Geophysical Research Abstracts
Vol. 20, EGU2018-16409, 2018
EGU General Assembly 2018

Magnetic structure and propagation of a solar flux rope from the Sun to Saturn

Erika Palmerio (1), Emilia Kilpua (1), Marilena Mierla (2,3), Andrei Zhukov (2,4), David Barnes (5), Olivier Witasse (6), Luciano Rodriguez (2), Alexey Isavnin (7), Christian Möstl (8,9), Beatriz Sánchez-Cano (10), Elias Roussos (11), Adam Masters (12), Neel Savani (13,14), Teresa Nieves-Chinchilla (15,14)

(1) Department of Physics, University of Helsinki, Helsinki, Finland, (2) Solar-Terrestrial Center of Excellence, SIDC, Royal Observatory of Belgium, Av. Circulaire 3, 1180, Brussels, Belgium, (3) Institute of Geodynamics of the Romanian Academy, Jean-Louis Calderon 19-21, 020032 Bucharest-37, Romania, (4) Skobeltsyn Institute of Nuclear Physics, Moscow State University, 119992 Moscow, Russia, (5) STFC-RAL Space, Rutherford Appleton Laboratory, Harwell Campus, OX11 0QX, UK, (6) ESTEC, European Space Agency, Noordwijk, Netherlands, (7) Center for Mathematical Plasma Astrophysics, Department of Mathematics, KU Leuven, 200 B, 3001 Leuven, Belgium, (8) Space Research Institute, Austrian Academy of Sciences, 8042 Graz, Austria, (9) Kanzelhöhe Observatory-IGAM, Institute of Physics, University of Graz, 8010 Graz, Austria, (10) Radio and Space Plasma Physics Group, Department of Physics and Astronomy, University of Leicester, Leicester, UK, (11) Max Planck Institute for Solar System Research, Justus-von-Liebig-Weg 3, 37077, Göttingen, Germany, (12) The Blackett Laboratory, Imperial College London, Prince Consort Road, London, SW7 2AZ, UK, (13) Goddard Planetary Heliophysics Institute, University of Maryland, Baltimore, Maryland USA, (14) NASA, Goddard Space Flight Center, Greenbelt, Maryland USA, (15) Catholic University of America, Washington, DC, United States

The prediction of the magnetic structure, arrival time, and arrival speed of coronal mass ejections (CMEs) at different locations in the heliosphere is the subject of intense study and utmost importance for understanding how CMEs evolve after they erupt. CMEs form in the solar atmosphere as helical magnetic field structures known as flux ropes. The magnetic structure of flux ropes at the time of their eruption can be inferred through indirect proxies based on the source region of the CME. These proxies allow us to reconstruct the "instrinsic flux rope type" at the time of the eruption. However, the knowledge of the magnetic structure of the flux rope at the Sun does not always imply a successful prediction of the magnetic structure at Earth, on in general in interplanetary space. This is because CMEs can change their orientation and shape due to deflections, rotations, and deformations.

In this work, we study in detail a filament eruption and related CME that took place in May 2012, with the aim of estimating how the knowledge of the intrinsic flux rope type is useful in the case of CMEs that are associated with rotating filaments. We aim to compare the magnetic structure of the CME flux rope as seen at the Sun with observations at different planets. We use observations from multiple vantage points in order to analyse the evolution of the flux rope from the Sun throughout the heliosphere. We use remote-sensing observations of the solar disk, the corona, and the inner heliosphere, and in situ measurements taken at Venus, at Earth, at Mars, and at Saturn. We estimate the arrival time and speed at different planets by applying the Stereoscopic Self-Similar Expansion model (SSSE) to Heliospheric Imagers data. Finally, we study galactic cosmic rays and energetic particles associated with the CME event (i.e. Forbush decreases and solar energetic particles, SEPs).