WP3: Deriving/cataloguing kinematics of STEREO/HI CMEs based on geometrical and forward modelling

Identification of Solar Sources

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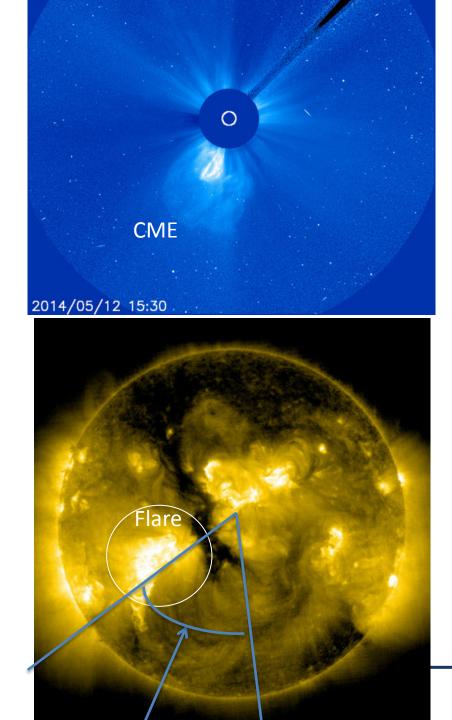


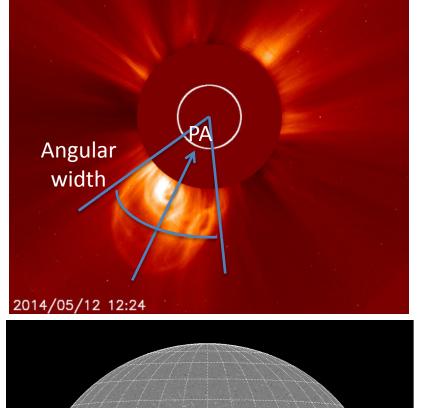




WP3 Overview

- WP3: Deriving/cataloguing kinematics of STEREO/HI CMEs based on geometrical and forward modelling
 - Apply geometrical, forward and (prototype) inverse modelling methods to derive CME parameters, which will be added to the catalogue (including back- and forward-projections to 'predict' CME launch and arrivals at various solar system locations).
- TCD contribution: Inverse CME modelling to study of *solar sources* and *associated activity*.



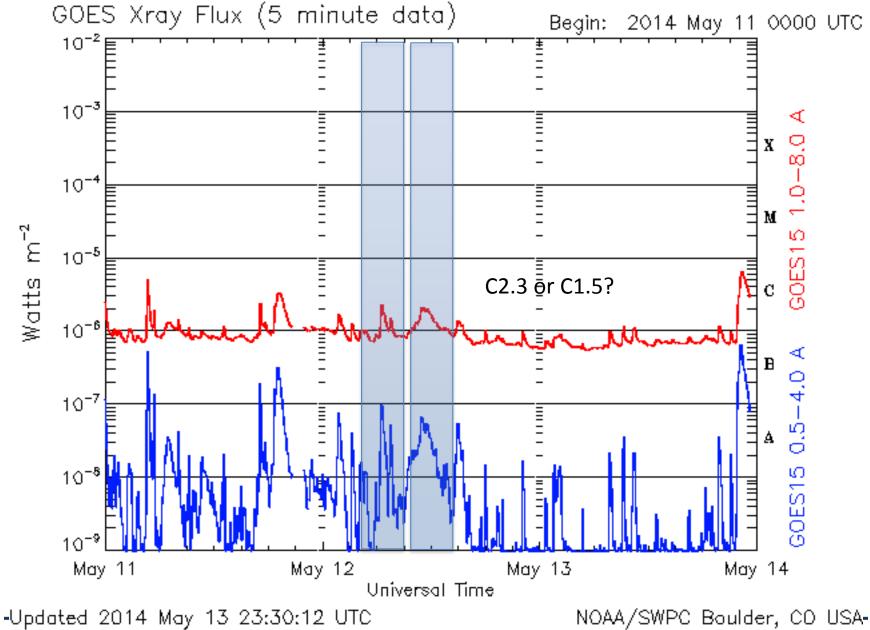


12057 Active Region

SolarMonitor.org

12053

12052



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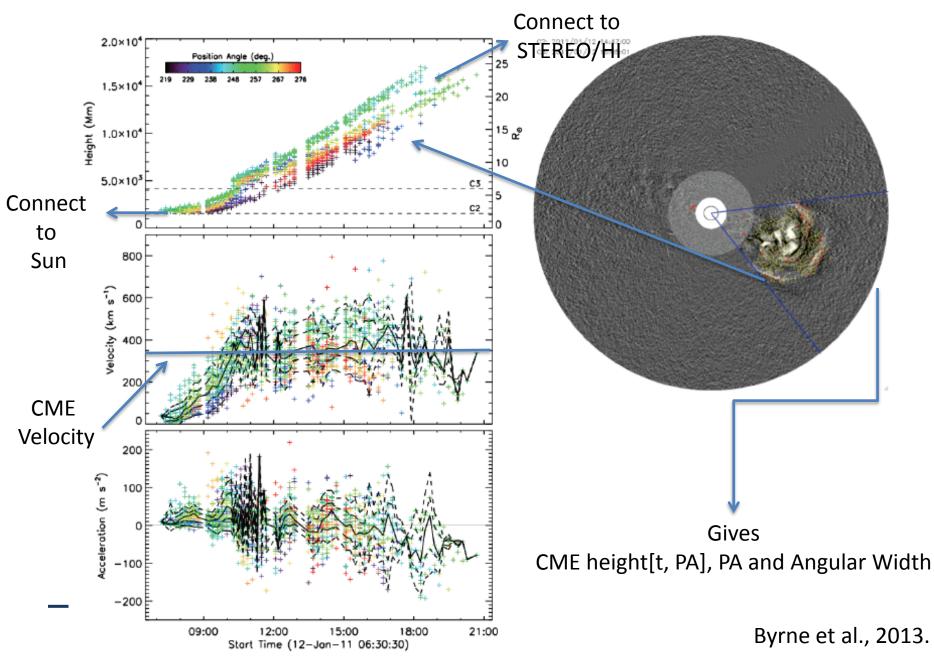


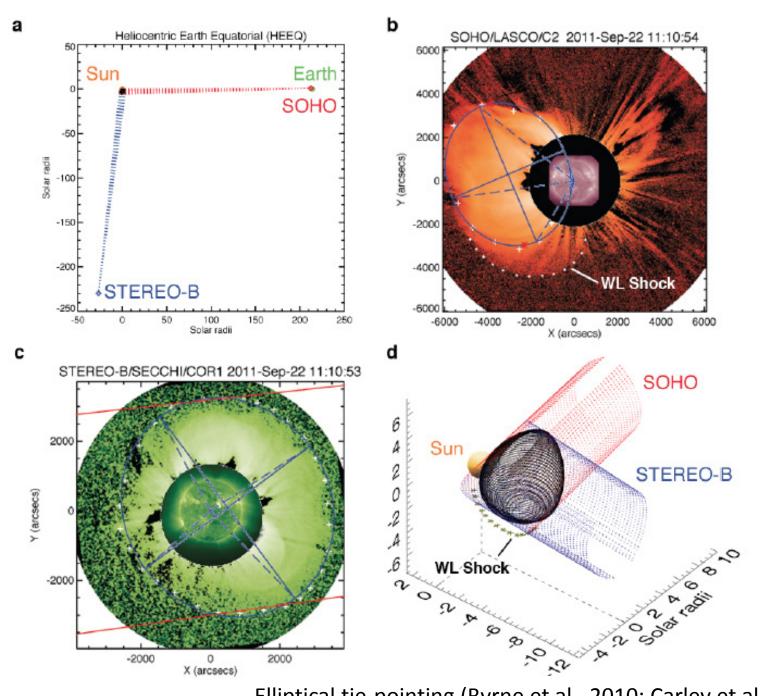
- PA ± ΔPA + launch time (t ± Δt) + 3D Trajectory
 => Latitude and longitude windows
- Active regions: NOAA/SWPC Solar Region Summary
- **Solar flares:** NOAA/SWPC Events List & LMSAL Latest Events
- EUV Dimming Regions: HEK
- **EUV Waves:** HEK/CorPITA (Long et al. 2010)
- Coronal holes: HEK/SPOCA & CHARM (Krista & Gallagher 2009)

Constraining CME Launch Information

- Use CME kinematics at <32 R_s
- STEREO/COR1 & COR2 & SOHO/LASCO
- Automated CME properties including kinematics from CORIMP (Byrne et al. 2012, 2013)
- CORIMP will have kinematics for *all* well-observed STEREO CMEs.
- Gives **PA** $\pm \Delta PA$ and **launch time (t** $\pm \Delta t$).

Coronal Image Processing (CORIMP)





Elliptical tie-pointing (Byrne et al., 2010; Carley et al., 2013)

Estimating Launch Time and Associated Activity

• For constant velocity CME:

$$t_{Earth} = t_{Sun} + \frac{1AU}{v_{CME}}$$

But CME velocity not constant, so launch time:

$$t_{Sun} = t_{rf} - \int_{r_{Sun}}^{r_f} \frac{dr}{v_{CME}(r)}$$

 Use to define *launch-time window* and search for associated flares and EIT waves. Source Identification using Combined Spatial and Temporal Information

- Use CME
 - Position angle (PA $\pm \Delta$ PA)
 - Velocity (v $\pm \Delta v$)
- To estimate on-disk flare, AR, etc
 - Launch position window (latitude $\pm \Delta$, longitude $\pm \Delta$)
 - Launch time window (t $\pm \Delta t$)

Source Observations

- Photospheric, chromospheric and coronal observations from:
 - SOHO
 - SDO
 - STEREO
 - RHESSI
 - GOES
- Investigate solar sources of heliospheric phenomena, by *back-projecting* to Sun.