Three-Dimensional MHD Simulation of the Interaction between CME and Ambient Plasma in Solar Corona

*Masaki Shirota[1], Kanya Kusano[1], Daikou Shiota[1]

1.Institute for Space-Earth Environmental Research, Nagoya University

Coronal mass ejections (CMEs) are one of main drivers of various disturbances in space weather. In particular, the timing of arrival, the strength, and the amount of southward magnetic flux brought by CMEs are important for the magnitude of the space weather disturbances, and those are depend on the following factors: whether the CMEs hit the earth or not, speeds of the CMEs, and the magnetic field structures within the CMEs. Because the factors are determined as a results of the dynamics in their propagation as well as in formation in the solar corona, the understanding of the influence of ambient corona on the dynamics of CMEs is necessary for an improvement of space weather forecast. However, what determines the structure and intensity of magnetic field of CME is not yet well understood.
In this study, we performed magnetohydrodynamic simulations of a formation process of CMEs in the solar corona, focusing on the interaction between an ejecting flux rope and its ambient field by extending the work by Shiota et al. (2010). We examined the dynamics of magnetic flux rope in three different ambient plasma conditions: the uniform atmosphere, the hydrostatic atmosphere, and the steady state of the solar wind.
In the uniform atmosphere case, the flux rope are decelerated very much with continues rotation around the propagation direction as same as the previous study (Shiota et al. 2010). In contrast, we found that in the other two cases the flux rope speed is much faster than in the uniform atmosphere case because of a much weaker drug force in the stratified or steadily flowing plasma. Since the magnetic interaction between the flux rope and the ambient field seems to be weaker in those cases, the rotation of CME becomes weaker. We will discuss how the ambient plasma influences the dynamics of the CMEs.

Keywords: magnetohydrodynamic, coronal mass ejections (CMEs), corona

