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Reconstruction of CME-driven shocks detected by multi-spacecraft observations

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Shocks driven by coronal mass ejections (CMEs) are the most relevant accelerators of solar energetic particles (SEPs) in the inner heliosphere. SEPs are of great scientific interest because they represent a natural hazard in the near-Earth environment, from the instruments on board spacecraft to the electricity networks and astronauts' lives. In this study, we aim at analyzing CME-driven shocks, possibly observed by multiple spacecraft. We use remote sensing observations from Stereo-A, SOHO, Parker Solar Probe and Solar Orbiter to analyse shock waves both in 2D and 3D and to determine their physical parameters, such as the compression ratio and the Mach numbers. Physical quantities estimated through remote-sensing observations can be compared with in-situ measurements from various instruments. Following the evolution of the parameters characterizing the CMEs from the source to space will help space weather models to improve predictions on the arrival of SEPs at the Earth. This study is achieved in the context of the research project "Data-based predictions of solar energetic particle arrival to the Earth: ensuring space data and technology integrity from hazardous solar activity events" funded by the Italian Ministry of Research under the grant scheme PRIN-2022-PNRR.

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