



## **Long-duration Ejecta Resulting from the Interaction of Two CMEs: Case Study for the 2001 March 19–22 event**

Noé Lugaz and Charles Farrugia

University of New Hampshire, Space Science Center and Department of Physics, Durham, United States  
(nlugaz@guero.sr.unh.edu)

A significant portion of transients measured by spacecraft at 1 AU does not show the well-defined properties of magnetic clouds (MCs). Among these non-MC ejecta, some are thought to be associated with the interaction of successive coronal mass ejections (CMEs). A particular focus has been on recognizing and understanding multiple-MC events, where two MCs cross the spacecraft path one after the other with signs of interaction between them.

Here, we discuss another type of complex ejecta resulting from the interaction of two CMEs with different orientations, which differs from previously studied multiple-MC events. We have combined 3-D MHD numerical simulations with the SWMF of isolated and interacting CMEs with the analysis of *in situ* measurements to determine the typical properties of such events and their expected geo-effectiveness. We focus, in particular, on the analysis of the long-duration transient event measured in 2001 March 19–22. We find that these events are associated with a smooth rotation of the magnetic field vector over an extended duration and do not exhibit clear signs of interaction. Due to the long driving of Earth's magnetosphere, such events may result in intense, long-duration geo-magnetic storms, with a sequence sawtooth events, and may sometimes be misidentified as isolated CMEs.