Guest Investigator Final Report

Project Title: **Studying the Low-Corona Initiation Phase of CMEs**

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Project Abstract:

An important aspect of studying CMEs, is the ability to resolve their low-corona propagation and associated source regions on the disk; be it a flaring or non-flaring active region, a prominence/filament eruption or other rising loop system, or else a "stealth CME" without any specifically detectable source. Prominence lift-offs often become the core material of a CME, and rising loops often form some part of the CME morphology. Their low-corona kinematics and morphology provide insight into the early forces at play, and so a rigorous study of such phenomena is key to understanding the physics involved in the initiation phase of CMEs. New CORIMP techniques for detecting and characterising CMEs in coronagraph data have been developed and applied to the SOHO/LASCO and STEREO/SECCHI datasets (Morgan et al. 2012; Byrne et al. 2012). But to connect CMEs to their source regions, data from disk imagers, such as PROBA2/SWAP and SDO/AIA, should be used in tandem with the coronagraph observations. However, difficulties arise due to the varying instrument specifications, e.g., image passbands, fields-of-view (FOVs), cadences, etc. Therefore, to bridge the gap between the white-light images of the extended corona and the EUV observations of the solar disk and low corona, we propose to use the SWAP imager in conjunction with the MLSO/MK4 coronagraph to directly compare the observations of CMEs as they erupt through the overlapping FOVs. This will allow a direct correspondence of features in the EUV images with those in the white-light images, providing new insight into the connection of CMEs to the Sun during their initial phases of eruption and acceleration away from their source regions on the disk.

Primary ROB Contact(s): Dan Seaton

Which Instrument(s) was/were used: SWAP

Were other instruments used in collaboration with PROBA2?

No

(Optional) Description of collaboration:

MK4, SDO/AIA, LASCO

Was there a dedicated observing campaign performed or planned?

No

(Optional) Description of campaign:

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Brief Description of work performed during the visit:

Methods of multiscale image analysis were employed and their efficacy on the SWAP data tested for revealing CME structure while suppressing other features. The methods employed are described in detail in Young & Gallagher (2008), whereby successive filtering of an image via a Gaussian and derivative-of-Gaussian produces a number of scales of detail to be inspected. This also produces an image with intensities that represent the relative edge strengths in the original image, which can be used to characterize the structure of interest Ã¢â‚¬â€œ specifically for this case the erupting material involved in the CME. In order to overlap the observations from SWAP and MK4, the core material of the CME in its early eruption phase was chosen for its higher signal to noise ratio than the CME front, for example, that was not discernible in the early stages of the observations. In the LASCO field-of-view, the core material was determined to be moving at the same speed as the CME front, at ~500 km/s. The front portion of the core material in the MK4 images was characterized via point-&-click methodology on the multiscale images of enhanced edges, and an ellipse was fit to the curved front. The same was done for the erupting loop structure observed in SWAP, with the expectation that it might directly correlate to the CME core. However, it was found that the erupting material that starts at the same time and location in both the MK4 and SWAP images, did not proceed to erupt at the same rate. Rather the core material observed in MK4 moves at greater speeds than the loop structures observed in SWAP; rising from an initial speed of ~100 km/s (at ~1.5 R_Sun) to a final speed of ~ 400 km/s (at ~2 R_Sun), while the loops continue to steadily rise at ~100 km/s. The reason for this is unclear, and requires further investigation.

Future Plans:

Investigate the flare profile of the event in tandem with the eruption dynamics as determined from the SWAP & MK4 overlap and upper-coronal observations of LASCO.

Has this work been published?

Planned

If so, Where? Reference/DOI? ADS Link?

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Please add below any other comments you might have:

This is a progress report and the work is ongoing.