MAGNETIC FLUX ROPE LIST: A Brief Description

Analysis Period and Data Sources

This list contains all possible magnetic clouds that were manually identified in the solar wind data from WIND (January 1995 – February 1998) and ACE (March 1998 – December 2009). Identification of the events is based on the model fittings of the observed magnetic fields and solar wind velocity to two force-free magnetic field models: a cylinder model and a torus model. Details of these models are described in the reference given below.

Structure of List

The list consists of two parts, the yearly lists for the cylinder fitting and for the torus fitting. The torus fitting was performed for those cases: (1) when the event duration is comparatively long (typically exceeding 30 hours), (2) when the direction of the axis obtained from the cylinder fitting is close to the Sun-Earth line (typically the angle smaller than 15º), and (3) the cylinder fitting does not return any satisfactory results (large error).

Contents of Each List

Each yearly list gives the parameter set describing the geometry of the magnetic flux rope itself and the encounter with the satellite. The plot of observed and calculated solar wind condition can be seen by simply clicking each parameter line. Each plot shows time profiles of magnetic field intensity, Bx, By, Bz components in the GSE coordinate, degree of magnetic field fluctuations, the solar wind bulk velocity, number density, alpha/proton ration, proton temperature, and the plasma beta based on proton data. At the bottom, magnetic field variations are displayed by vector plots projected on XY-, XZ- and YZ-planes. The vector rotation in the YZ-plane is one of the prominent signatures of magnetic flux ropes.

Cross-Reference between Cylinder and Torus

For some events, both cylinder and torus models well reproduce the observed magnetic field variations. In such cases, cross-reference between the cylinder and torus fitting results is easily made by clicking “T” in the “Torus” column in the Cylinder List, and “C” in the “Cylinder” column in the Torus List.

Notes for the event number

In some cases, it is hard to determine the start and end times of the event uniquely, as is known. In such cases, two or more possible event intervals were selected and the fitting result for each of them is given in the list. The event numbers with attached “a”, “b”, … indicate such situations. In addition, for some events two different results come out for the same interval selection, especially in the torus fitting. In such cases, the list shows them with attachment “m”, “n”, … to the event numbers.

Description of parameters in the Cylinder List

Column 1 (No.): Serial event number in each year.

Column 2 (Start / End): Start and end times of the identified magnetic flux ropes

 (year/month/day/hour: minute, UT).

Column 3 (Shock 1/ Shock2): Times of shock arrivals (year/month/day/hour: min, UT)

 Shock 1 is a shock preceding the magnetic flux rope, probably driven by

 the magnetic flux rope (or ICME).

 Shock 2 is a shock detected within the flux rope interval, probably

 overtaken from behind. When Shock 2 exists, the fitting was made by

 using only data before the shock.

Column 4 (R0): The radius of the flux rope cylinder at the time of encounter. The cylinder

 radius changes with time, t as R0 (1 + t/T0). Unit is AU.

Columns 5 & 6 (0 & 0): The latitude and longitude angles of the cylinder axis field.

Column 7 (IP): The impact parameter. The sign refers to the direction of X Baxis.

Column 8 (B0): The magnetic field intensity at the cylinder axis at the time of encounter.

 The intensity at the axis changes as B0/(1 + t/T0)2.

Column 9 (Usw): The bulk speed of the magnetic flux rope.

Column 10 (T0): The time constant for self-similar expansion of the flux rope (in hours).

Column 11 (Sign): The magnetic helicity sign. R = right-handed, L = left-handed.

Column 12 (Erms): The error-estimating figure, defined as the rms difference between the

 observed and calculated fields divided by the maximum observed field

 intensity within the flux rope.

Column 13 (Torus): Marker for cross-reference to the torus fitting. Click “T”, then the torus

 result appears.

Column 14 (Remarks): For future usages.

Description of parameters in Torus List

Column 1 (No.): Serial event number in each year.

 The event number with \* attached indicate that the fitting was made with

 a fixed value for Rc arbitrarily. The parameters should be modified in the

 future.

Column 2 (Start / End): Start and end times of the identified magnetic flux ropes

 (year/month/day/hour: minute, UT).

Column 3 (Shock 1/ Shock2): Times of shock arrivals (year/month/day/hour: min, UT)

 Shock 1 is a shock preceding the magnetic flux rope, probably driven by

 the magnetic flux rope (or ICME).

 Shock 2 is a shock detected within the flux rope interval, probably

 overtaken from behind. When Shock 2 exists, the fitting was made by

 using only data before the shock.

Column 4 (Rc): The major radius of torus

Column 5 (R0): The minor radius of torus at the time of encounter. The minor radius

 changes with time, t as R0 (1 + t/T0). Unit is AU.

Column 6 & 7 ( & ): The latitude and longitude angles (in degrees) of a vector normal to the

 torus plane defined by the axial magnetic field.

Column 8 (Bx-sgn): The sign of the Bx component of the axial field, indicating on which side

 the spacecraft encountered the torus.

Column 9 & 10 (py & pz): The position in the YZ-plane of the spacecraft track from the torus

 axis, normalized by R0.

Column 11 (p): The minimum distance from the torus axis to the spacecraft in unit of R0.

Column 12 (B0): A parameter to determine the intensity (in nT) of the toroidal magnetic

 field. For details see the reference below.

Column 13 (Usw): The bulk velocity of torus at the time of encounter (in km/s). The bulk

 velocity changes with time, t as: Usw – d-fctr\*t.

Column 14 (d-fctr): The deceleration factor of the torus bulk motion (in km/s/hour).

Column 15 (T0): The time constant for self-similar expansion of the flux rope (in hours).

Column 16 (H): The magnetic helicity sign. R = right-handed, L = left-handed.

Column 17 (Erms): The error-estimating figure, defined as the rms difference between the

 observed and calculated fields divided by the maximum observed field

 intensity within the flux rope.

Column 18 (Torus): Marker for cross-reference to the torus fitting. Click “T”, then the torus

 result appears.

Column 19 (Remarks): For future usages.

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References

Marubashi, K. and R. P. Lepping, Long-duration magnetic clouds: a comparison of analyses using torus- and cylinder-shaped flux rope models.