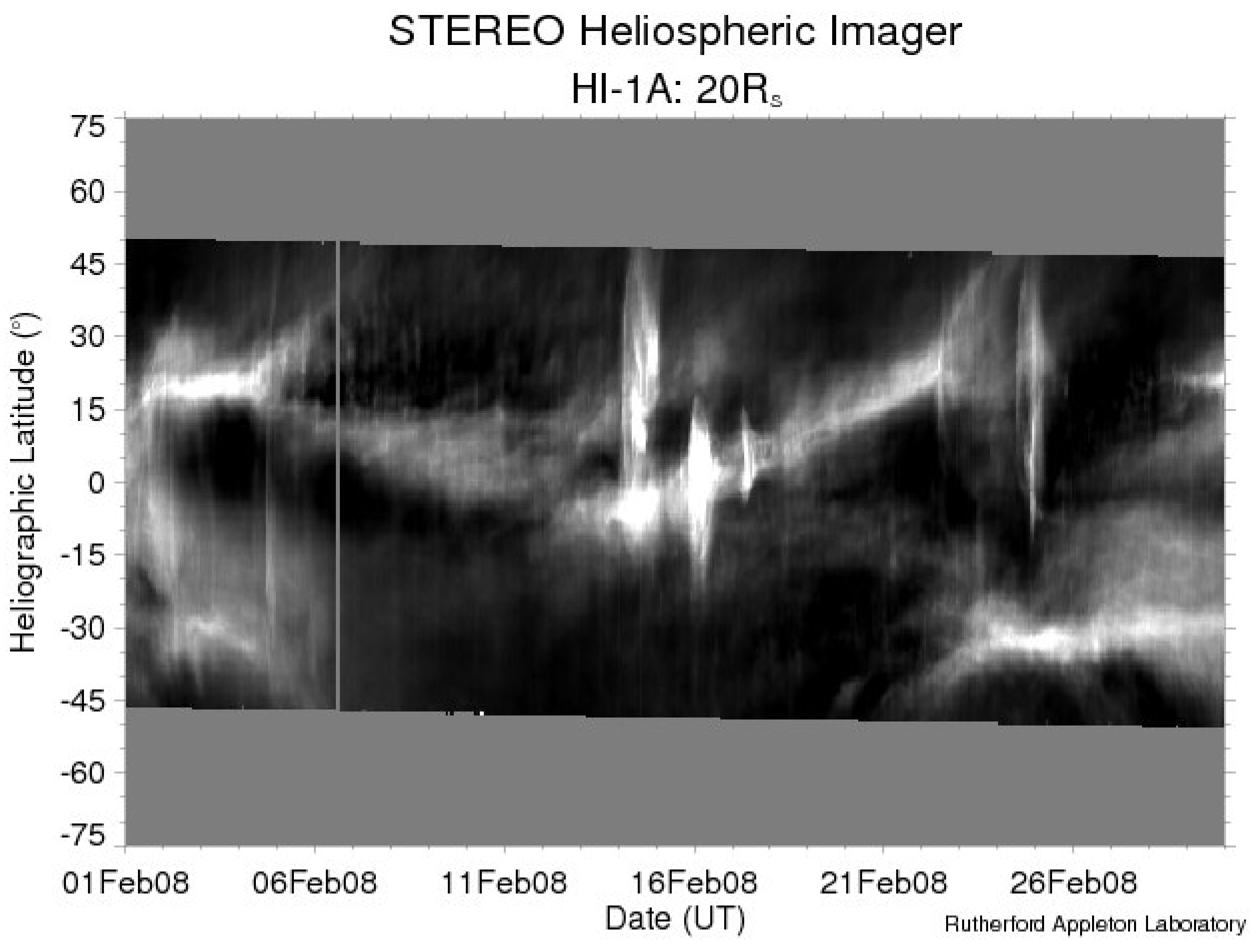
- 3D distribution of the 109 HI ICMEs from 2007 and 2008





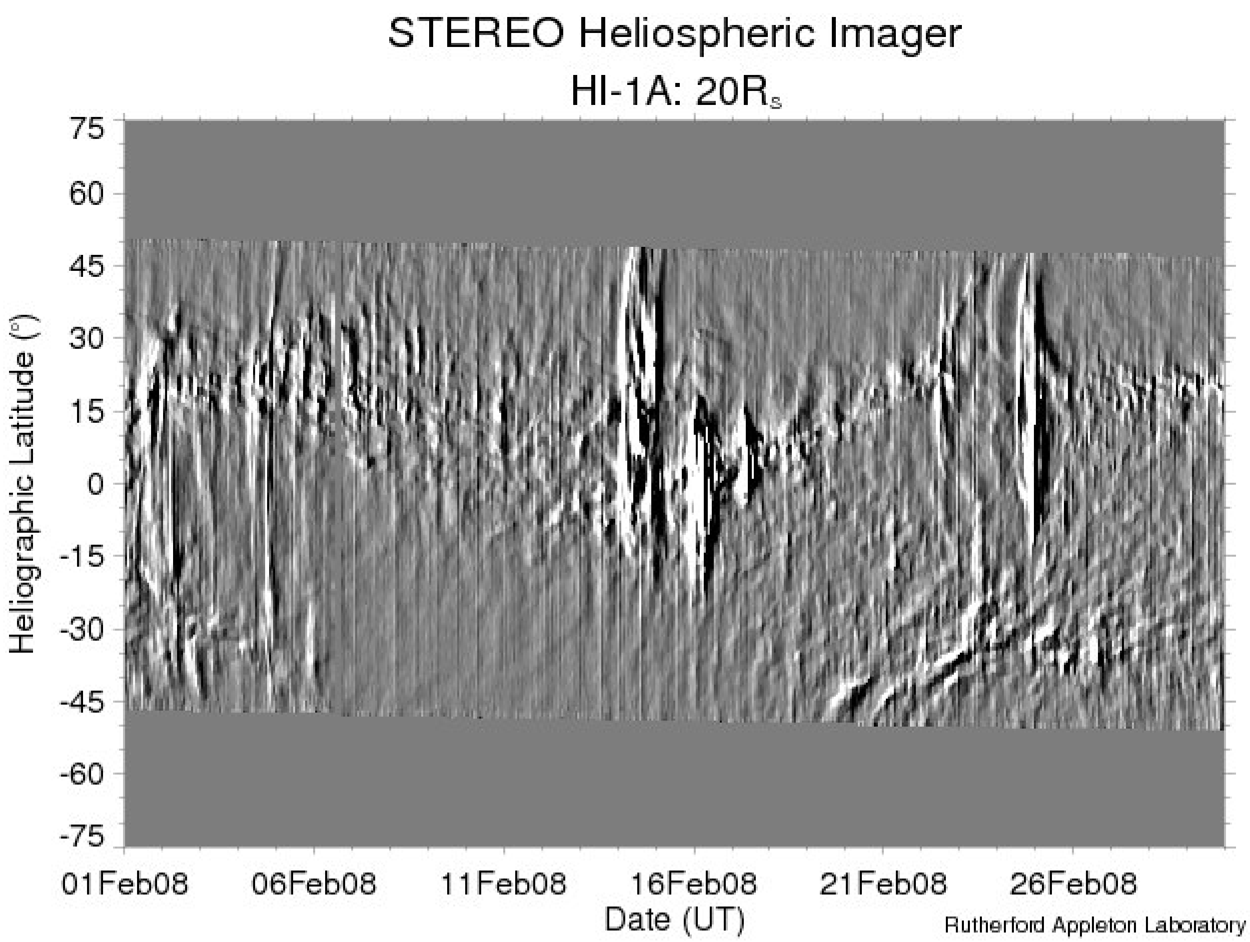
STEREO – Heliospheric Imagers – ‘Products’

- c-map – a Carrington style map showing the streamer belts and CME activity



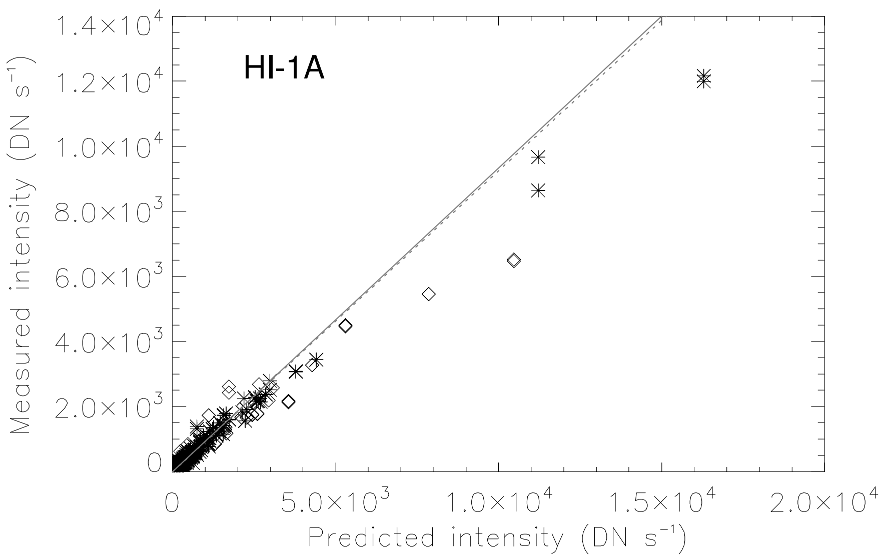
STEREO – Heliospheric Imagers – ‘Products’

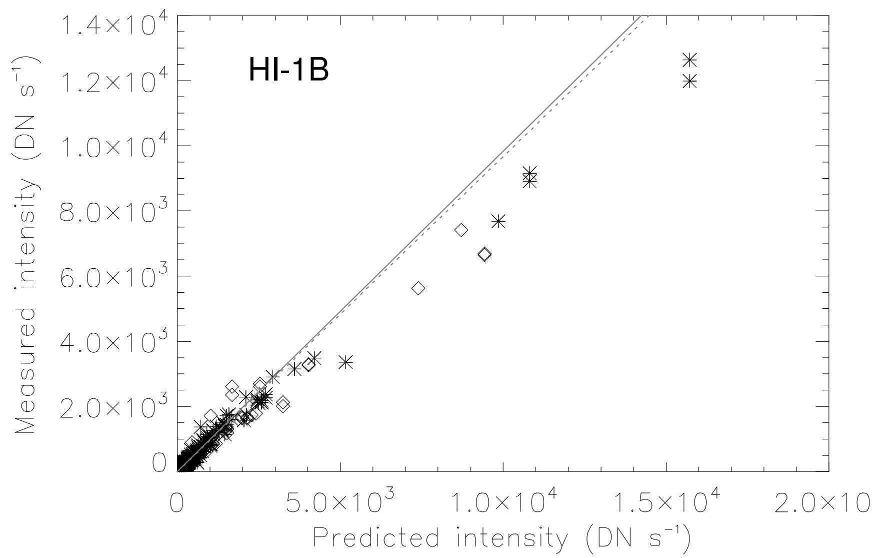
- c-map – a Carrington style map showing the streamer belts and CME activity – a differenced version reveals fine structure in the steamer belts



STEREO – Heliospheric Imagers – Stellar Photometry Calibrations

- Measured response to star determined by aperture photometry
- Compared with predicted response calculated by folding stellar spectrum through instrument response function
    - Many 100's of stars of various spectral types and known spectra used (903 and 541 for HI-1A and HI-1B, respectively)



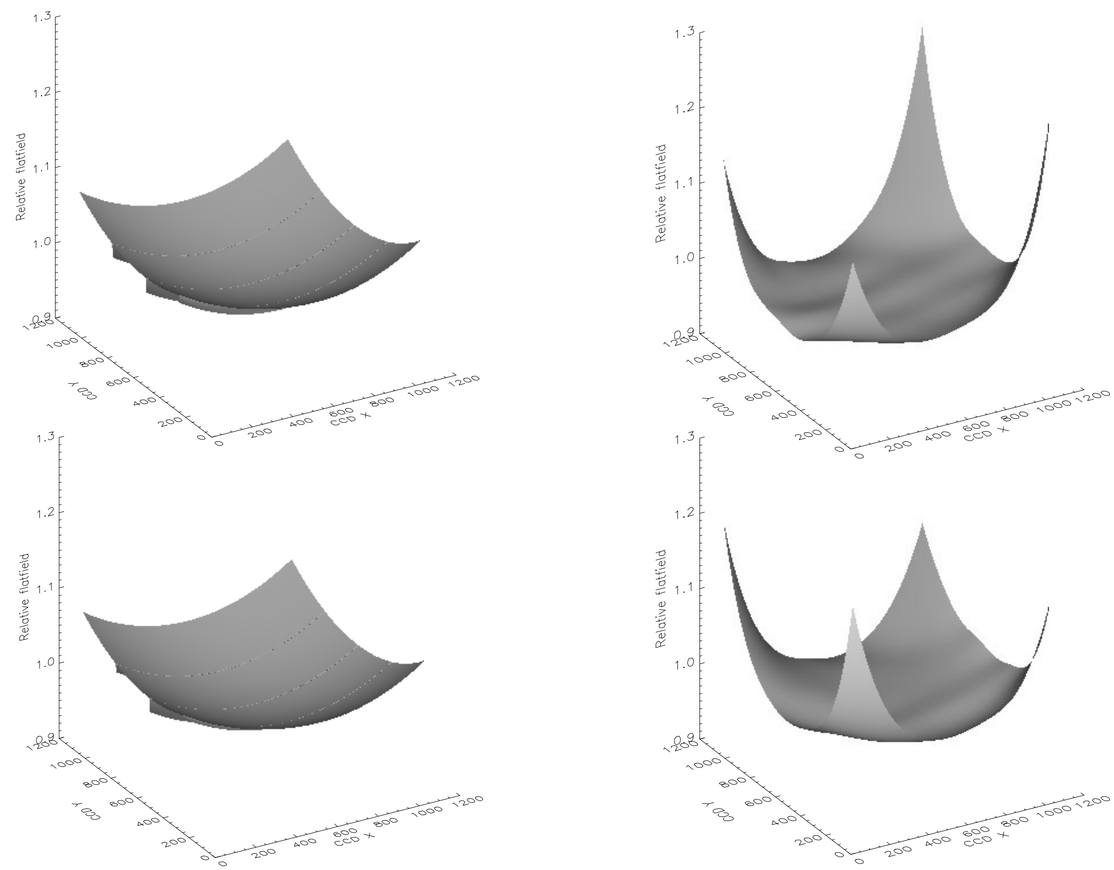


Note: The outliers with large intensities lie below the fitted lines due to saturation effects. Including/excluding these has neglible effect on the fits.

STEREO – Heliospheric Imagers – Large-Scale Flat Field Responses

- Slope of line calibrates absolute errors in the instrument response function (i.e. systematics such as absolute value of CCD QE, filter responses, CEB gain …)
  - ➢ 0.93 for HI-1A; 0.98 for HI-1B
- Drift of stars across FOV enables flat-field calibration (for aperture photometry)

- Surface plots of pre-launch & optimised large-scale flatfield for HI-1A (top left & right) and HI-1B (bottom left & right)



STEREO – Heliospheric Imagers – Calibration Factors for Diffuse Flux

- Need conversion factors from DN s^{-1} $pixel^{-1}$ to MSB (B_O), S10 units and SI units
  - 1 S10 unit corresponds to flux of 10^m star (of solar spectral type) spread over 1 square deg of sky
  - SI units measured in W m^{-2} s^{-1} over 300-1080 nm (overall waveband of HI-1)
- Solar spectrum data of Neckel & Labs (1984) folded through calibrated HI-1 instrument response
  - Gives ***total*** response I_O in DN s^{-1} if instrument were to view solar disk.
- Procedure to obtain conversion factor C_{MSB} (from DN s^{-1} $pixel^{-1}$ to B_O) is then

  $C_{MSB} = n_{pix} / I_O$ where n_{pix} is number of pixels imaging solar disc, and

  $n_{pix} = \pi \, (D_O / 2^*d_{pix})$ where d_{pix} is angular dimension of pixel.

- Similar procedures for other two conversion factors.

STEREO – Heliospheric Imagers – Calibration Factors for Diffuse Flux

- Conversion factors from DN s^{-1} $pixel^{-1}$ to diffuse flux units –

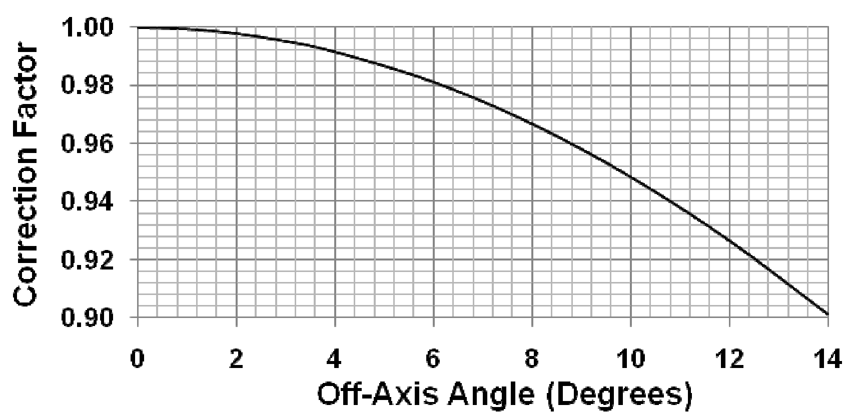
	C_{MSB}	C_{S10}	C_{SI}
HI-1A	8.99×10^{-14}	199.8	1.40×10^{-6}
HI-1B	9.04×10^{-14}	200.9	1.41×10^{-6}

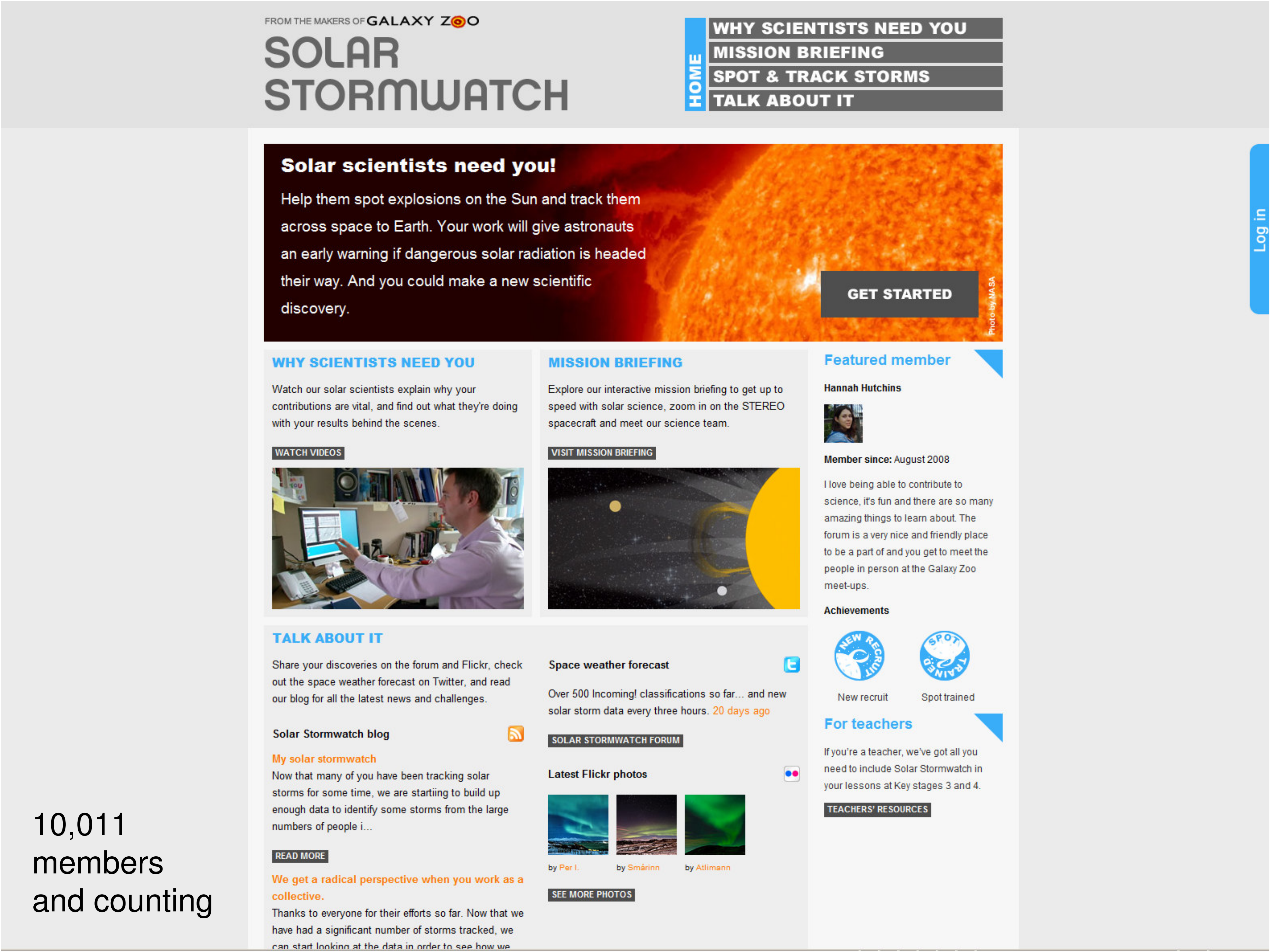
- Note these are values ***on-axis***; the pixel size varies significantly off-axis for HI
- Can derive the off-axis correction to these factors using the HI image projection -

$R = F_p\,(\mu+1)\sin\alpha\,/\,(\mu+\cos\alpha)$ where F_p is the paraxial focal length

μ is a distortion param (Brown *et al.*, 2009)

- This is effectively an additional flat-field correction to be applied for diffuse objects in addition to the FF correction derived from stellar photometry.





10,011 members and counting

SOLAR STORMWATCH

HOME

WHY SCIENTISTS NEED YOU
MISSION BRIEFING
SPOT & TRACK STORMS
TALK ABOUT IT

My Solar Stormwatch

Log out

SPOT

QUESTION

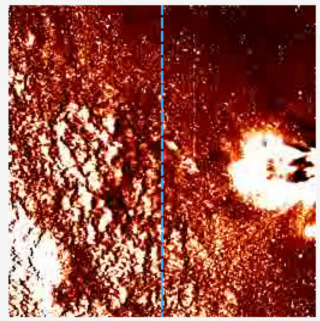
When did the front of the solar storm get to the dotted halfway line in the STEREO Ahead camera?

INSTRUCTIONS

Play the video until the front of the solar storm is roughly at the dotted halfway line. Then use the nudge **FORWARD** and **BACK** buttons to find exactly when the storm reached it. Press the **HALFWAY NOW** button to record your answer.

STEREO BEHIND

STEREO AHEAD



PLAY

PAUSE

BACK

FORWARD

ADD CLIP TO FAVOURITES

Time - 12.50

YOUR ANSWER

STEREO AHEAD

HALFWAY NOW

Hints & tips

- If you think there is more than one solar storm in this clip, just pick your favourite. You'll get a chance to record another one at the end.
- Remember, solar storms begin from the outside edge of the cameras, and move towards the middle.
- **Watch a *How to...* screencast.**

HOW TO... **SPOT A SOLAR STORM (1)** 3:58

HOW TO... **SPOT A SOLAR STORM (2)** 4:01

Extra info

What's the point of this measurement?

First we're asking you to mark when your solar storm gets halfway across the camera. Next you'll get to spot when it first appears. From these measurements we can make a rough estimate of its speed and, if you're making measurements in both cameras, its direction.

SOLAR STORMWATCH

WHAT'S THAT?

QUESTION

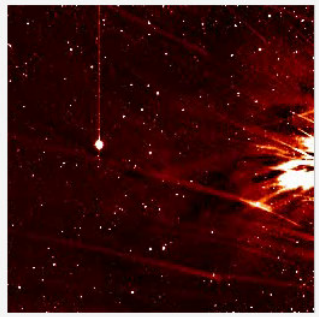
Can you spot comets, particle strikes or anything else interesting?

INSTRUCTIONS

Watch the video. If you spot something, pause it, then use the nudge **FORWARD** and **BACK** buttons to find the frame when it's most visible. Then press the relevant **RECORD** button in the answer section.

STEREO BEHIND

STEREO AHEAD



PLAY

PAUSE

BACK

FORWARD

ADD CLIP TO FAVOURITES

Time - 10.20

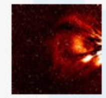
YOUR ANSWER

COMET	PARTICLE STRIKE	OPTICAL EFFECT	SOMETHIN ELSE	
RECORD	RECORD	RECORD	RECORD	NOTHING TO SEE

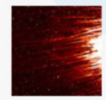
TIMESTAMPED:

Hints & tips

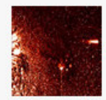
- Want to double-check what each feature should look like? OK.



Comet



Particle strike



Optical effects

See more examples on Flickr. (opens in a new window)

- It's ok if something appears more than once, just record both times it appears.
- You can record more than one type of feature per video clip.
- **Watch a *How to...* screencast.**

HOW TO... PLAY WHAT'S THAT? 3:54

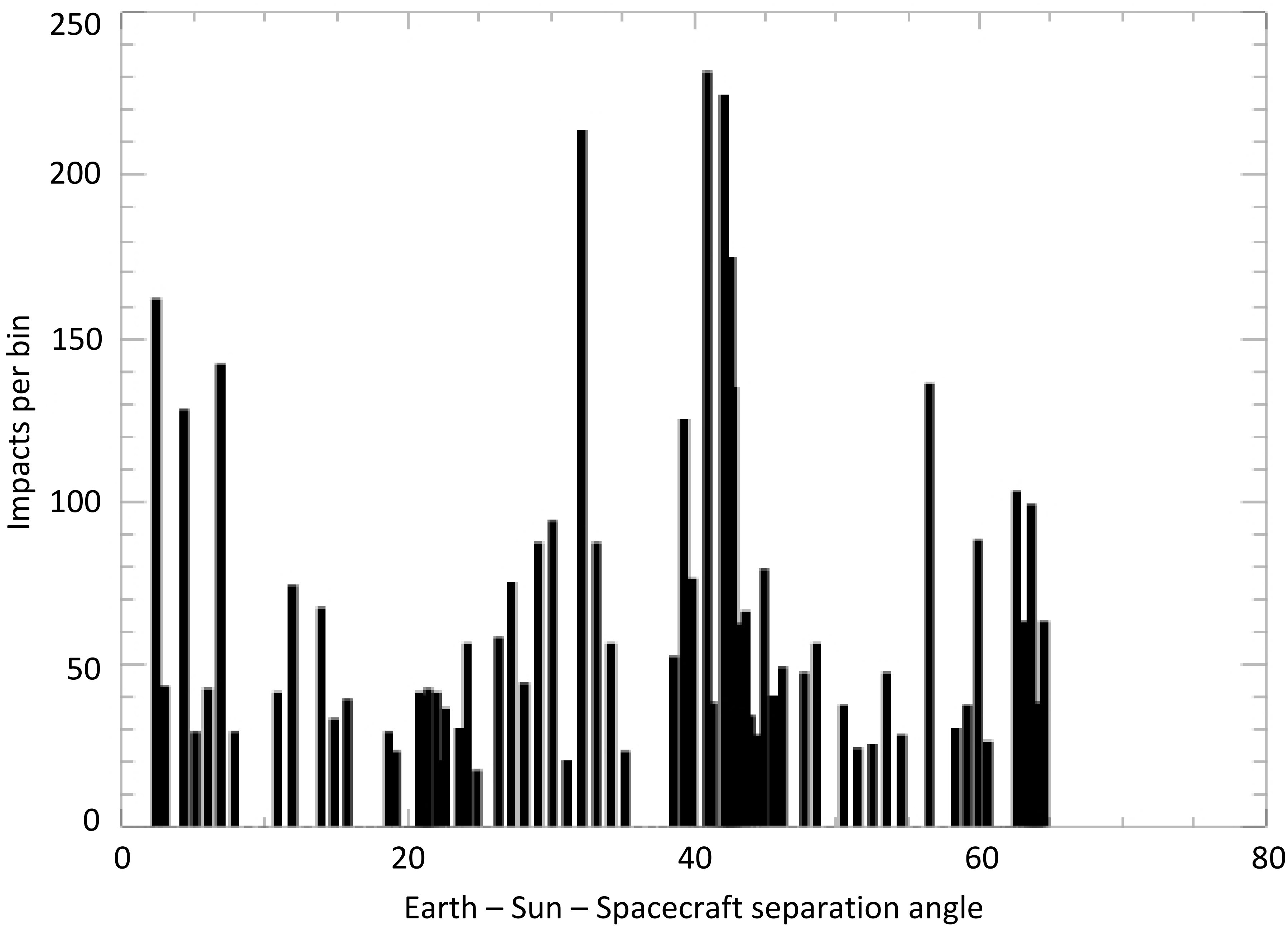
Extra info

Why do scientists want me to spot these features?

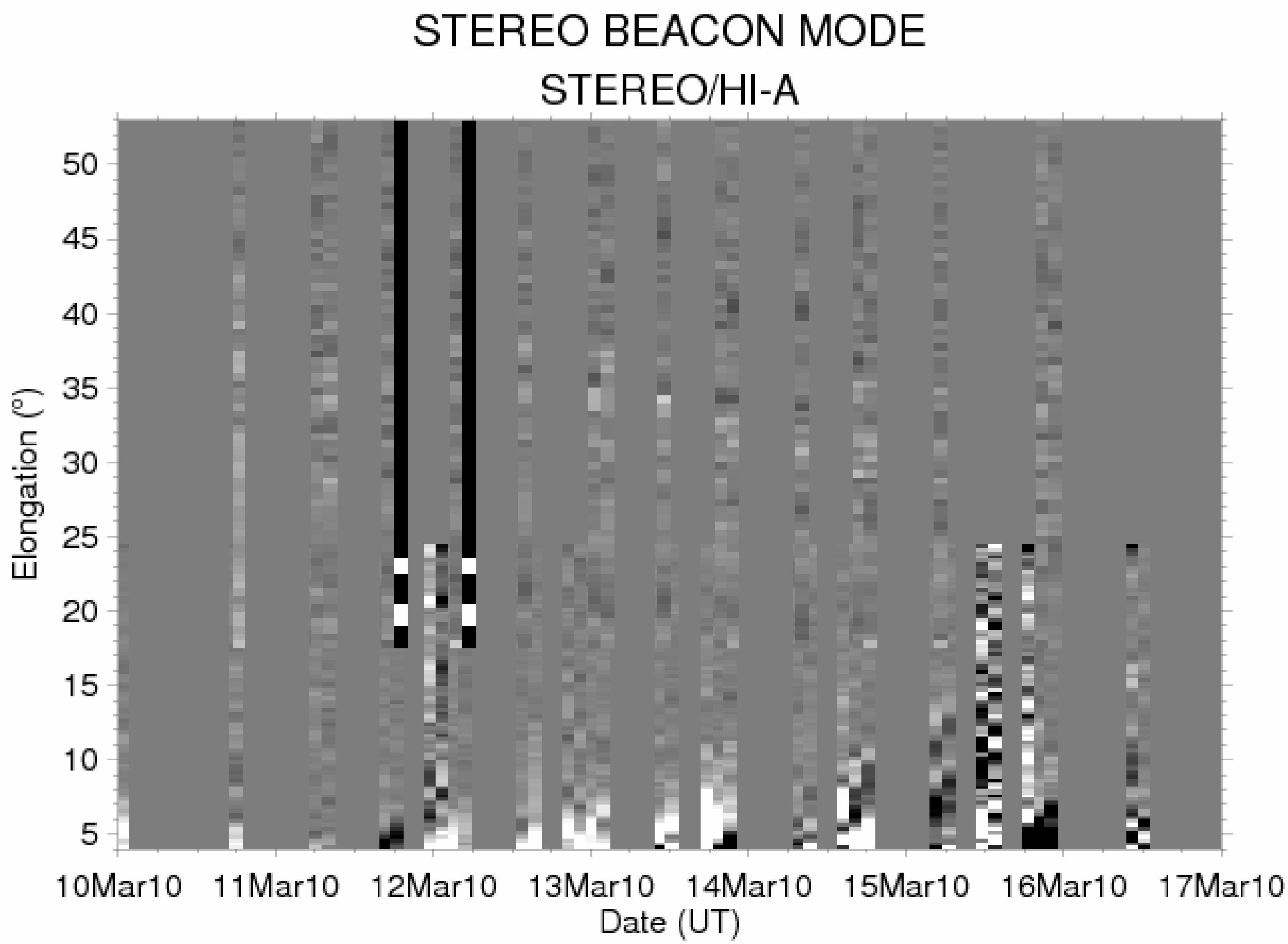
STEREO's heliospeheric imagers capture a wide angle view of space, which means they snap all sorts of interesting and unexpected things besides solar storms. But so far scientists don't know what's common and what's not. Your work will help provide the answers.

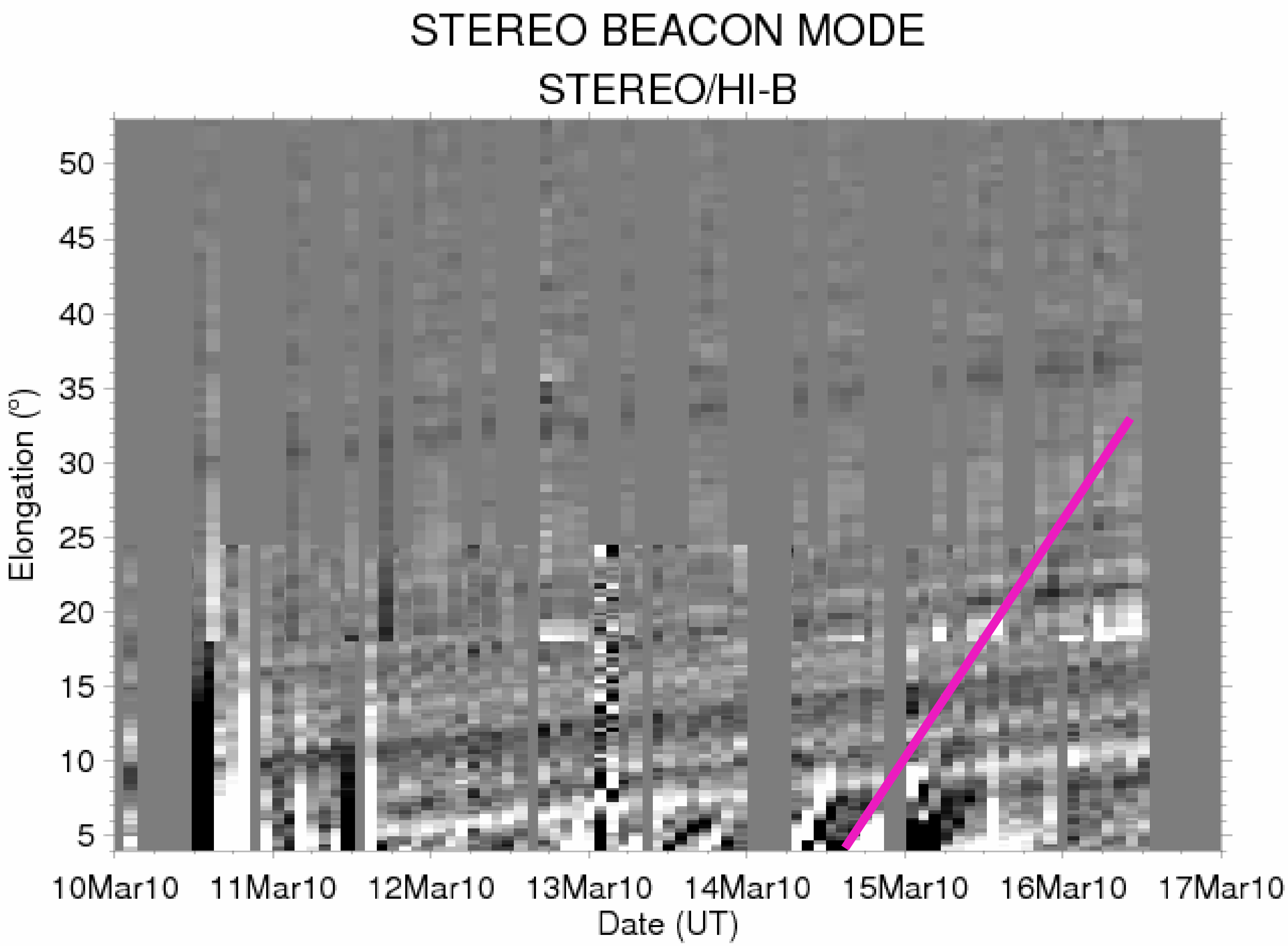
My Solar Stormwatch

Log out



250
200
150
100
50
0
Impacts per bin
0
20
40
60
80
Earth – Sun – Spacecraft separation angle


STEREO BEACON MODE
STEREO/HI-A
Elongation (°)
50
45
40
35
30
25
20
15
10
5
10Mar10
11Mar10
12Mar10
13Mar10
14Mar10
15Mar10
16Mar10
17Mar10
Date (UT)



CME launched on 14th March predicted to arrive at 1 AU at 12 UT on 18th March ± 5 hours travelling at a longitude of -21 ± 17 degrees