Complex interactions of the shock wave and ambient coronal structures

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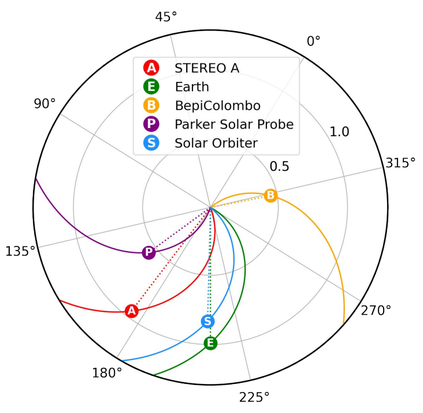
INTRODUCTION

- **Study Focus**: Study of the flare-CME event on 2 November 2021.
- **Flare & CME**: M1.7 GOES X-class flare from AR 12891; Halo CME propagating strongly in north-east direction.
- **Radio Event**: Type II, type III, and type IV bursts observed, Structured, multiple-lane type II indicates shock interaction with the ambient coronal structures.
- **Objective**: Investigate the relationship between the CME-driven shock wave and its driver.
- **Methods**: Radio observations with direction finding method, and 3D CME modeling using EUHFORIA.

Summary

- Multiple lane type II was observed to associated with the event showing complex shock wave interaction with the ambient coronal structures in the low corona and fast solar wind further from the Sun.
- Interplanetary radio shock signature was at the significantly lower heights than the heights obtained from white light observations showing that type II burst might be originating from the flank region of the CME.
- The modelled CME with EUHFORIA was observed to be propagating above Earth. This is due to difficulty in reconstructing the high speed stream (HSS) from the northern coronal hole.
- HSS was modelled somewhat better but still strongly inaccurate when the earlier (30 Nov) magnetogram was used for the modeling.

Event Description



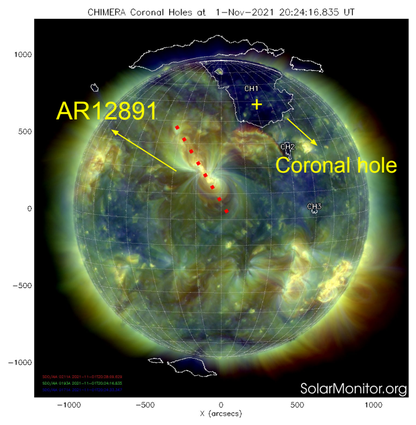
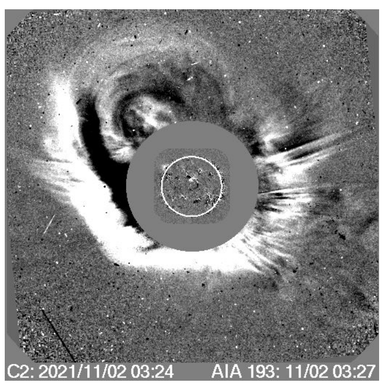


Fig 1: Left: Different spacecraft positions during the studied event.

Right: EUV image of the Sun obtained from SDO/ AIA 211, 193 & 171 Å. The coronal holes, defined by CHIMERA tool are shown in the same image. The positive northern polar coronal hole is the source of the high speed stream (HSS) observed before the shock arrival at Earth.



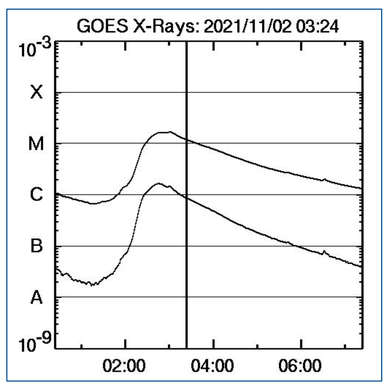


Fig 2: Left: SOHO/LASCO C2 image of Halo CME propagating in the north-east direction from the Sun-Earth line.

Right: The plot shows M1.7 X-class flare associated with the coronal mass ejection.

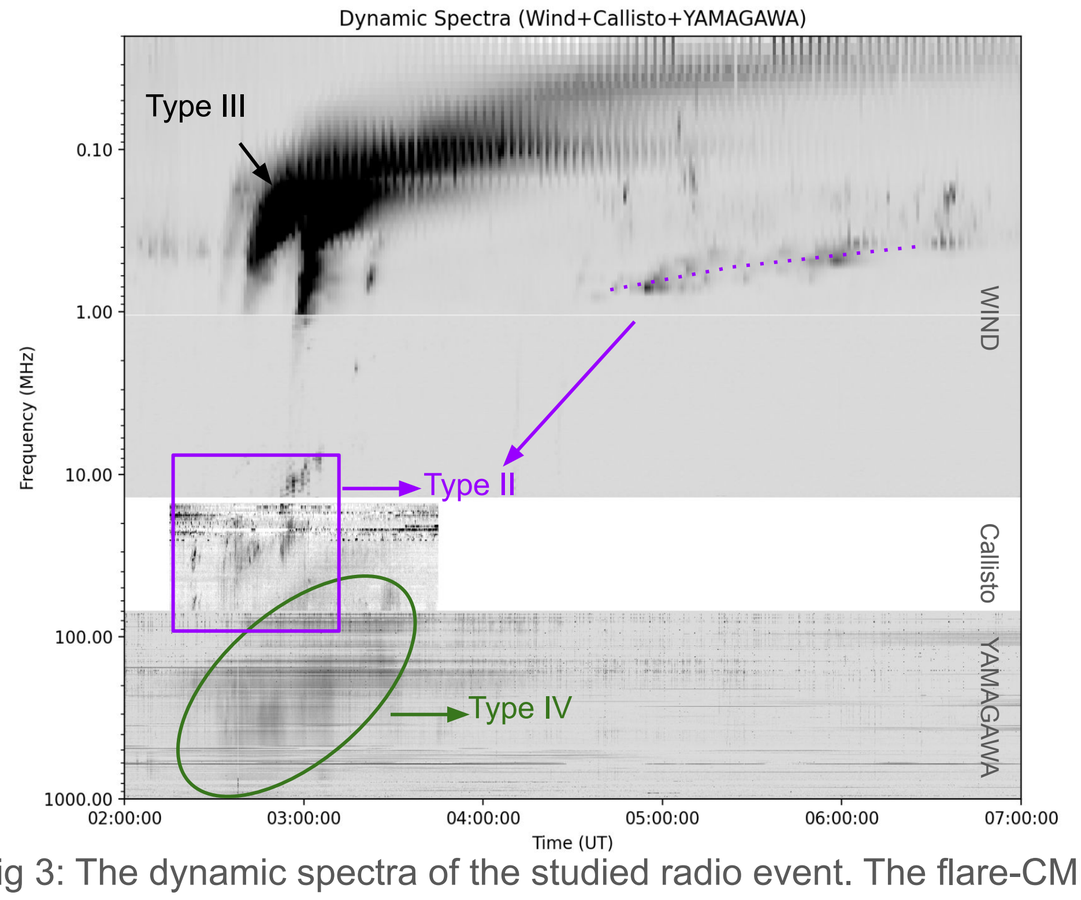


Fig 3: The dynamic spectra of the studied radio event. The flare-CME event was associated with type III, type II (shock signature) and type IV burst. Multi-lane structure of type II burst observed in the metric range showed complex shock wave interaction with ambient coronal structures.

RESULTS

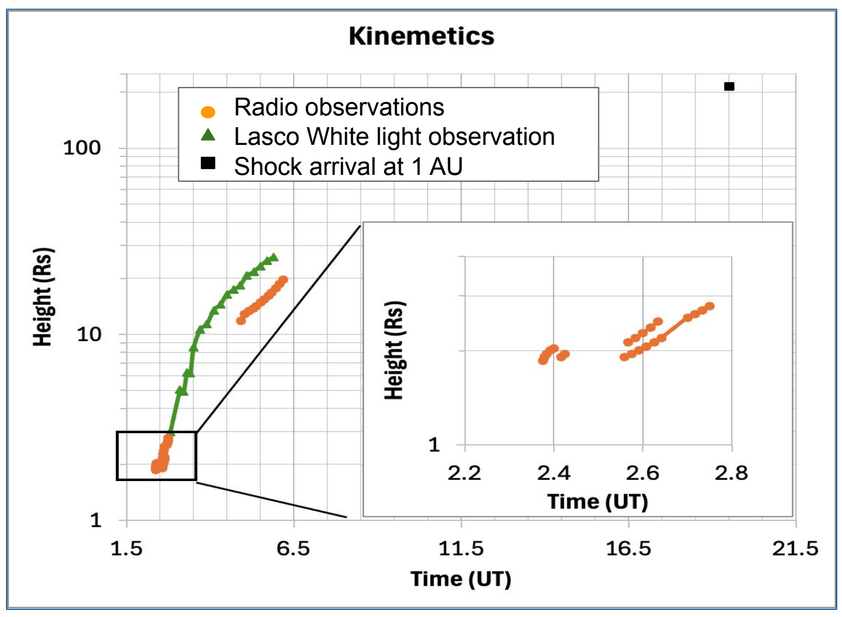


Fig 4: The shock wave kinematics were obtained from the white light (LASCO) and radio observations (Density model by Vrsnak et al 2004).

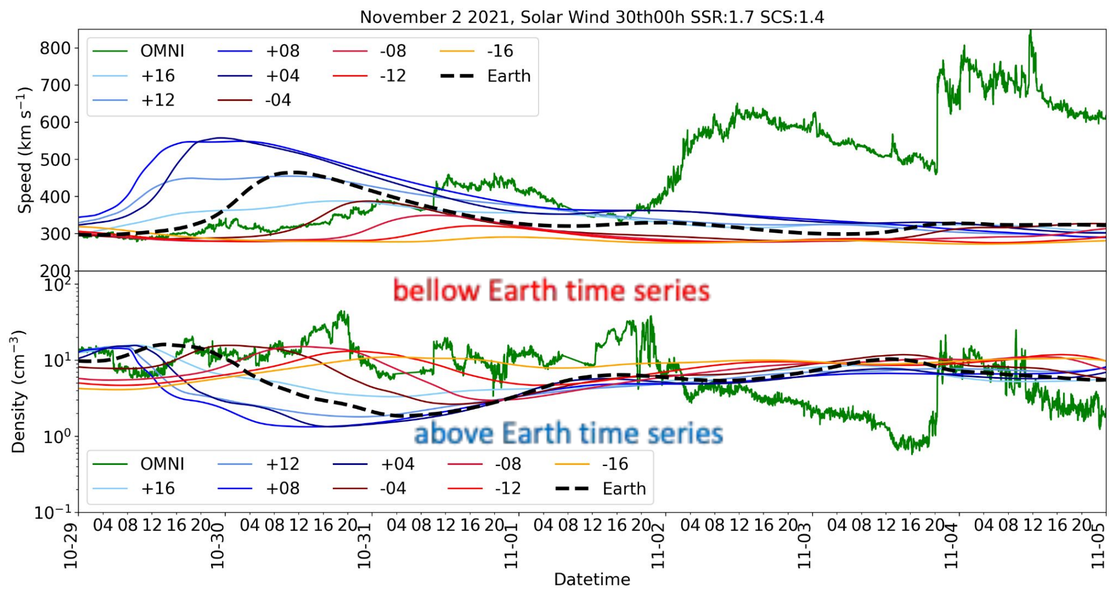


Fig 5: The plot shows fast solar wind observed before the shock arrival modelled with EUHFORIA (EUropean Heliospheric FORecasting Information Asset).

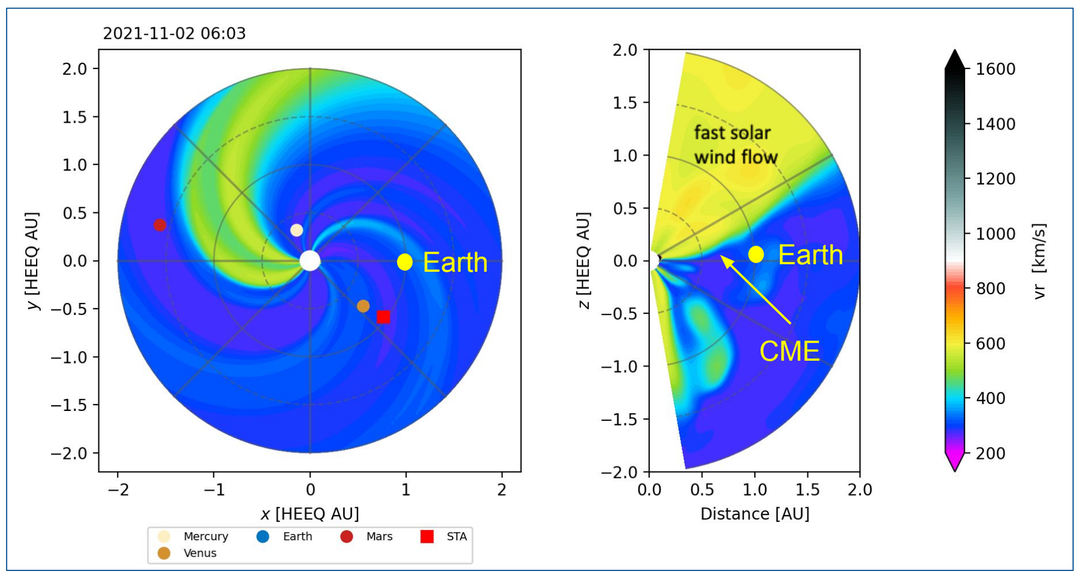


Fig 6: The 2D plot of the modelled solar wind and CME shows that the CME is propagating above Earth and through the fast solar wind flow.

Get to know more about this flare-CME event at
Poster No. 115: “Modeling of non-radially propagating CMEs”!!