

March 4, 2015

Space Weather Event Report:  
Preliminary Analysis of Latest Events

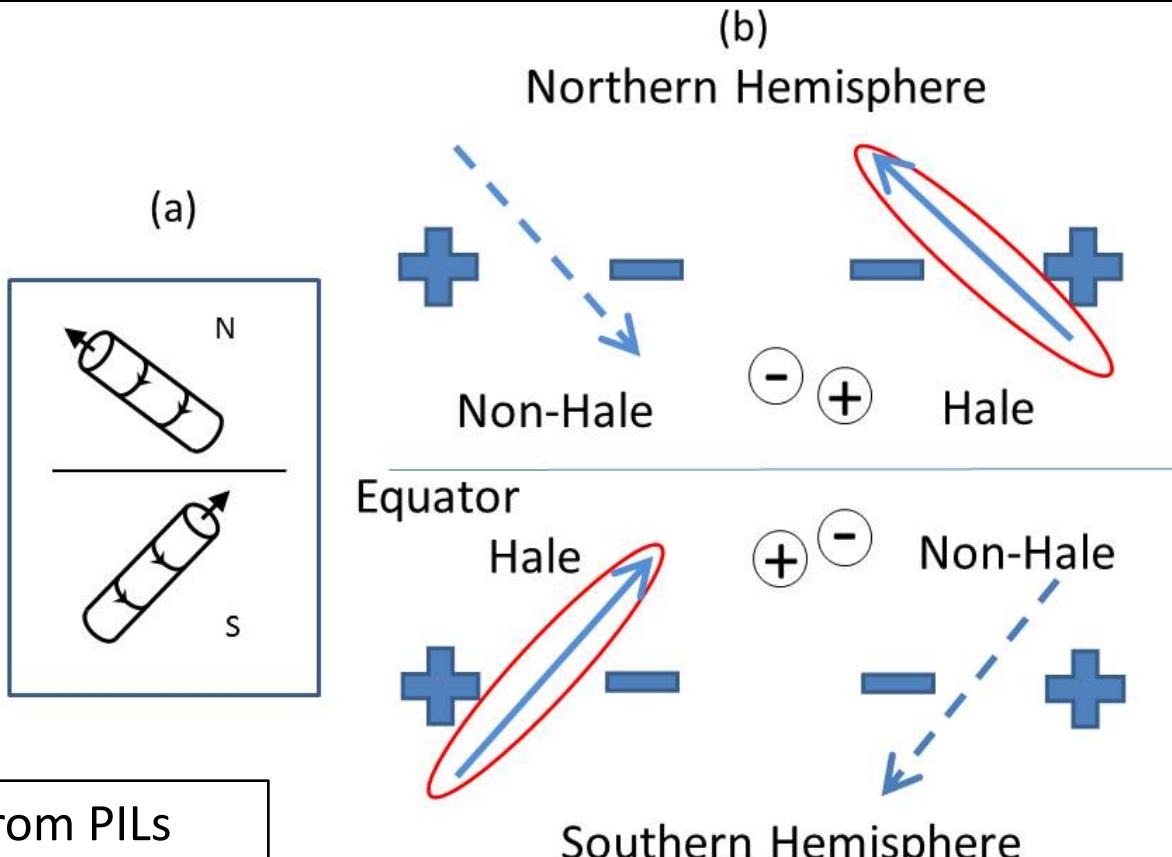
# Flux rope analysis of solar wind structures associated with the selected events

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## Introduction-1

# Importance of Flux Rope Analysis of ICMEs



Flux ropes: erupt from PILs  
Flux rope axis: parallel to PIL  
Helicity rule: LH (N), RH (S)



True?

Prediction of IMF variation: possible from solar observations

## Introduction-2 Selected Evnets

### (A) Geomagnetic storm:

gradually started around 03 UT on 27 August, 2014

slow CMEs? High-speed solar wind?

FLUX ROPE detected

### (B) Weak SC-storm:

SC at 15:54 UT on 12 September (Kakioka)

X1.6 LDE flare AR 12158 (N11E05), 17:21 UT 10-Sep

Halo CME, Proton event

FLUX ROPE detected

### (C) Large Active Region AR 12192 (19 – 26 October, 2014)

No ICME signatures

### (D) Weak geomagnetic storm:

gradually started on 04 November, 2014

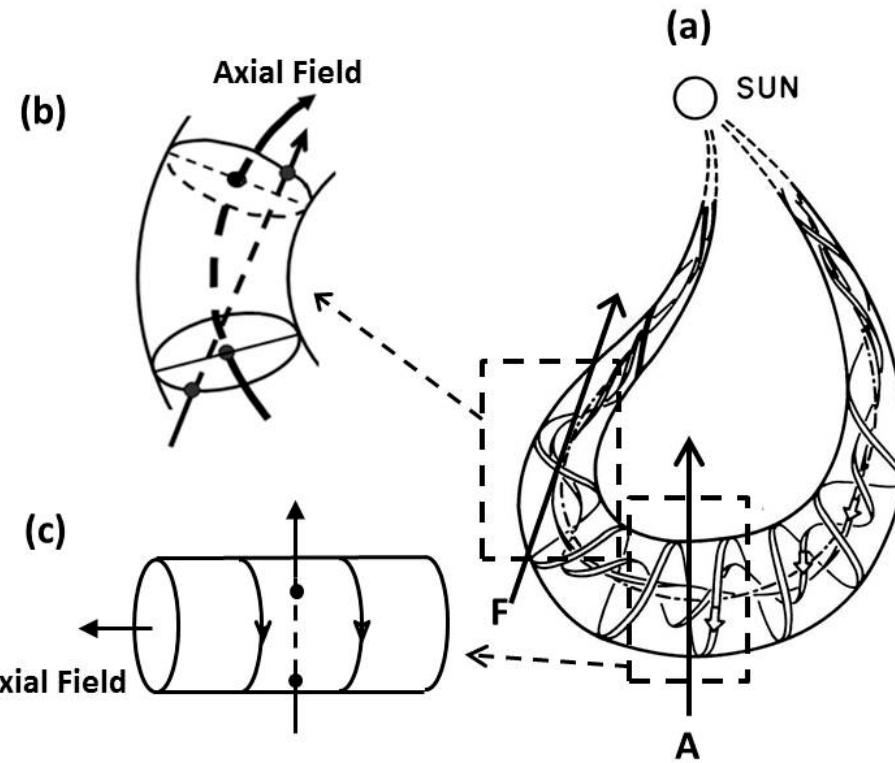
high energy protons enhancement 1-4 November

Filament eruption? Flare?

FLUX ROPE possible

## Introduction-3 Analysis method (two models) & Problems

Fitting to  
Toroidal model

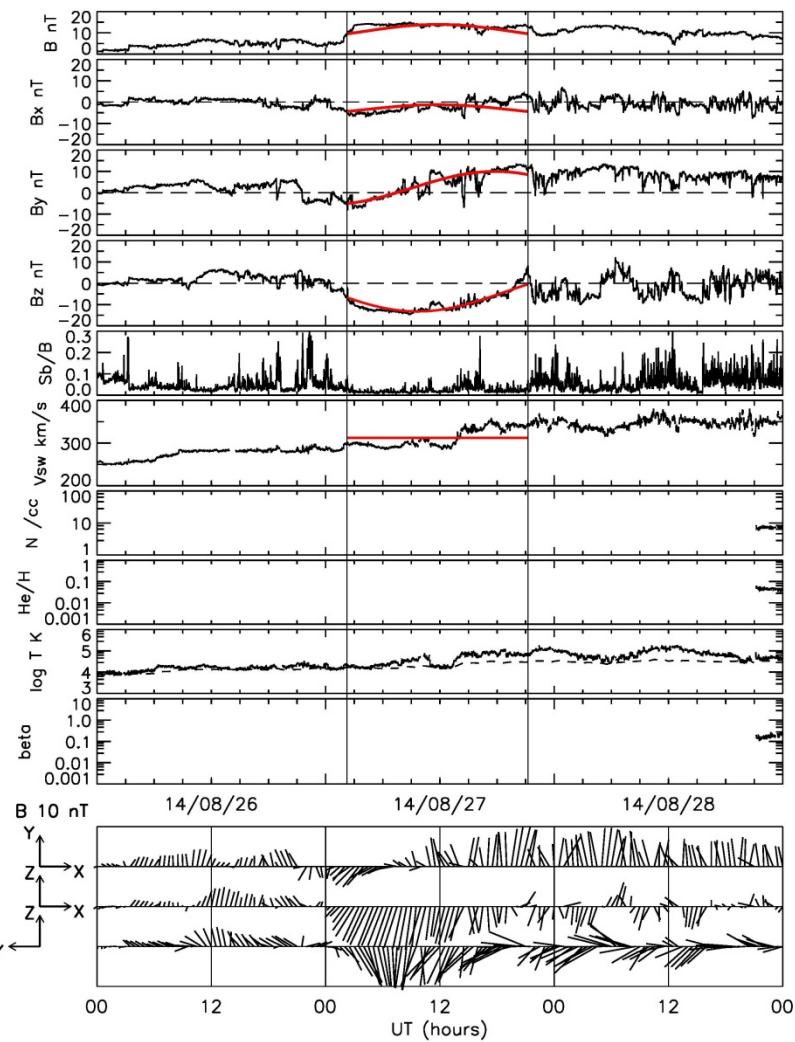


Fitting to  
Cylindrical model

Problems: Fitting does not always provide a unique solution  
We show (many) possible geometries for 3 flux ropes.

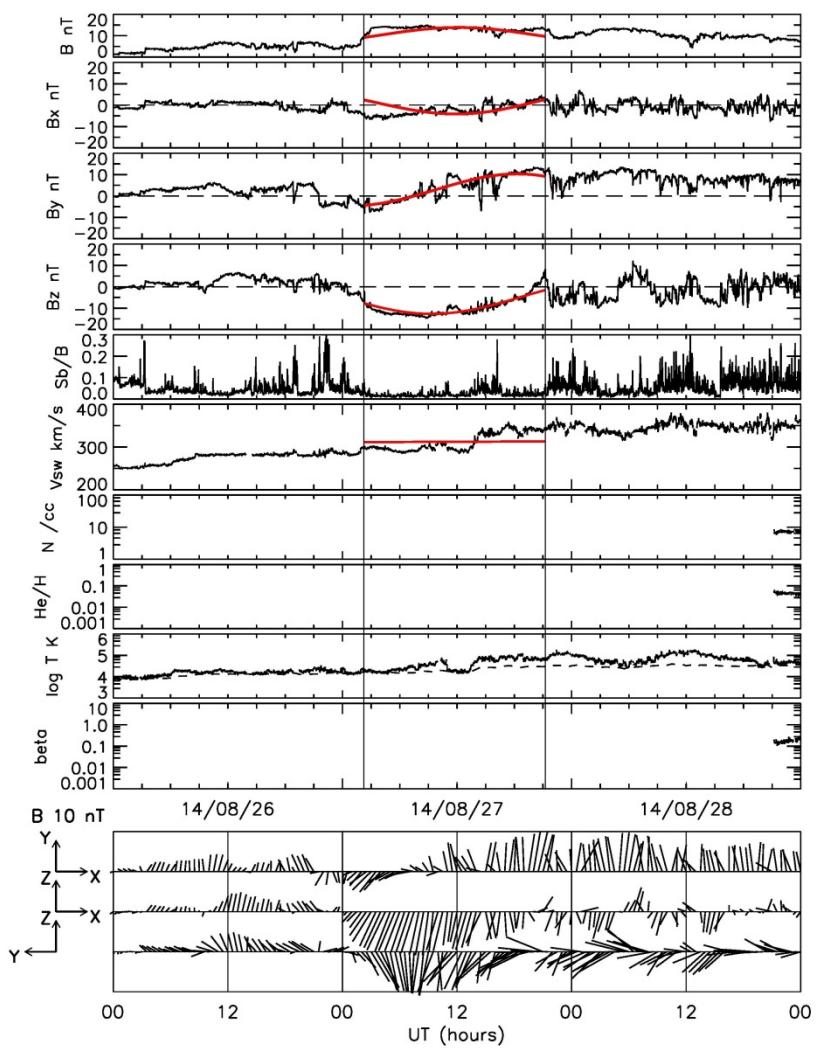
# Event A

Cylinder



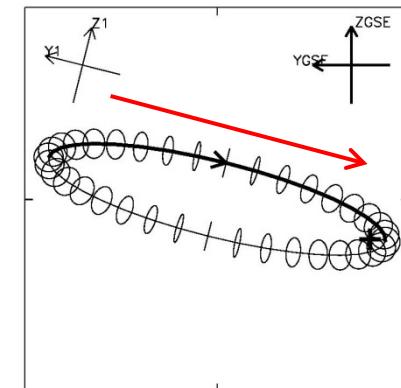
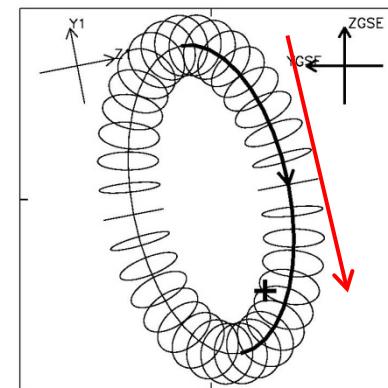
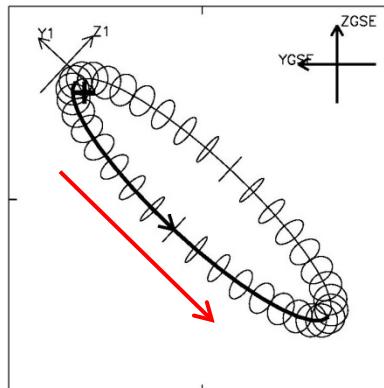
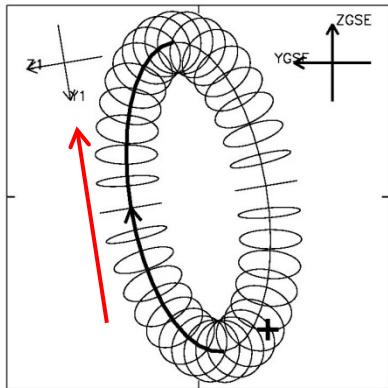
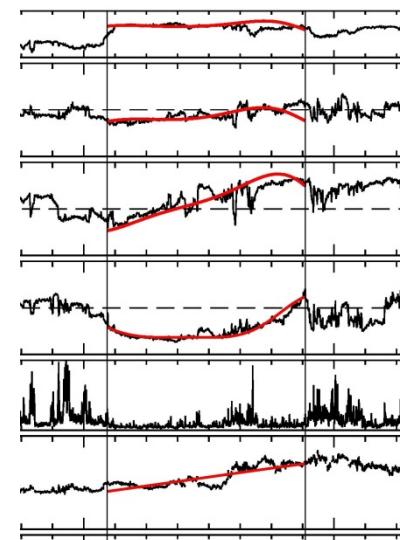
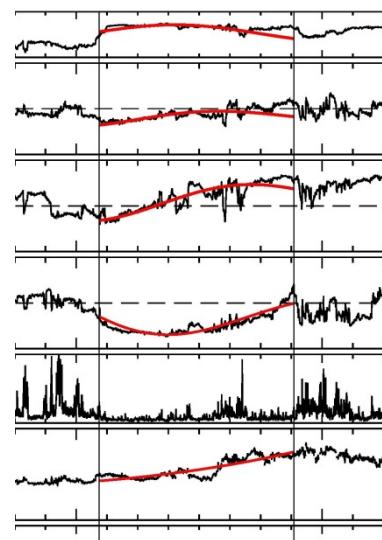
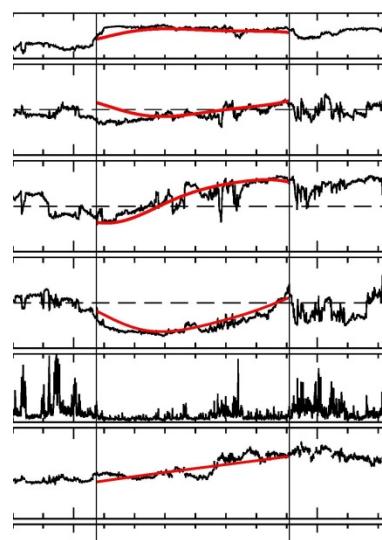
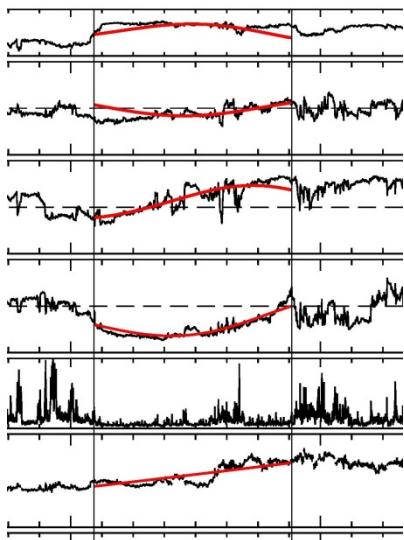
Lat=-42 $^{\circ}$ , Lon=25 $^{\circ}$ , sgn=-1, Ro=0.067  
Erms=0.286

Cylinder



Lat=-23 $^{\circ}$ , Lon=168 $^{\circ}$ , sgn=-1, Ro=0.040  
Erms=0.302

# Event A/Torus



R=0.267, r=0.053  
Lat=-8 $\square$ , Lon=64 $\square$   
Erms=0.282

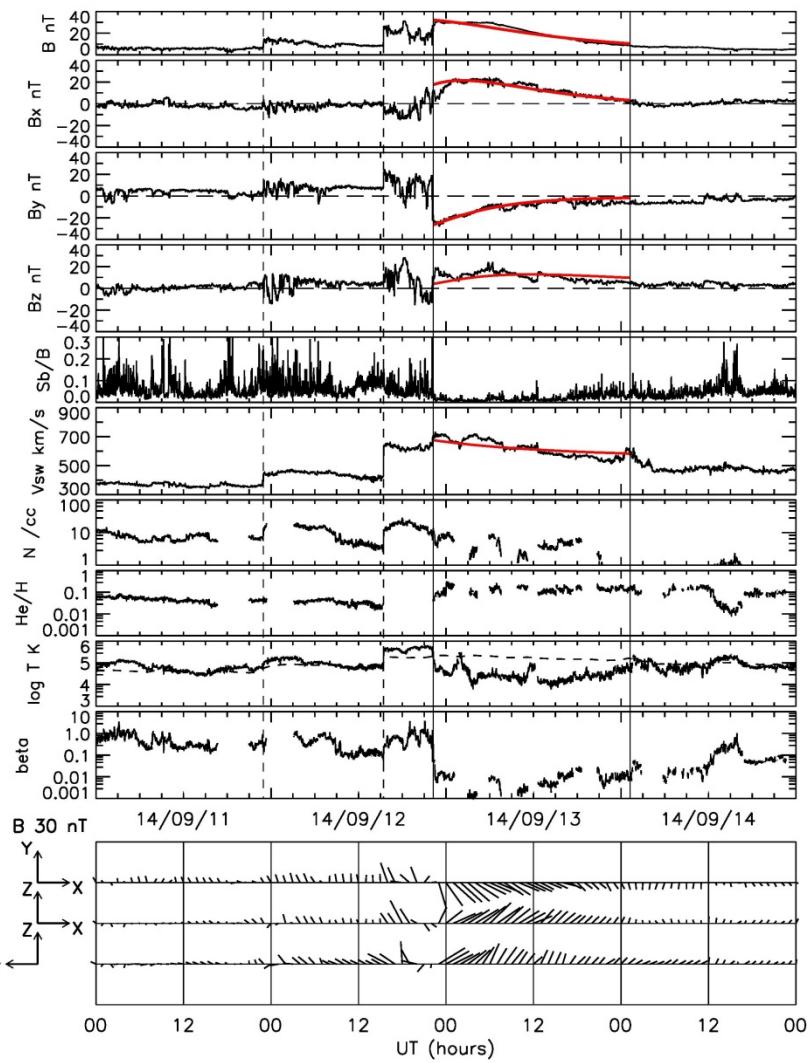
R=0.203, r=0.020  
Lat=45 $\square$ , Lon=250 $\square$   
Erms=0.331

R=0.300, r=0.058  
Lat=9 $\square$ , Lon=301 $\square$   
Erms=0.268

R=0.192, r=0.016  
Lat=71 $\square$ , Lon=313 $\square$   
Erms=0.299

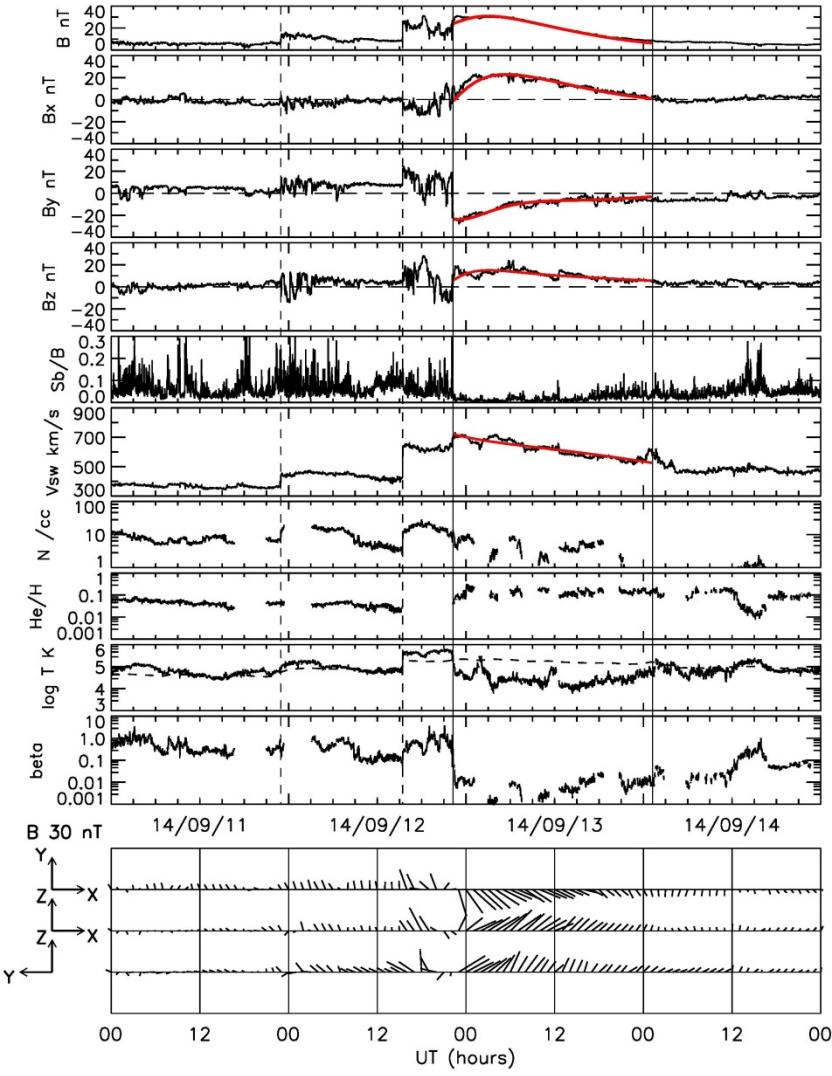
# Event B

## Cylinder (L)



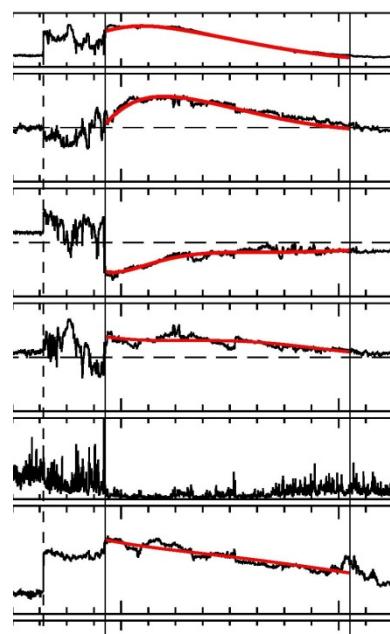
Lat=-11, Lon=32, sgn=-1, Ro=0.143  
Erms=0.190

## Torus (R)

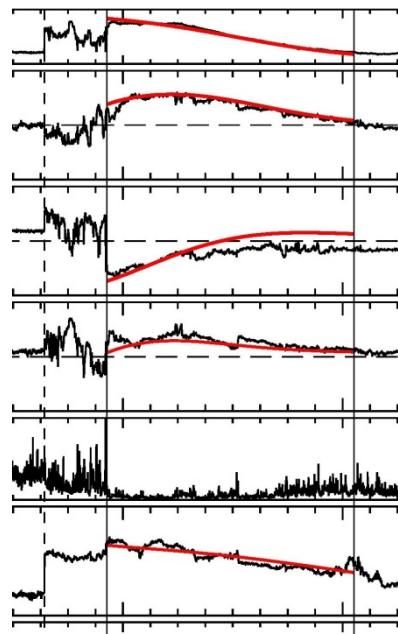


R=0.389, r=0.051, Lat=-29, Lon=79  
Sgn=1, Erms=0.123

L

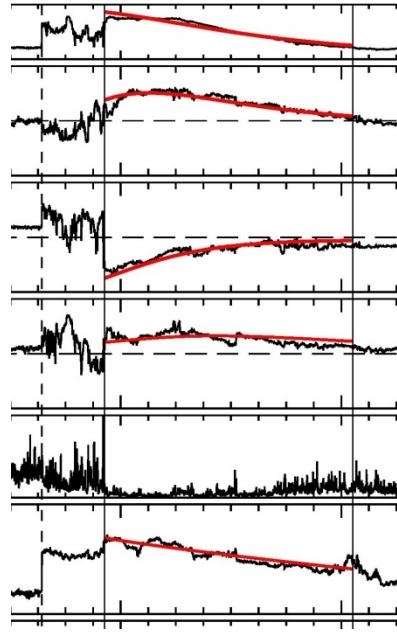


L

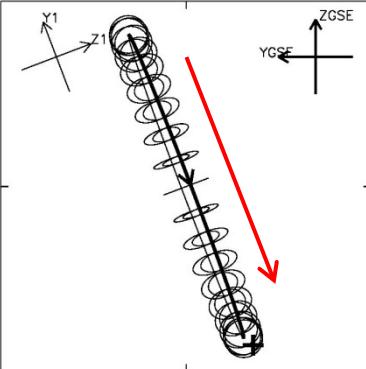
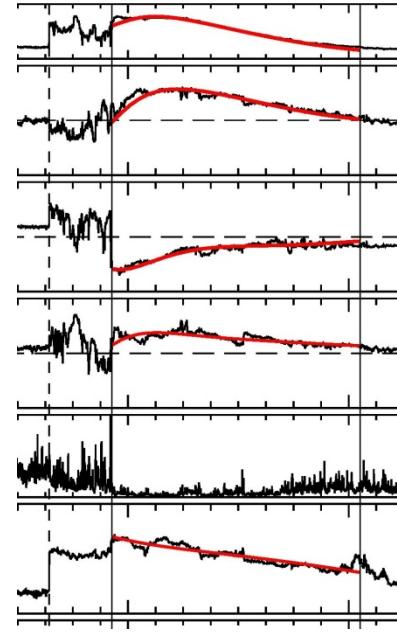


## Event B (Torus)

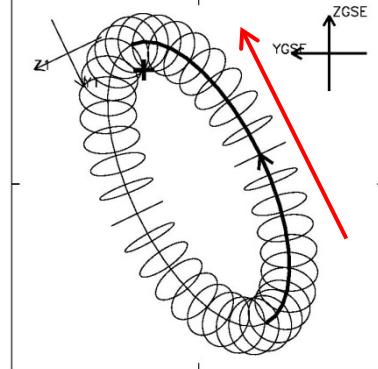
L



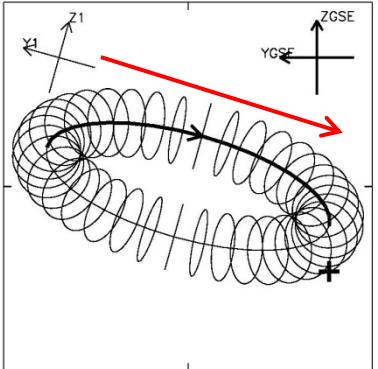
R



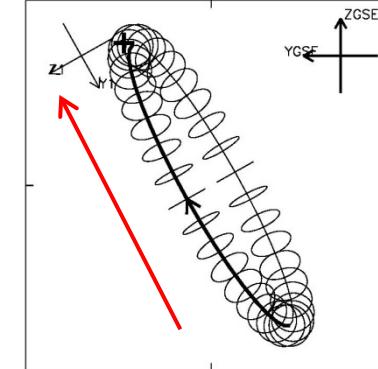
$R=0.433, r=0.050$   
 Lat=21 Lon=272  
 Erms=0.122



$R=0.463, r=0.085$   
 Lat=-23 Lon=119  
 Erms=0.322



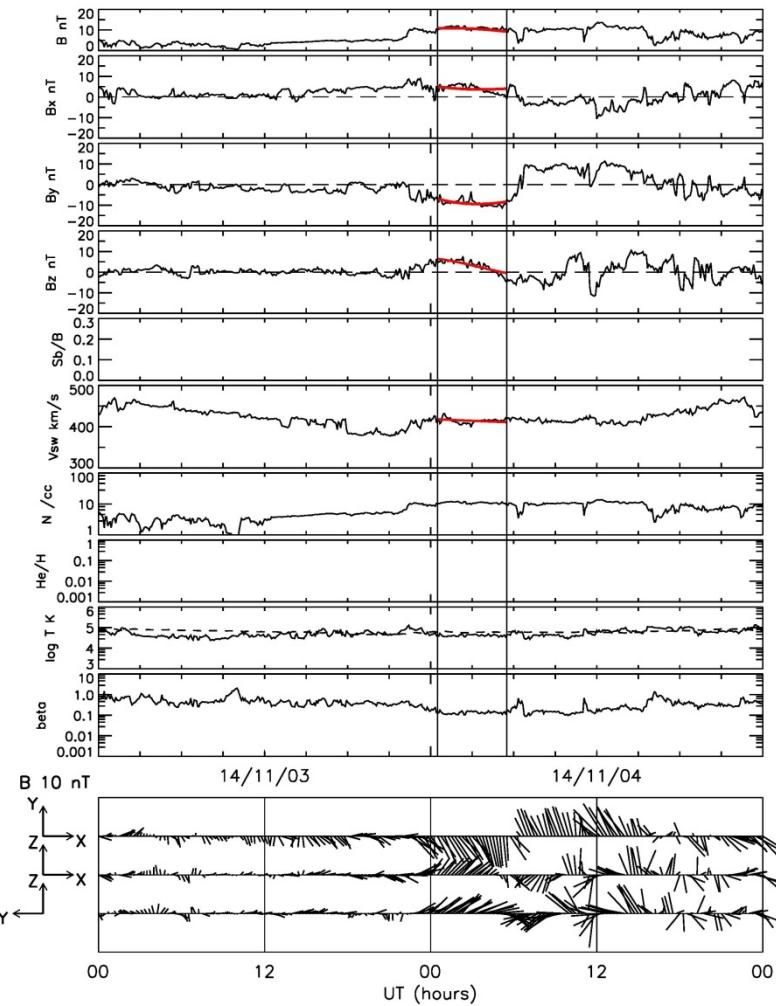
$R=0.778, r=0.181$   
 Lat=64 Lon=325  
 Erms=0.167



$R=0.389, r=0.051$   
 Lat=-29 Lon=79  
 Erms=0.123

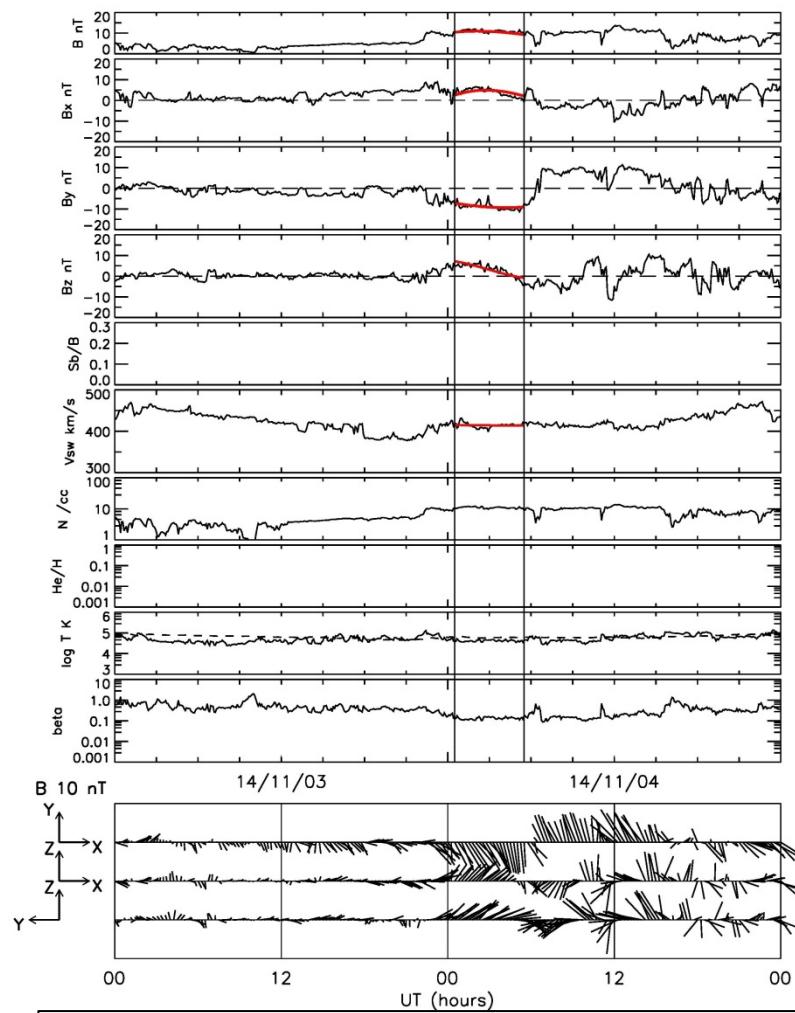
# Event D (Cylinder)

L



Lat=12 $\square$ , Lon=206 $\square$ , sgn=-1, Ro=0.033  
Erms=0.223

R



Lat=-6 $\square$ , Lon=14 $\square$ , sgn=1, Ro=0.015  
Erms=0.195

## Summary

Model fitting sometimes yields many possible geometries.  
(Fitting doesn't give us a unique solution.)

This happens when the magnetic field rotation in the Y-Z plane  
is not evident (or the “glancing passage of spacecraft”).

We need special attention in using the model fitting analysis  
to determine the geometry of interplanetary flux ropes.

How can we select the right geometry?

3D observation? (if possible)

consistent relationship with something else (e.g. PILs)

others?