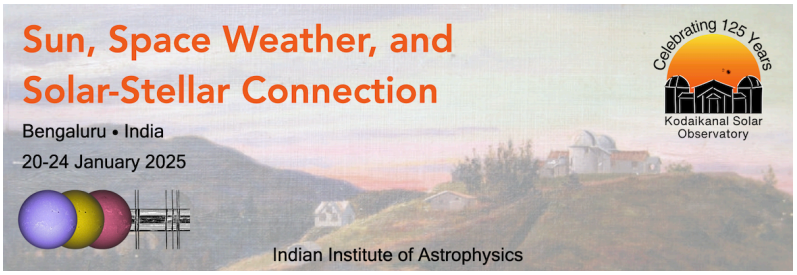

Contribution ID: **163** Type: **Contributed talk**

Constraining CME Magnetic Flux in EUHFORIA Using Helicity Content: Case Study of the 10 March 2022 CME Observed by Solar Orbiter

Friday, January 24, 2025 12:00 PM (15 minutes)

Constraining the magnetic field strength of coronal mass ejections (CMEs) from observations is one of the key challenges in predicting their space weather impact on Earth. In this work, we present a new method for constraining the magnetic flux of a spheromak CME model in the frame of the EUropean Heliospheric FORecasting Information Asset (EUHFORIA). In this approach, we use the estimated magnetic helicity content of the CME to determine its axial field strength (B0), which we equate to the magnetic field strength (Bspheromak) at the spheromak's magnetic axis. The amount of helicity transported to the CME has been estimated by taking the net helicity difference between the pre- and post-eruptive phase of the source active region (AR). This estimated helicity budget of the associated CME is further used to constrain a Lundquist flux-rope model with geometrical parameters obtained through a graduated cylindrical shell (GCS) model to determine B0 at the GCS-fitted height. From this, Bspheromak and radius derived from the geometrical parameters of the CME, we estimate the CME's toroidal magnetic flux, which is then used as input for the EUHFORIA simulation. We validate our approach by applying the method to the CME that erupted on 10 March 2022 from NOAA AR 12962, observed by Solar Orbiter at 7.8 degrees east of the Sun-Earth line at a distance of 0.43 AU, complemented by WIND measurements at L1 (0.99 AU). The CME's helicity was estimated to be $(-7.1 \pm 1.2) x 10^{41} Mx^2$. The CME's axial magnetic field at GCS fitted height of 7.6 Rs was B0=2067 ± 405 nT, with a power-law variation with distance extending to L1 and characterised by an index of −1.23 ± 0.18. Extrapolating this magnetic field to the inner boundary of EUHFORIA (21.5 Rs), we obtained Bspheromak=1058 ± 288 nT, from which we estimate the spheromak's toroidal flux as (10.32 ± 6.4) × 10^{12} Wb. By modelling this CME from 21.5 Rs to Earth, we assess how well in situ magnetic field measurements align with the model's predictions at 0.43 AU and 0.99 AU. We report a reasonable agreement which demonstrates our method's efficiency and value.

Contribution Type

Theme

Connecting Solar Corona to Heliosphere

Primary author: KOYA, SHIFANA (University of Ioaninna Greece)

Co-authors: Prof. NINDOS, Alexander (University of Ioaninna Greece); Mr ISAVIN, Alexey (Centre for Mathematical Plasma Astrophysics, KU Leuven, Belgium); Dr MAHARANA, Anwesha (Centre for Mathematical Plasma Astrophysics, KU Leuven, Belgium); Prof. MURAWSKI, Kris (UMCS, Poland); Dr GEORGOULIS, Manolis (John

Hopkins Applied Physics Laboratory); Dr SARKAR, Ranadeep (University of Helsinki); Prof. PATSOURAKOS, Spiros (University of Ioaninna Greece)

Presenter: KOYA, SHIFANA (University of Ioaninna Greece)

Session Classification: Extreme Events