Numerical Simulation on the Propagation and Deflection of Fast Coronal Mass Ejections (CMEs) in the Heliosphere

Fang Shen[1,2], Yousheng Liu[1,2] and Yi Yang[1,2]

[1] SIGMA Weather Group, State Key Laboratory of Space Weather, National Space Science Center, Chinese Academy of Sciences, Beijing, 100190, People's Republic of China; fshen@spaceweather.ac.cn

[2] College of Earth Sciences, University of Chinese Academy of Sciences, Beijing, 100049, People's Republic of China

Abstract

Previous research has shown that the deflection of coronal mass ejections (CMEs) in interplanetary space, especially fast CMEs, is a common phenomenon. The deflection caused by the interaction with background solar wind is an important factor to determine whether CMEs could hit Earth or not. As the Sun rotates, there will be interactions between solar wind flows with different speeds. When faster solar wind runs into slower solar wind ahead, it will form a compressive area corotating with the Sun, which is called a corotating interaction region (CIR). These compression regions always have a higher density than the common background solar wind.

In this research, we use the newly developed three-dimensional (3D) flux-rope CME initialization model (Liu, Shen et al., 2019, APJ) and 3D IN (INterplanetary) -TVD-MHD model (Shen et al., 2018, APJ) to study the propagation and deflection of the fast CME in interplanetary space. We take the Carrington Rotation (CR) 2154 as case study to simulate the propagation and deflection of fast CME when it interacts with background solar wind, especially with the CIR structure. The simulation results show that the fast CME will deflect eastward when it propagates into the background solar wind no matter whether interacting with the CIR or not. When interacting with the CIR, the CME will deflect more obviously compared with the situation without CIR.