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Complete View of Solar Coronal Fast-mode Shock Waves: EUV wave + Halo CME

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We present the observations of spherical, circumsolar coronal shocks associated with flares and coronal mass ejections (CMEs). This talk shows their morphology seen from multiple vantage point observations; three-dimensional (3D) geometry determined by a forward modeling method[1,2]; kinematics all along the shock fronts in 3D[3]; and compression ratio (Mach number)[4]. The major findings are as follows: (1) Halo CMEs are the manifestation of spherically shaped fast-mode waves/shocks, rather than a matter of the projection of expanding flux ropes. The footprints of halo CMEs on the coronal base are the so-called EIT/EUV waves. (2) These spherical fronts arise from a driven shock (bow- or piston-type) close to the CME nose, and it is gradually becoming a freely propagating (decaying) fast-mode shock wave at the flank. (3) Such large longitudinal extents of these shock waves in the corona agree with those of the solar energetic particles (SEPs) in the heliosphere[5]. (4) The shock density compressions peak around the CME nose and decrease at larger position angles. (5) Last but not least, the supercritical region extends over a large area of the shock and lasts longer than past reports. These results offer a simple unified picture of the different manifestations for CME-associated waves, such as EUV waves and SEP events observed in a variety of regimes and heliocentric distances.

References

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