Characterization of global geometrical properties of magnetic clouds deduced from in-situ data

Miho Janvier*[1], Pascal Démoulin[2], and Sergio Dasso[3,4]

[1]LESIA - Observatoire de Paris – Observatoire de Paris – 5, Place Jules Janssen 92190 Meudon, France
[2]Observatoire de Paris (Observatoire de Paris) – Observatoire de Paris – LESIA, UMR 8909,(CNRS) Meudon Principal Cedex, France
[3]Instituto de Astronomia y Fisica del Espacio (IAFE) – Ciudad Universitaria, CABA, Argentina
[4]Deparatamento de Fisica, FCEN, UBA – Ciudad Universitaria, CABA, Argentina

Abstract

Magnetic clouds (MCs) are sub-classes of interplanetary coronal mass ejections. One of their main characteristics is the strong rotation of the magnetic field that indicates the existence of a twisted magnetic flux tube, commonly called a flux rope. 1D in-situ data from probes crossing magnetic clouds only give local information on the magnetic field. Fitting these data with analytical models provide the magnetic field distribution within a cross section and can locally determine the flux rope axis orientation.
We first investigate the non-flat probability distribution of the impact parameter, as deduced from WIND data by Lepping & Wu (Annales Geophysicae, 2010). We compare this distribution with similar ones obtained with synthetic data simulating MCs crossing. We find that the probability distribution of detected MCs in WIND data can be understood as a natural consequence of flattened flux rope cross sections. Especially, we find that the velocity of the propagating MCs can lead to two categories of cross section shapes: circular for the faster ones, and elongated for the slower ones.

We further investigate the typical flux rope global shapes by studying the distribution of local axis orientation. We propose a new statistical method that allows deriving the mean global shape axis from a statistical study of the 107 MCs observed by WIND. This shape is also found in 3D structures deduced from heliospheric imagers of propagating MCs.
Such a work gives an important understanding on the global shape of flux ropes. These new methods can be applied to any other flux rope models fitted to the in situ data.

Keywords: CME, magnetic cloud, magnetic fields

*Speaker