Maximum gradient method

We define a proxy quantity for the **weighted horizontal magnetic gradient:**

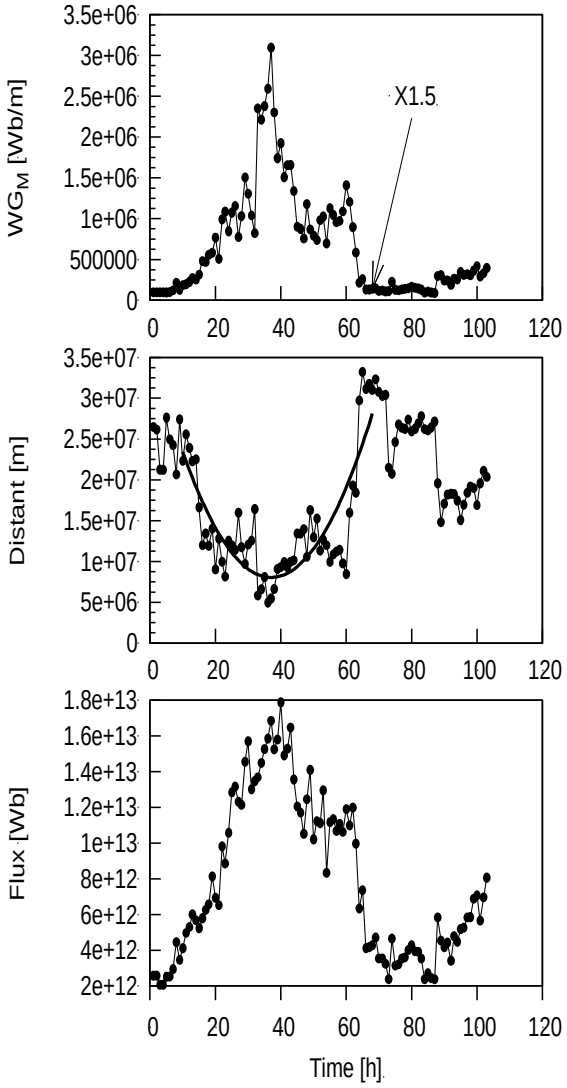
Magnetic flux

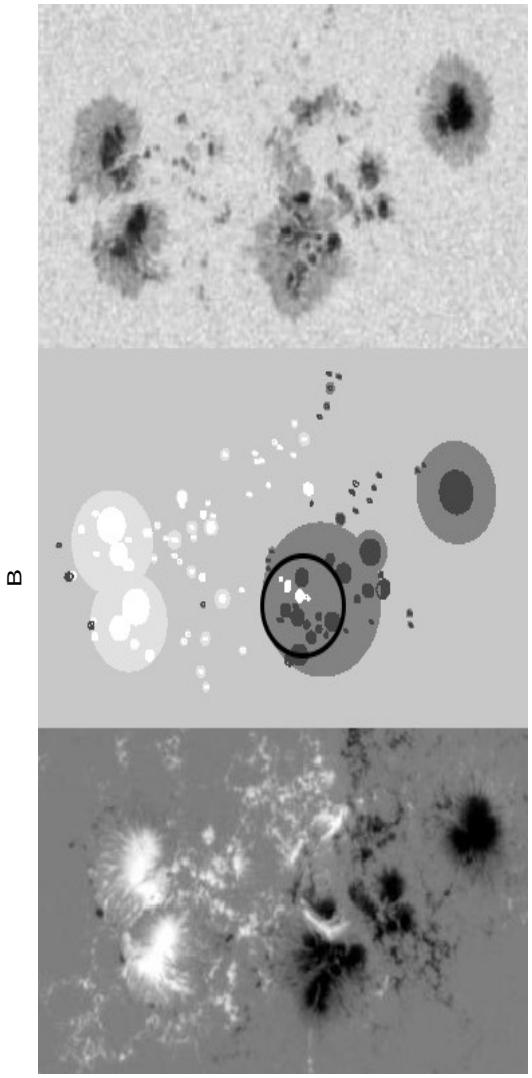
$$WG_M = \left| \frac{\sum_i B_{p,i} \times A_{p,i} - \sum_j B_{n,j} \times A_{n,j}}{d_{pn}} \right|$$

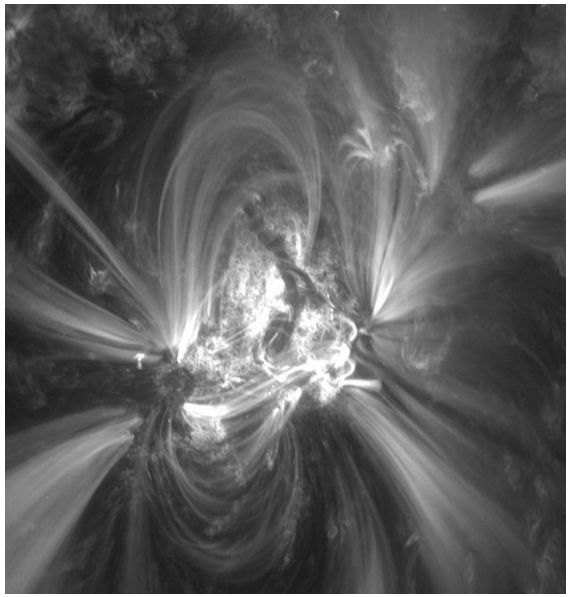
We follow the variation of WG_M in the area of highest magnetic gradient.

Korsos et al. ApJ, 802, L21, 2015

NOAA 11166

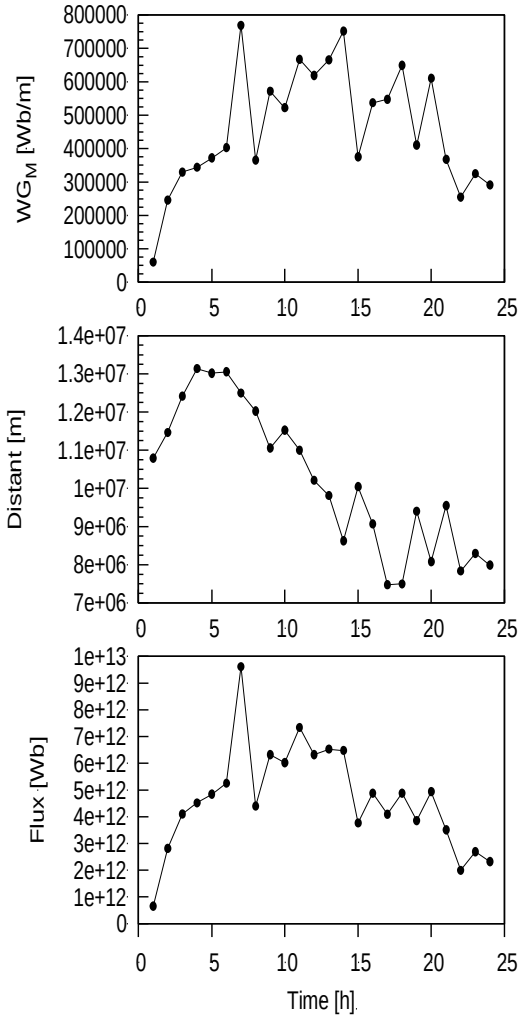

WG_M [Wb/m]
3.5e+06
3e+06
2.5e+06
2e+06
1.5e+06
1e+06
500000
0
X1.5
0
20
40
60
80
100
120
Distant [m]
3.5e+07
3e+07
2.5e+07
2e+07
1.5e+07
1e+07
5e+06
0
Flux [Wb]
1.8e+13
1.6e+13
1.4e+13
1.2e+13
1e+13
8e+12
6e+12
4e+12
2e+12
Time [h]

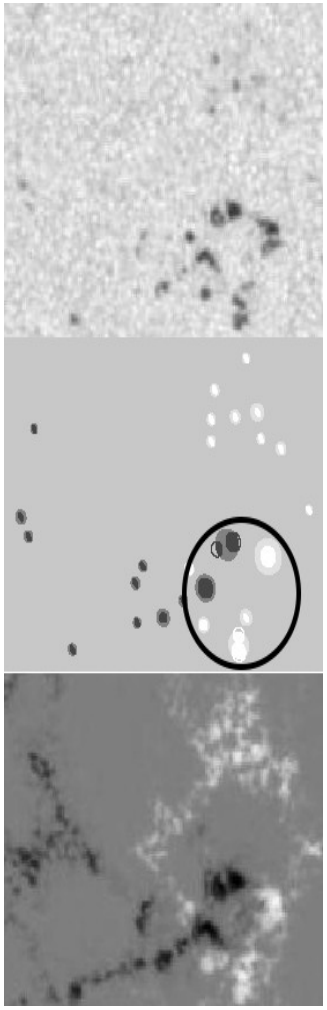

B



No Flare!

NOAA 11995

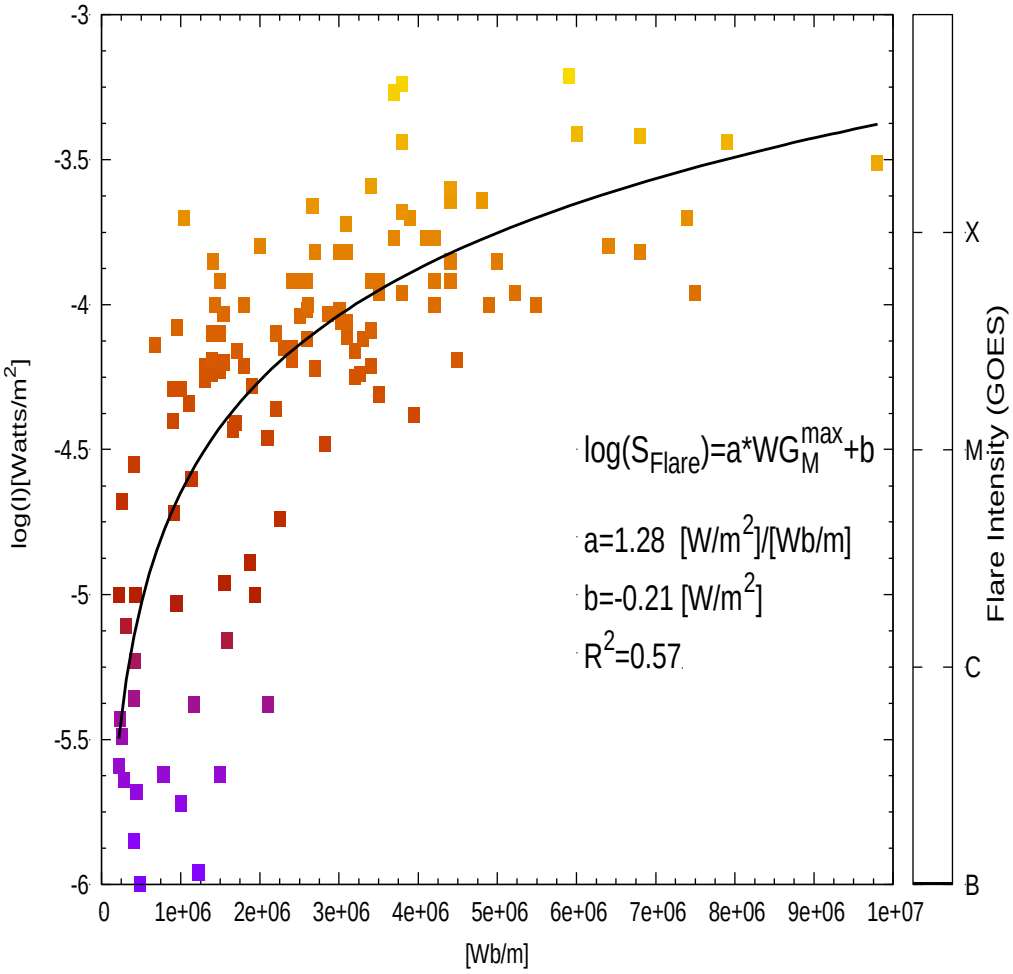




Inverse relationships to predict the flare intensity

The flare intensity can be estimated from the maximum of WG_M.

Relationship between the proxies of the free energy and the released energy



Korsos et al. ApJ, 802, L21, 2015

An unexpected phenomenon, two phases prior to the flare onset:

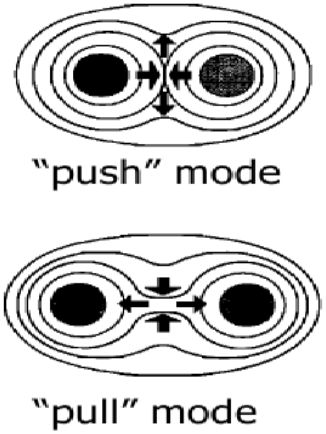
At first approaching and then receding fluxes of opposite polarities prior to flares.

Two similar results:

"... flare reconnection on a vertical current sheet is caused by the diverging flows that remove magnetic flux and plasma from the reconnection site. "
A theoretical result of Kusano et al., (2012, ApJ, 760, 31)

„Push and Pull-mode" of reconnection identified in laboratory experiments (Yamada ,1999)

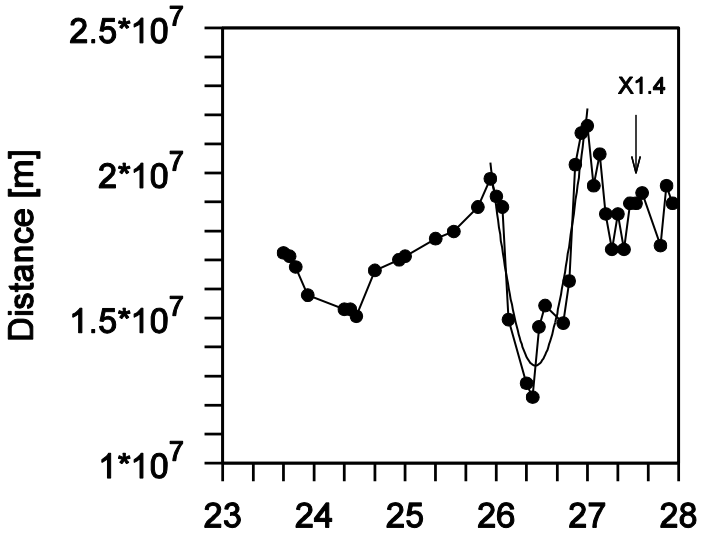
Reconnection Experiments
(Yamada 1999)

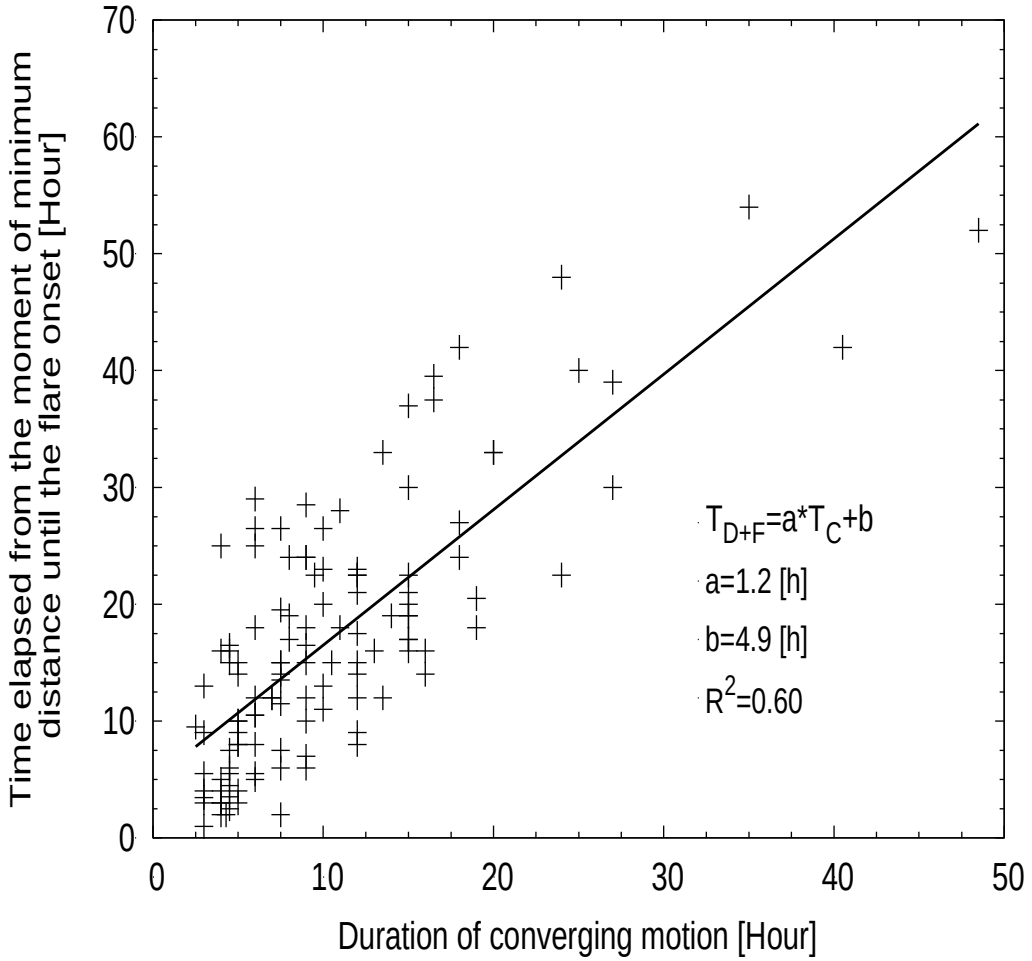


The estimate of the expected time of flare onset

Approaching and the time from the closest position until the flare onset.

#3:NOAA 8771

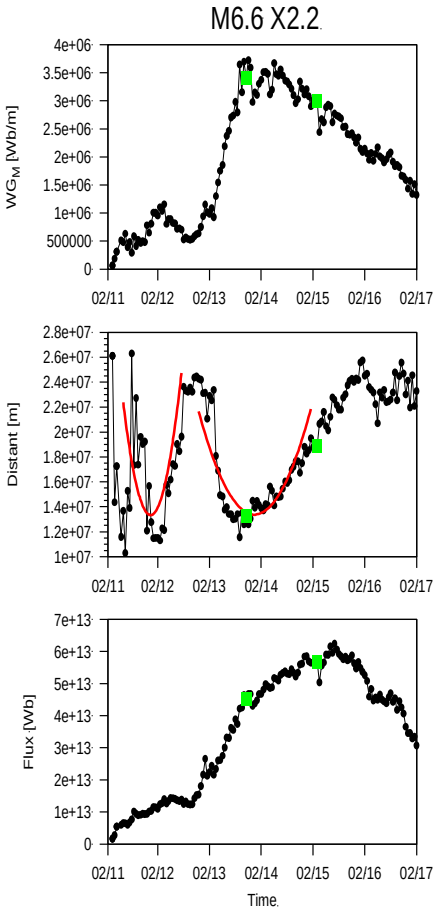




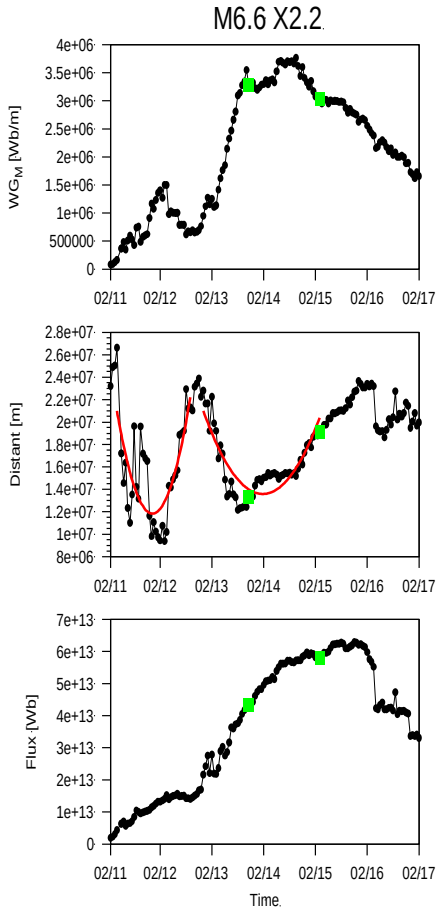
Korsos et al. ApJ, 802, L21, 2015

AR 11158

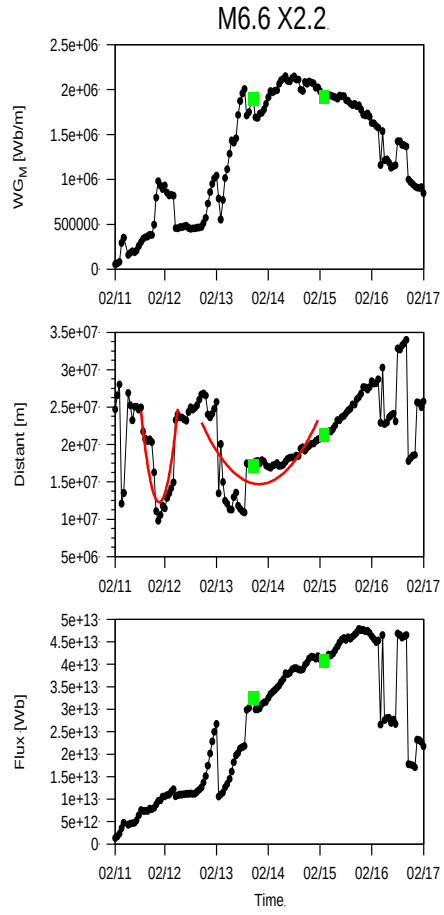
0 Mm



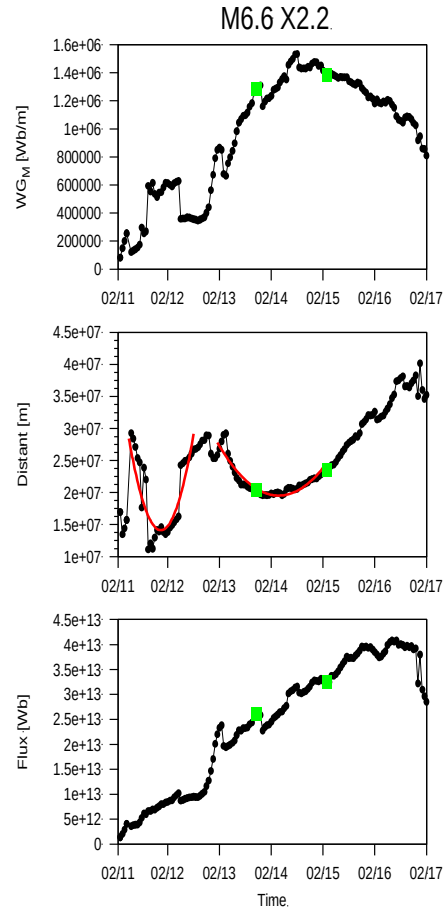
1 Mm



3 Mm

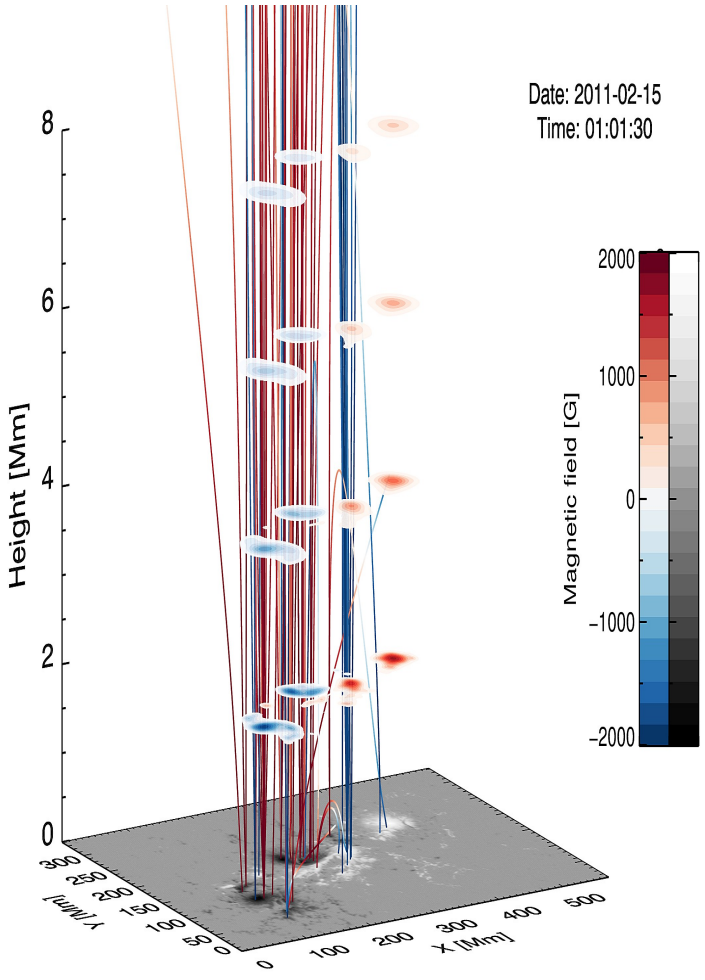


5 Mm



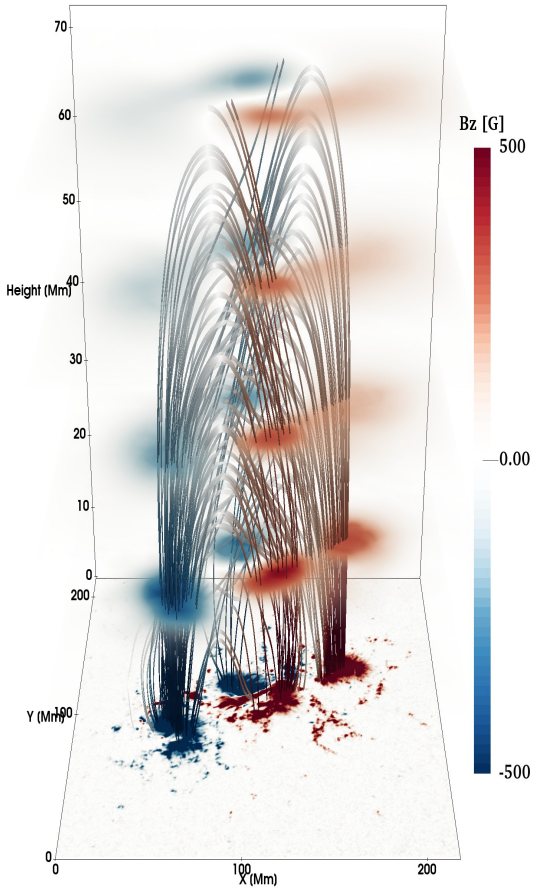
3D snapshot

AR 11158



Potential field extrapolation

AR 11158



Nonlinear force-free extrapolation

The actual starting times of approaching for the current heights