The role of photospheric shearing motions in a filament eruption related to the 2010 April 3 CME

Francesco Zuccarello*[1], Paolo Romano[2], Francesca Zuccarello[3], and Stefaan Poedts[1]

[1]KU Leuven – Celestijnenlaan 200B, bus 2400 B-3001 Leuven Belgium, Belgium
[2]INAF Catania Astrophysical Observatory – via S. Sofia 78, 95123 Catania, Italy, Italy
[3]University of Catania – Via S.Sofia 78, 95123 Catania, Italy, Italy

Abstract

Coronal mass ejections (CMEs) are huge expulsion of solar plasma and magnetic field in the interplanetary medium. Understanding the physics that lies beyond the CME initiation is one of the most fascinating research questions. Several models have been proposed to explain the initiation of CMEs. However, which model better explains the different aspects of the initiation process and the early evolution of the CMEs is a subject of ongoing discussion. We investigate the magnetic field evolution of NOAA 11059 in order to provide a further contribution to our understanding of the possible causes and mechanisms that lead to the initiation of the geoeffective CME that occurred on 2010 April 3.
Using KSO Hα images we determine the chirality of the active region and some properties of the filament that eventually erupted. Using SOHO/MDI line-of-sight magnetograms we investigate the magnetic configuration of NOAA 11059 by means of both linear force free and potential field extrapolations. We also determine the photospheric velocity maps using the Differential Affine Velocity Estimator (DAVE).
We find that the magnetic configuration of the active region is unstable to the torus instability. Moreover, we find that persistent shearing motions characterized the negative polarity, resulting in a southward, almost parallel to the meridians, drift motion of the negative magnetic field concentrations.
We conclude that persistent and coherent shearing motions played a significant role in facilitating the eruption. These shearing motions increased the axial field of the filament eventually bringing the fluxrope axis to a height where the onset condition for the torus instability was satisfied. Our observations show that both the magnetic configuration of the system and the photopsheric dynamics that preceded the event, were favourable for the eruption to occur.

Keywords: Magnetic fields, Torus instability, DAVE

*Speaker