



Contribution ID: 342

Type: Poster

Non-Radial and Multiple Interacting CMEs: A Multi-Spacecraft Perspective Combining Coronagraphs and Heliospheric Imagers

An accurate determination of the trajectory of Coronal Mass Ejections (CMEs) is crucial for space weather forecasting and assessing whether or not they will impact Earth. Deviation of CME trajectory from a radial propagation is often observed as a consequence of gradients in the local magnetic pressure or due to CME-CME interactions visible within the coronagraphs' field of view. The combination of coronagraphic and heliospheric observations can provide deeper insights into these phenomena, offering valuable information for future space weather forecasting.

On 2023 September 24, several spacecraft observed four non-radial and interacting CMEs. Our study presents an in-depth analysis of these CMEs for which the 3D trajectories are determined through a Graduated Cylindrical Shell forward-modeling technique combining full-disk imagers and coronagraphs onboard STEREO-A, SOHO, and Solar Orbiter, and making use, for the first time, of both the heliospheric imagers onboard Solar Orbiter and Parker Solar Probe. This multiple-viewpoint approach allowed us to determine eventual deflections in longitude or latitude from the source location.

Our analysis revealed CME-CME interactions in the very low corona. In particular, the second and third CMEs interacted causing a deflection of the second post-CME current sheet and producing a "bouncing effect" that deflected the two CMEs in opposite directions of about 15° in latitude. Additionally, strong magnetic fields near the source regions caused a 25° latitudinal deflection of the fourth CME. Finally, the interaction between the flank of the third CME with the post-CME outflow of the second one showed some interesting macro-scale interaction patterns.

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Session Classification: Coffee break and poster session 2

Track Classification: Multi-scale energy release, flares and coronal mass ejections