

The chirality of the event on November 20, 2003: relating solar imaging and solar wind measurements

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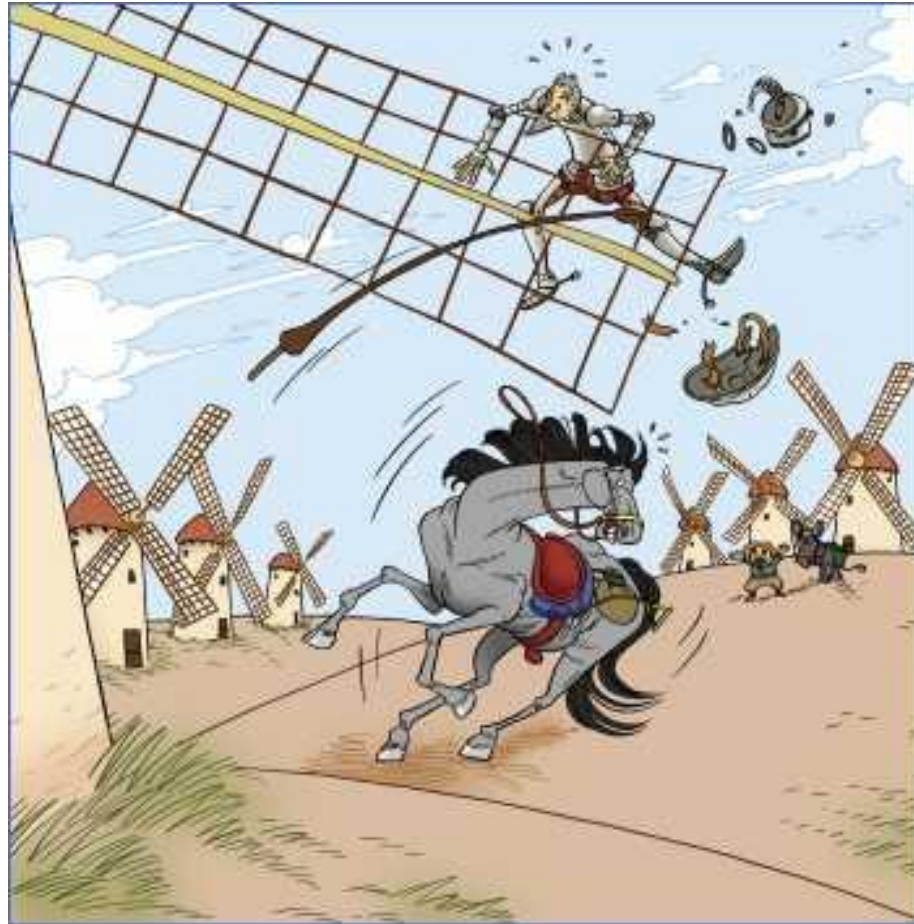
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Modelling flux ropes: from 1D to 3D

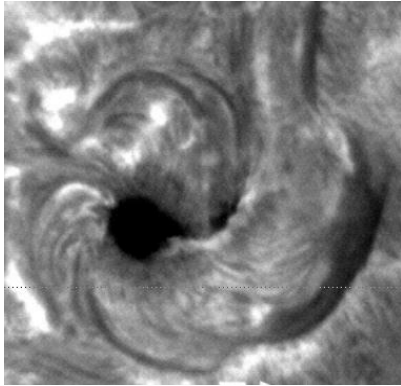


Modelling flux ropes: from 1D to 3D



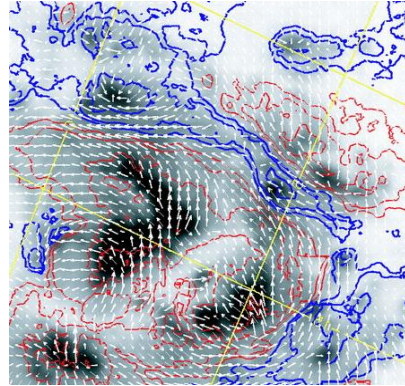
Evidences of magnetic helicity

* Sunspot whorls



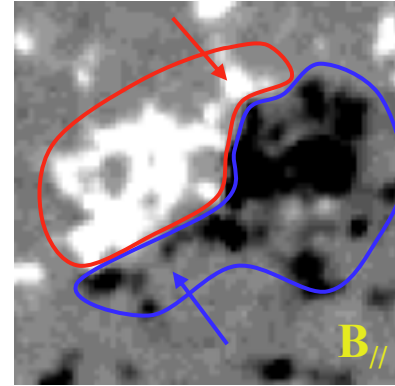
(Hale 1925, Chae 2001, Nakagawa et al. 1971)

* vector magnetograms



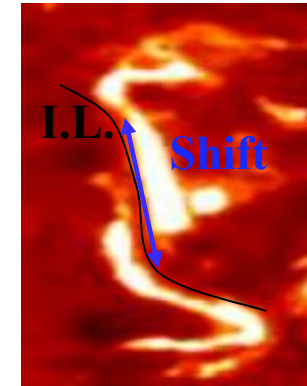
(Hagyard et al. 1990, Metcalf et al. 2005)

* Magnetic tongues



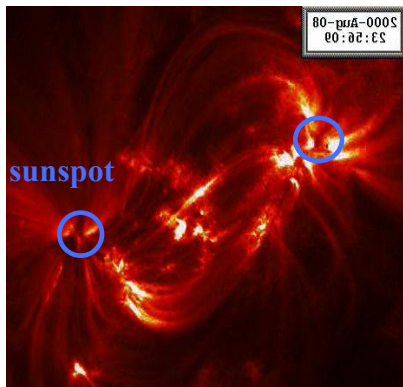
(Lopez et al. 2000 Green et al. 2007)

* Shift / J-shape of ribbons



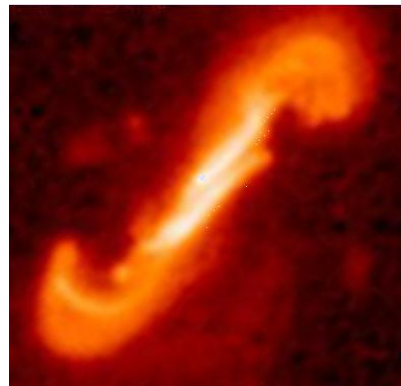
(Moore et al. 1995, Démoulin et al. 1996)

* coronal loops



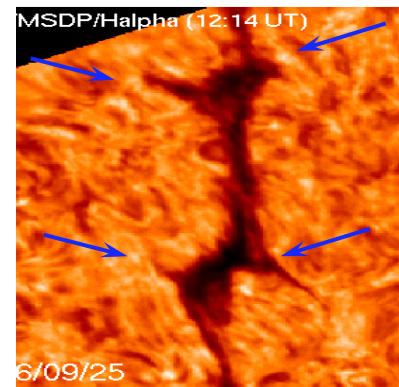
(Brown et al. 2003, Schmieder et al. 1996)

* X-ray sigmoids



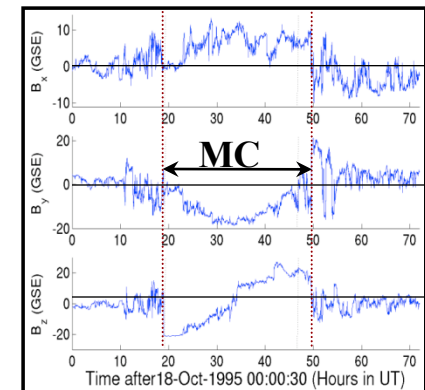
(Manoharan et al. 1996, Canfield et al. 1999)

* feet/barbs of filaments



(Martin et al. 1994, Aulanier et al. 1999)

* magnetic clouds



(Bothmer & Schwenn 1998, Dasso et al. 2006)

All have $H > 0$

The IP cause of the largest storm of solar cycle 23:

An 'ESW' MC

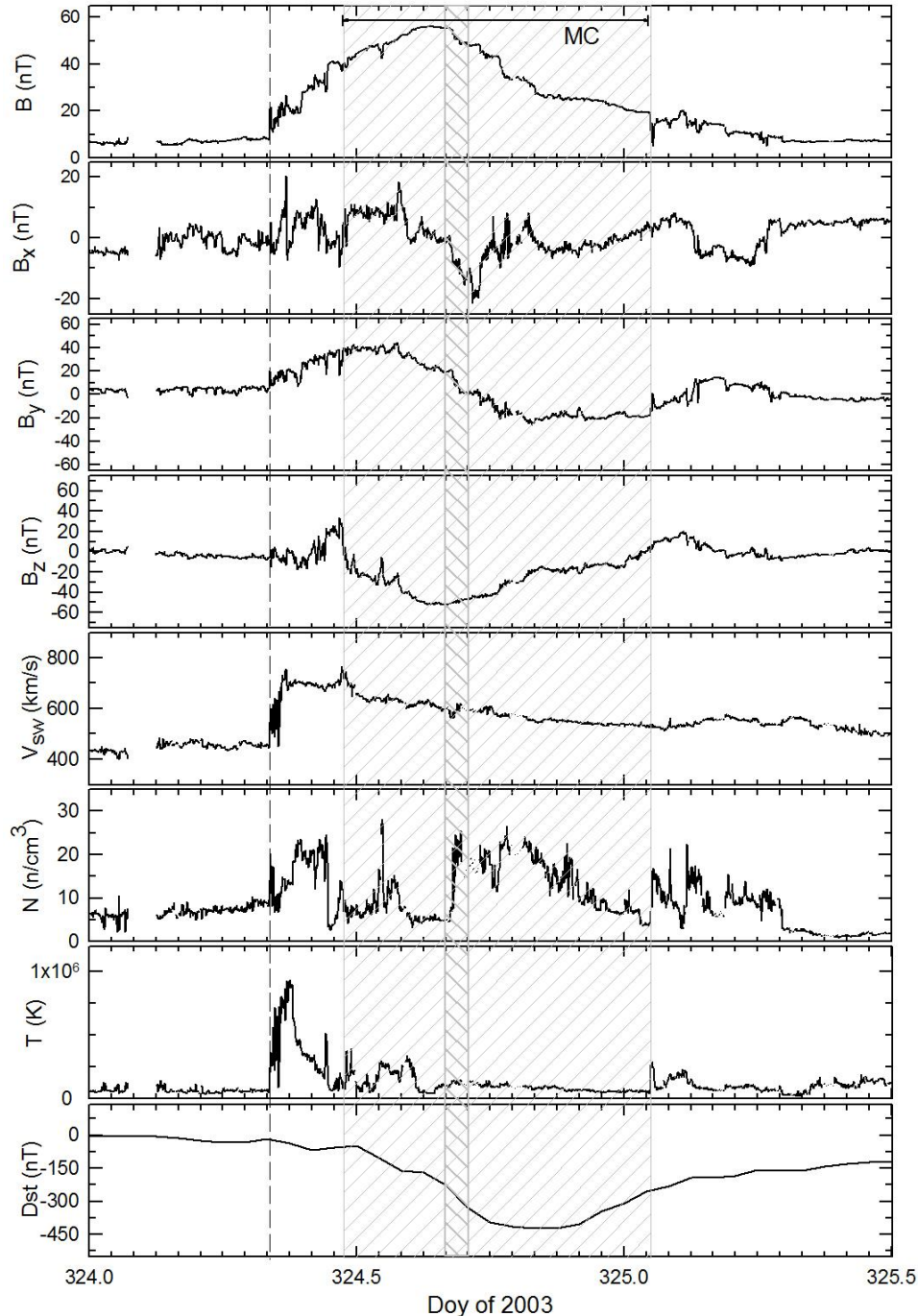
-Axis pointing to the South

-Extreme $B_z > 50$ nT

-Helicity > 0

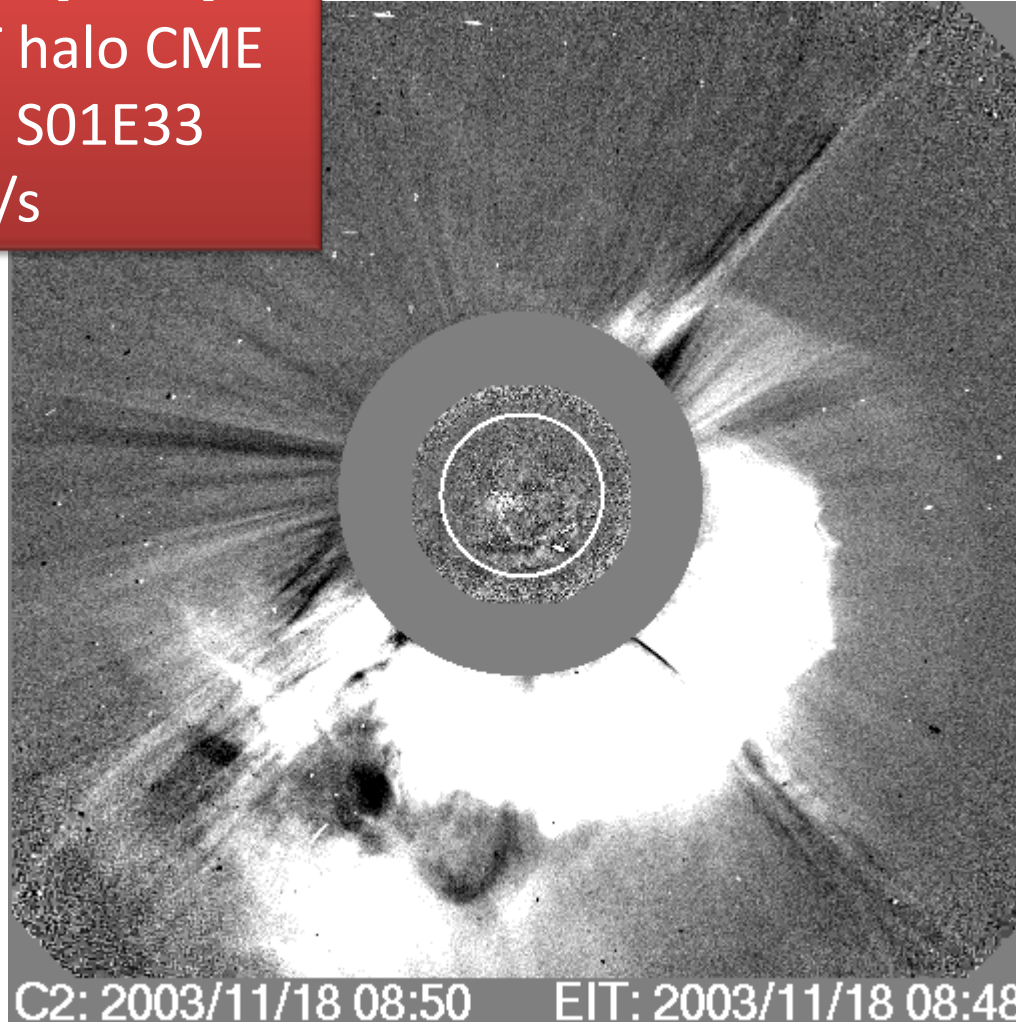
Yurchyshyn et al. [2005]

KASI list: Right handed

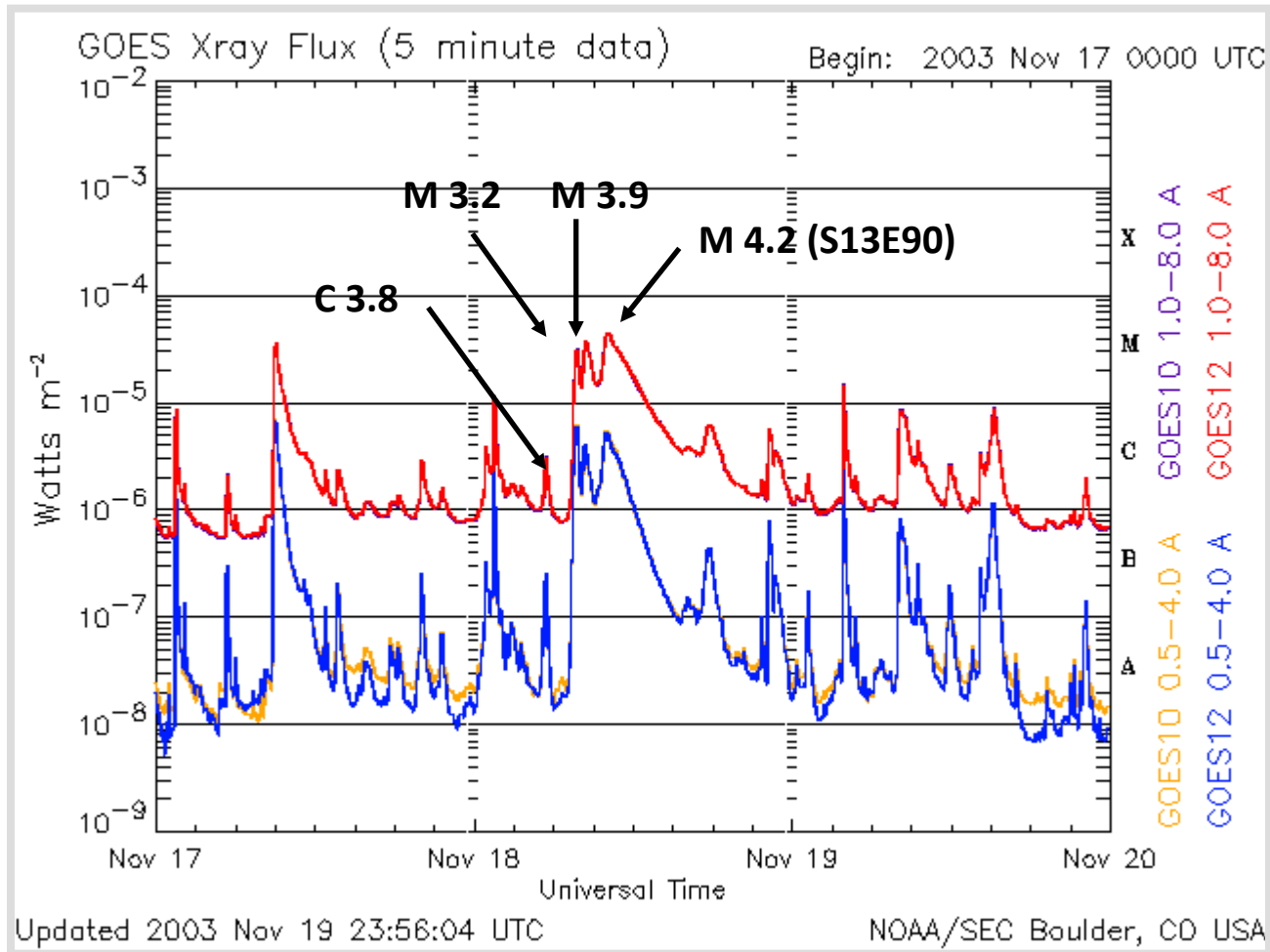


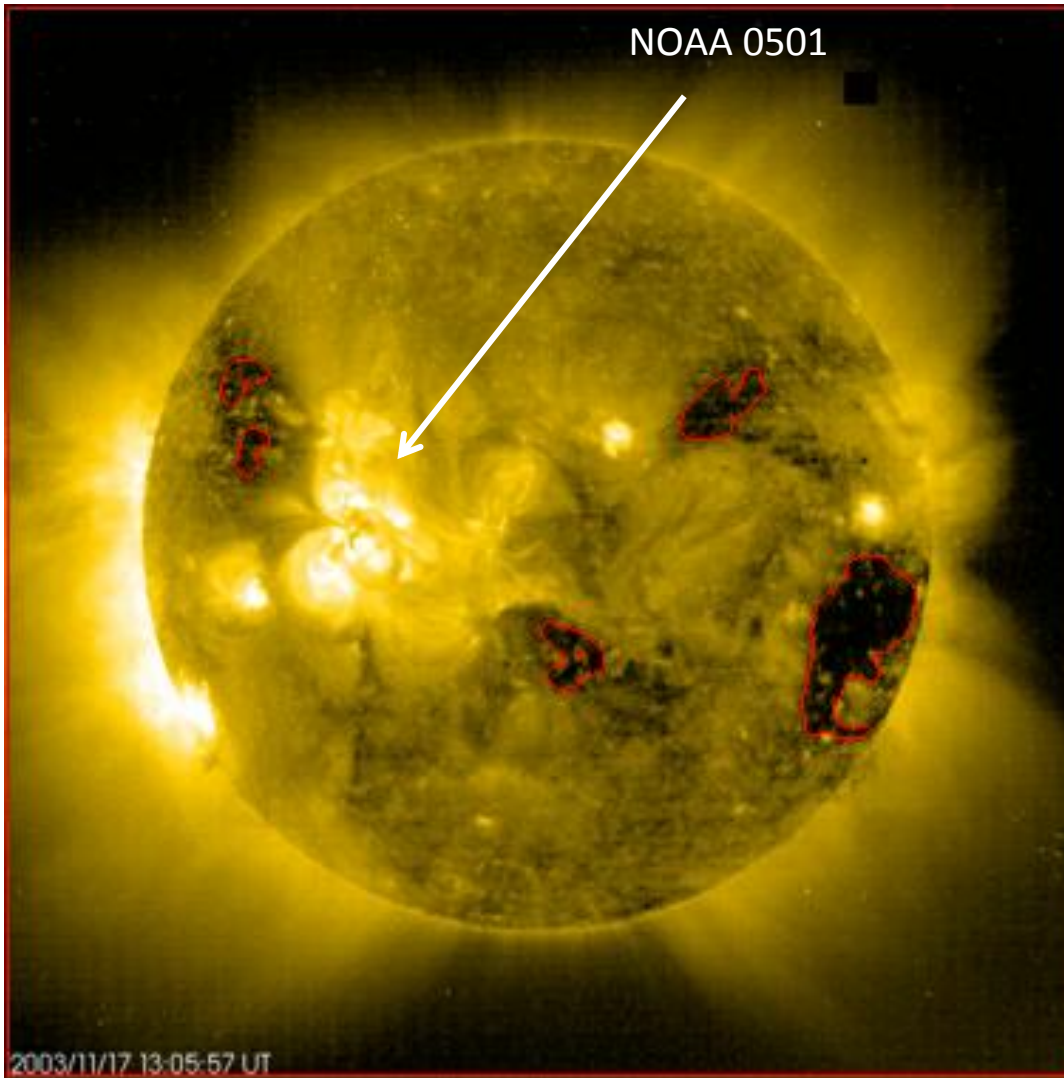
What about the Sun?

Gopalswamy et al. [2005] :
Nov. 18 08:50 UT halo CME
from AR10501 at S01E33
Speed ~ 1660 km/s



What about the Sun?





CMEs on Nov 18:

- P. Halo: 08:06

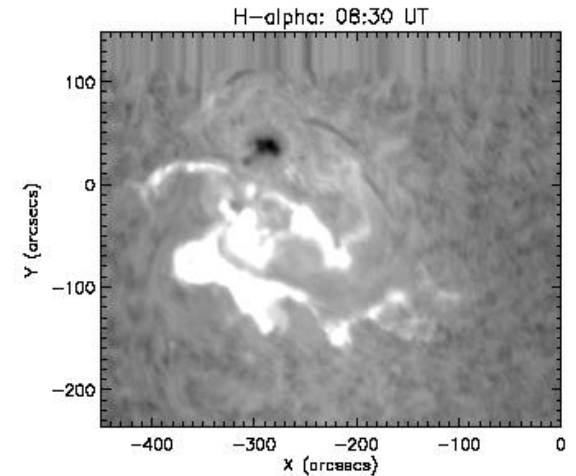
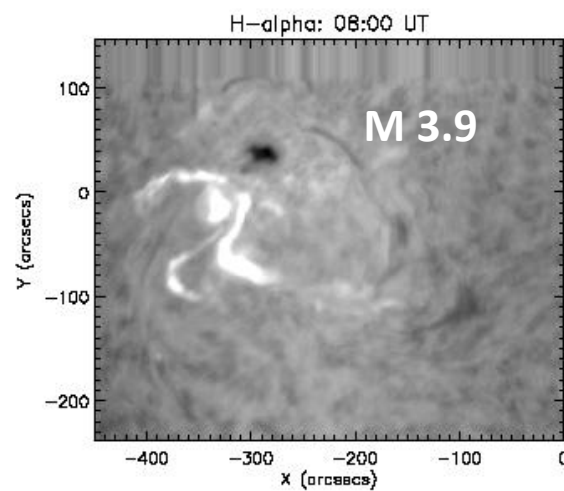
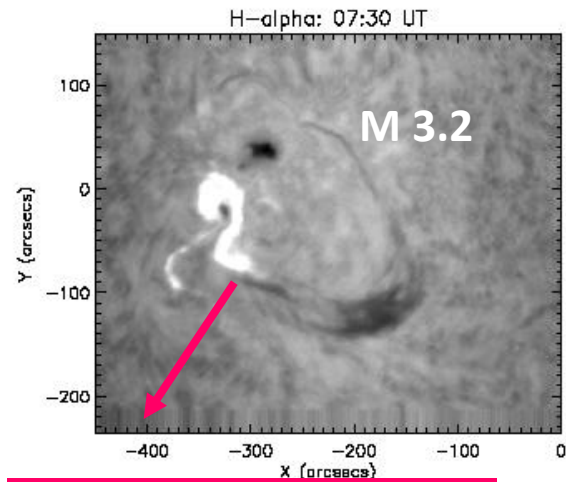
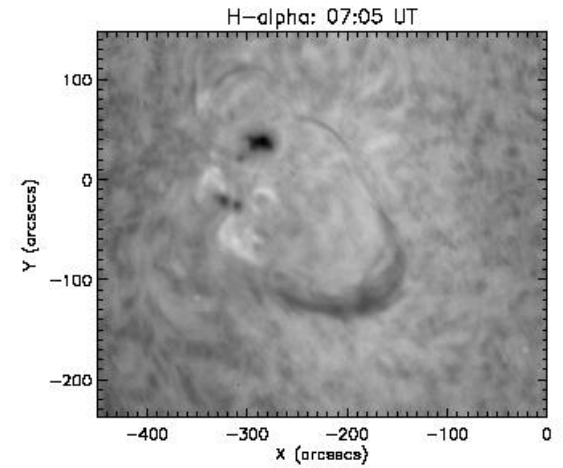
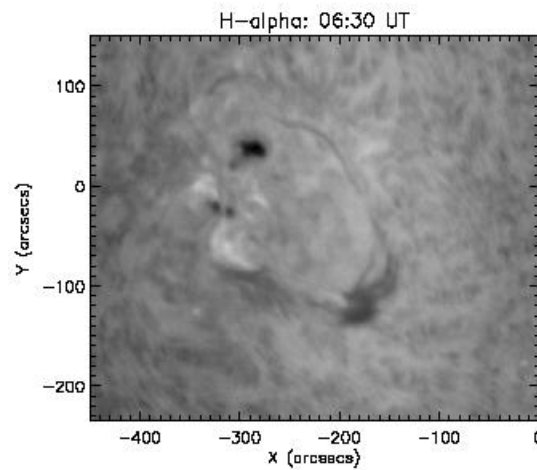
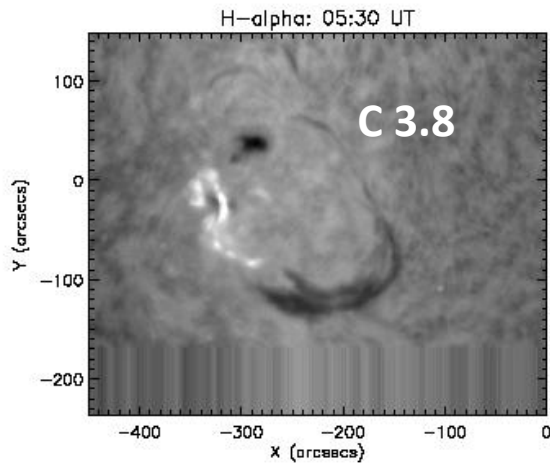
$v=1223$ km/s

- Halo: 08:50

$v=1660$ km/s

Both CMEs from
AR10501

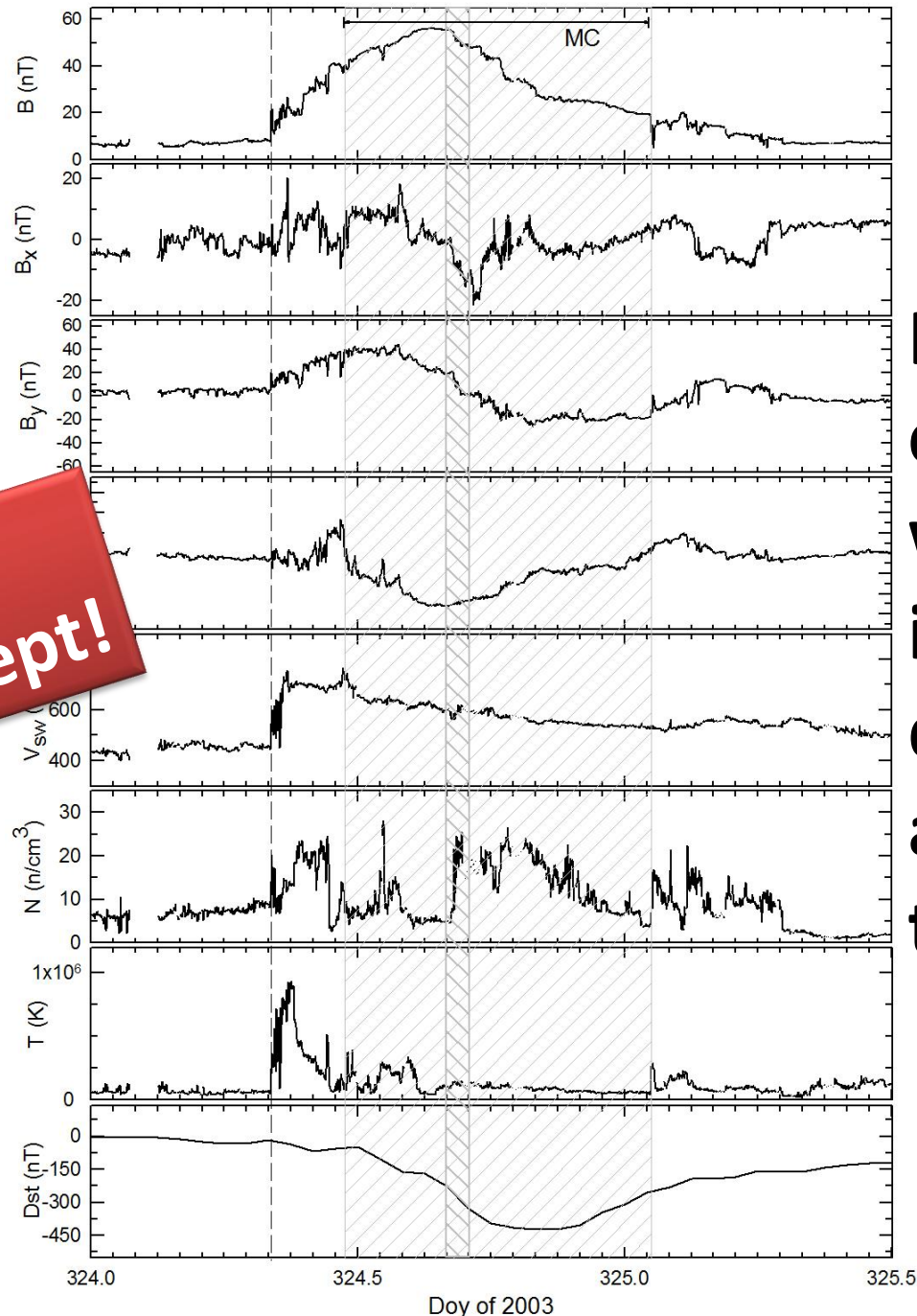
H α flares on 18 November 2003



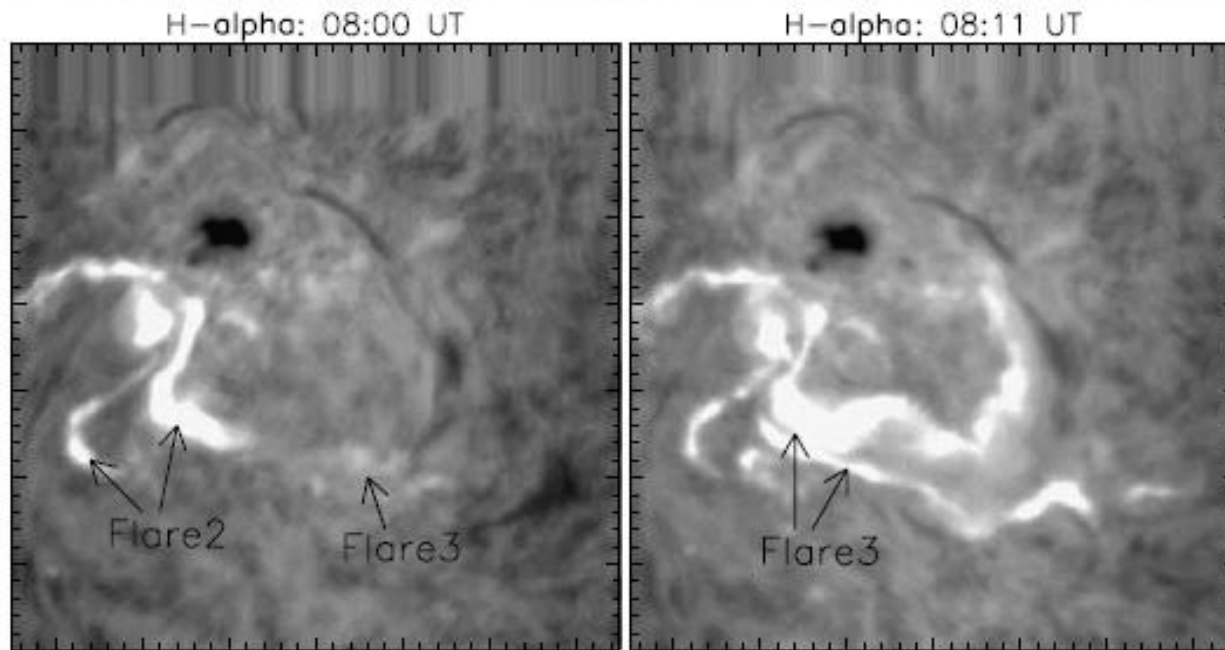
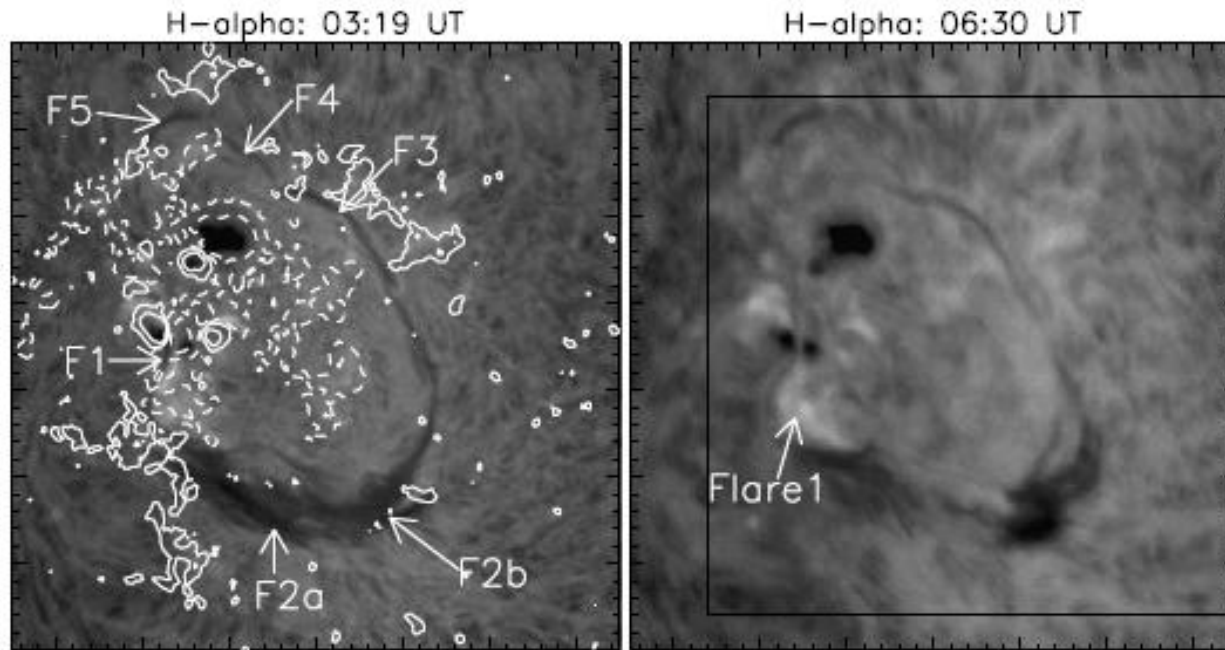
Reversed S Sigmoid

**A reversed-S
sigmoid
cannot be
related to an
ESW MC**

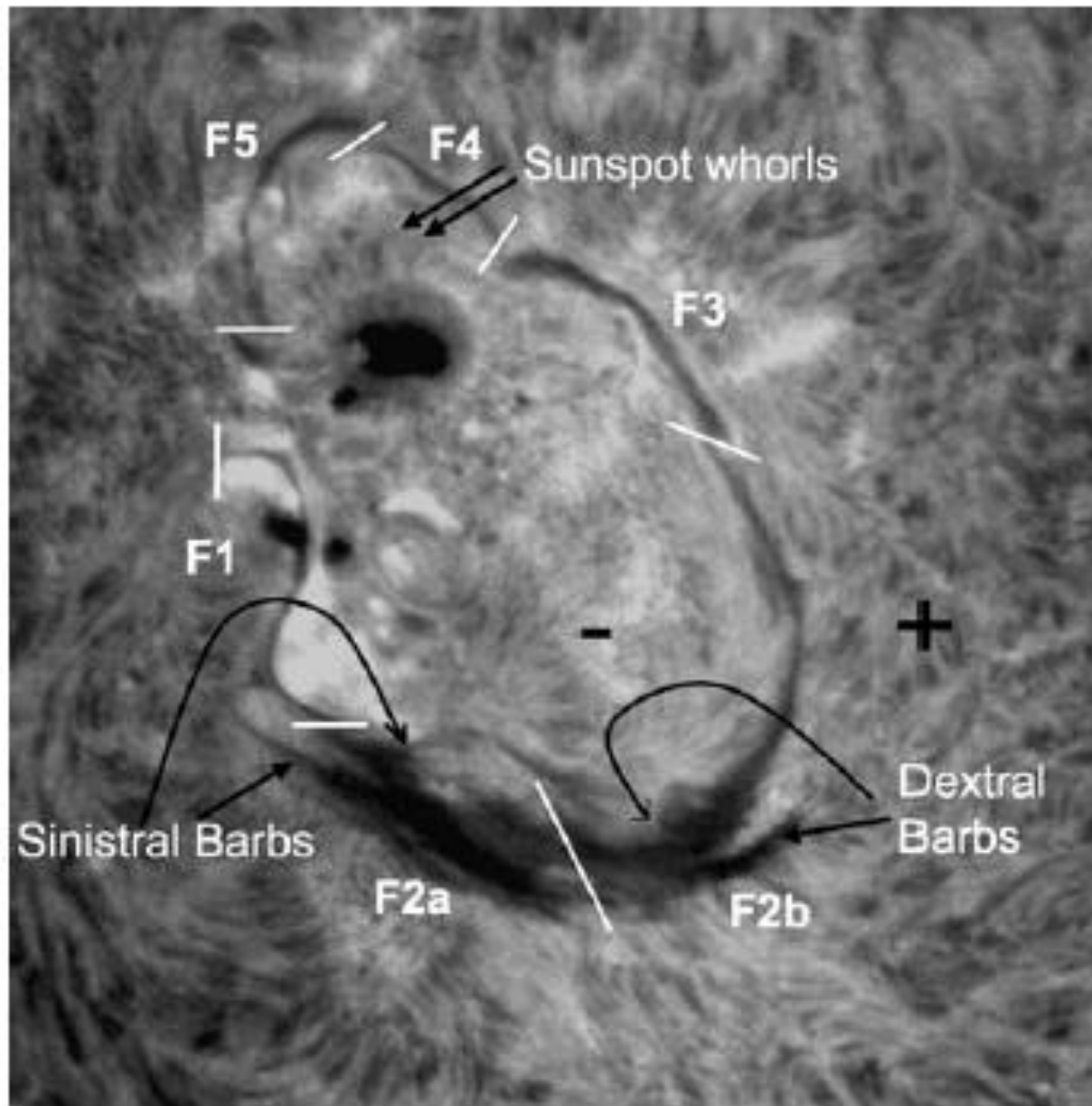
**The chirality
should be kept!**



**Intense B_z
coincides
with an
increase in
density and
a non-
typical B_x**



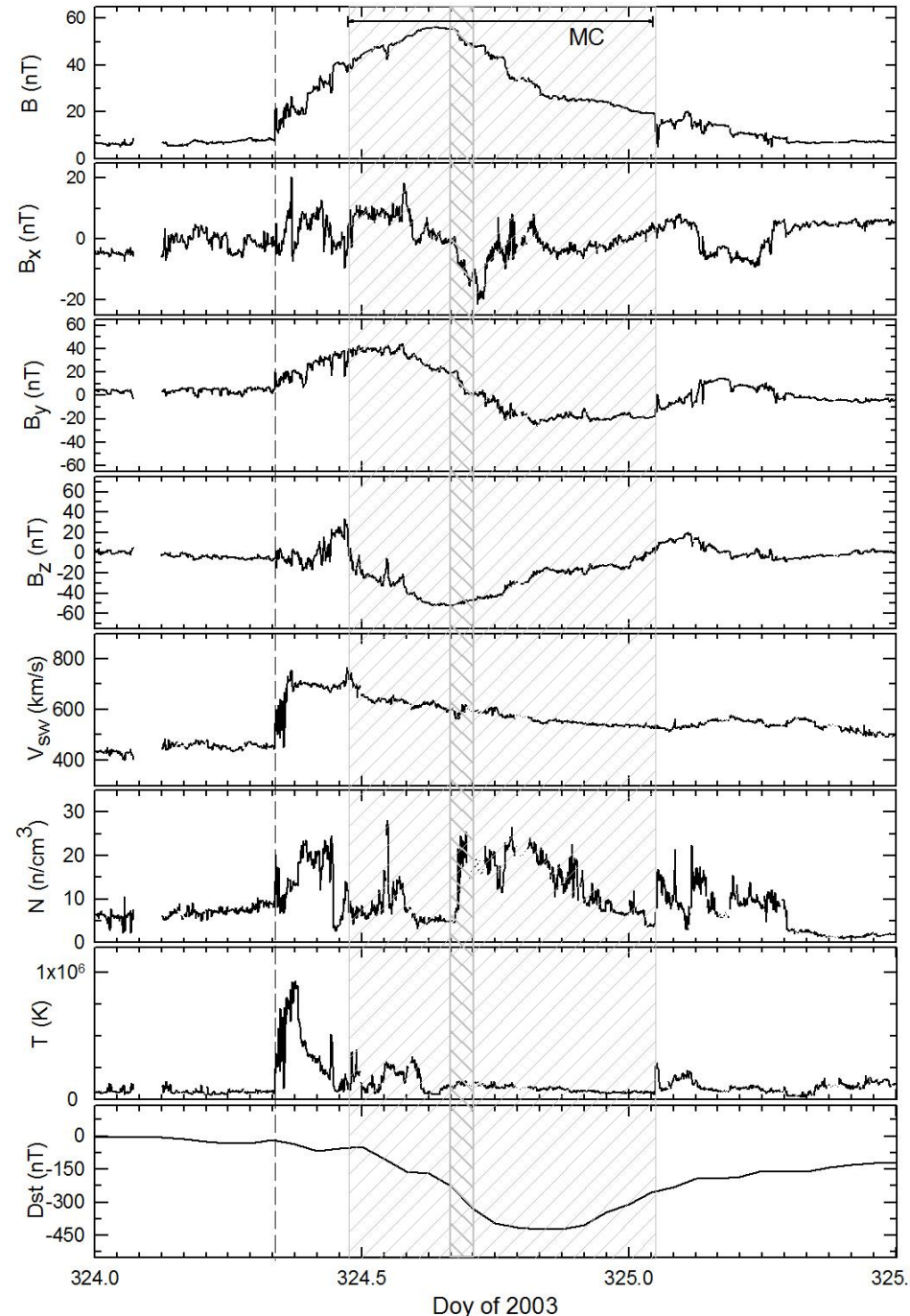
R. Chandra et al. [2009]



R. Chandra et al. [2009]

**Large drop on Dst
coincides with**

- a non-typical Bx**
- an increase in density ($5 \text{ cm}^{-3} \rightarrow >20 \text{ cm}^{-3}$)**
- an increase in temperature
by a factor > 2**



CONCLUSIONS

- Interaction between different segments of filaments with different helicity seems to be the explanation to the flux rope observed on November 20, 2003. **Is it a single event?**
- Although magnetic field at 1 AU is relatively smooth (B_x ?), the enhanced density might be considered as a remainder from solar interaction, which could have played a key role in the large *Dst* decrease
- **Chirality should be a key parameter in checking the fitting parameters of flux rope models and choosing the right solar source**

CHIRALITY
WILL PROVIDE
AN ANSWER

Is it a flux rope
or not?



Thank you!