Initiation of Stealth CMEs: Clues from Numerical Modelling and In-Situ Comparisons

Dana-Camelia Talpeanu (1,2), Francesco P. Zuccarello (1), Emmanuel Chané (1), Stefaan Poedts (1), Elke D’Huys (2), Marilena Mierla (2,3), Ilia Roussev (4,1)

(1) CmPA, KU Leuven, Leuven, Belgium, (2) SIDC, Royal Observatory of Belgium, Brussels, Belgium, (3) Institute of Geodynamics of the Romanian Academy, Bucharest, Romania, (4) Division of Atmospheric and Geospace Sciences – Directorate of Geosciences - National Science Foundation, Arlington, Virginia, USA

Coronal Mass Ejections (CMEs) are huge expulsions of magnetized plasma from the Sun into the interplanetary medium. A particular class of CMEs are the so-called stealth CMEs, i.e. solar eruptions that are clearly distinguished in coronagraph observations, but they don’t have a clear source signature. Observational studies show that about 60% of stealth CMEs are preceded by another CME whose solar origin could be identified.

In order to determine the triggering mechanism for stealth CMEs we are using the MPI-AMRVAC code developed at KU Leuven. We simulate consecutive CMEs ejected from the southernmost part of an initial configuration constituted by three magnetic arcades embedded in a globally bipolar magnetic field. The first eruption is driven through shearing motions at the solar surface. The following eruption is a stealth CME resulting from the reconnection of the coronal magnetic field. Both CMEs are expelled into a bimodal solar wind.

We analyse the parameters that contribute to the occurrence of the second CME. We obtain 3 different eruption scenarios and dynamics by changing the shearing speed with only 1%. The difference between the 3 cases consists in the characteristics of the second CME, which can be a failed eruption, a stealth CME, or a CME with a traceable source.

Furthermore, we compare the simulated signatures of the CMEs with the measured in-situ data from Messenger and ACE spacecraft and obtain a good correlation in arrival time and magnetic field components.

This study aims to better understand the triggering mechanism of stealth eruptions and improve the forecasting of their geomagnetic impact.