

# Photospheric Magnetic Activities to trigger Micro-Flares observed with the Hinode **SOT** and **XRT**

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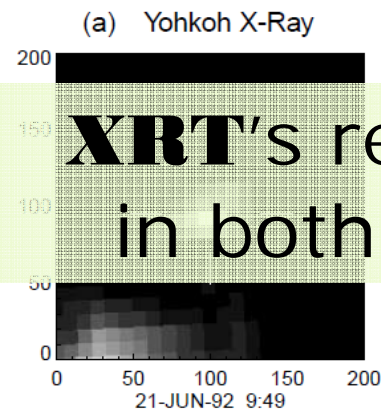
T. Shimizu (JAXA/ISAS), T. Tarbell (LMSAL)  
and Hinode team

# Motivation

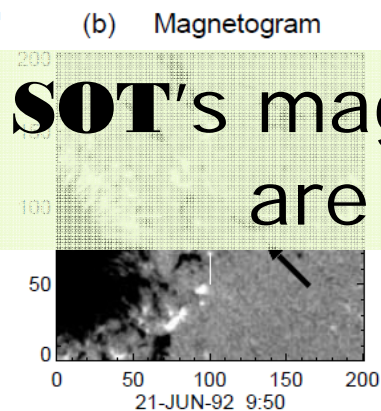
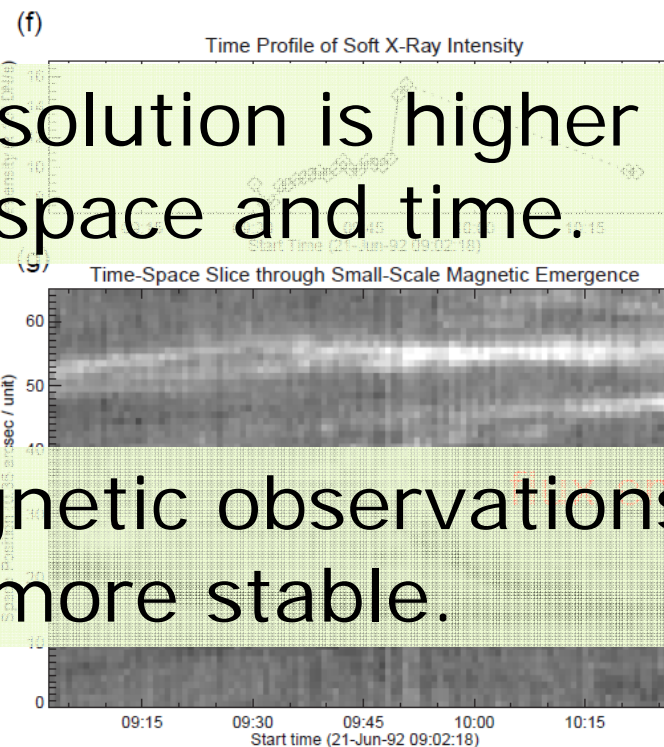
- To understand the coupling between photospheric magnetic activities and coronal transient events, as an elemental process of coronal heating.
- **Micro-flares** are a good target to study the coupling, because they **are smaller but simpler** than major flares.

# Motivation (cont.)

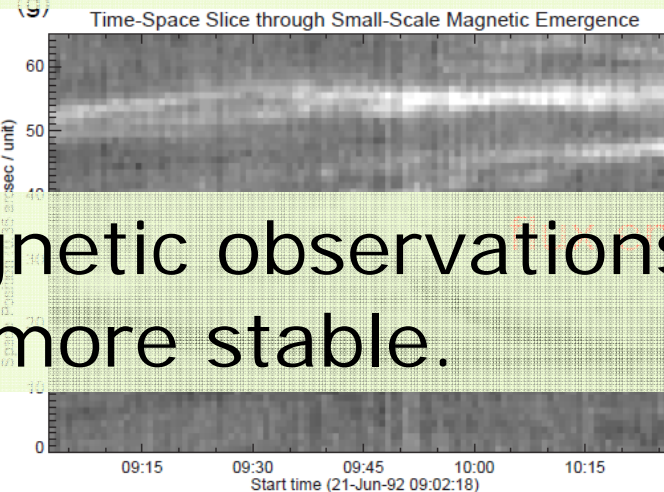
From Yohkoh/**SXT** and LaPalma data, Shimizu et al. (2002, ApJ) already pointed out that **flux emergence** plays an important role for (point-like) micro-flares.



**XRT's** resolution is higher in both space and time.



**SOT's** magnetic observations are more stable.

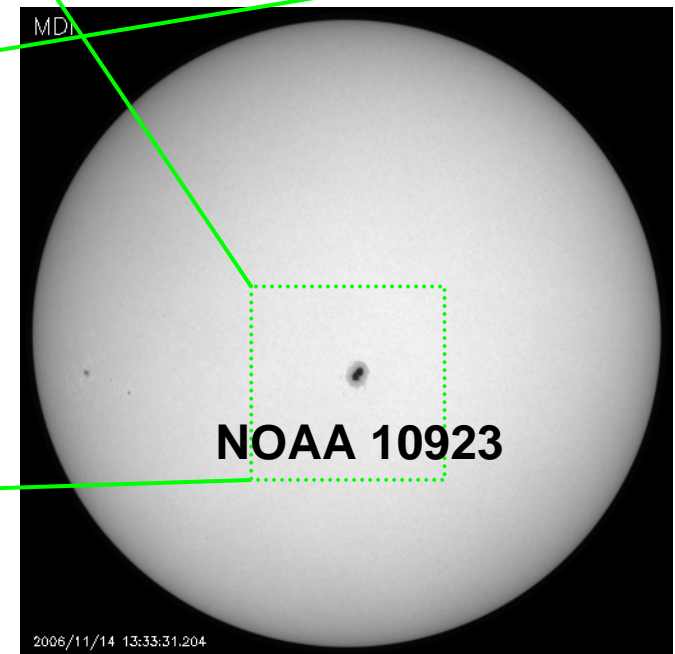
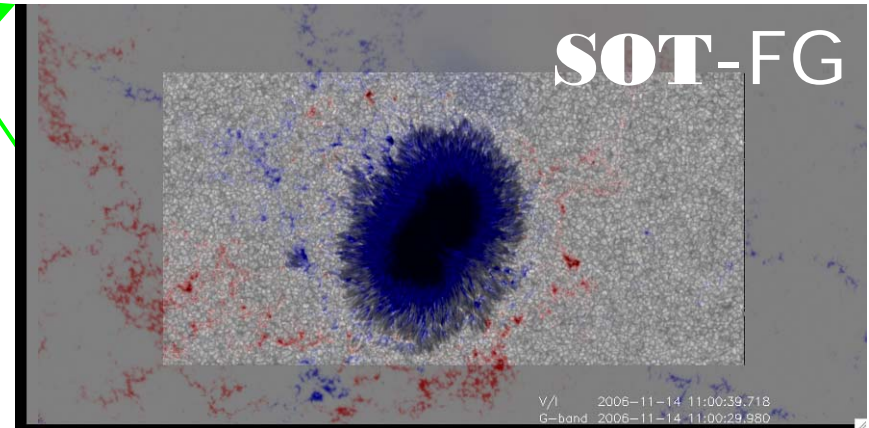
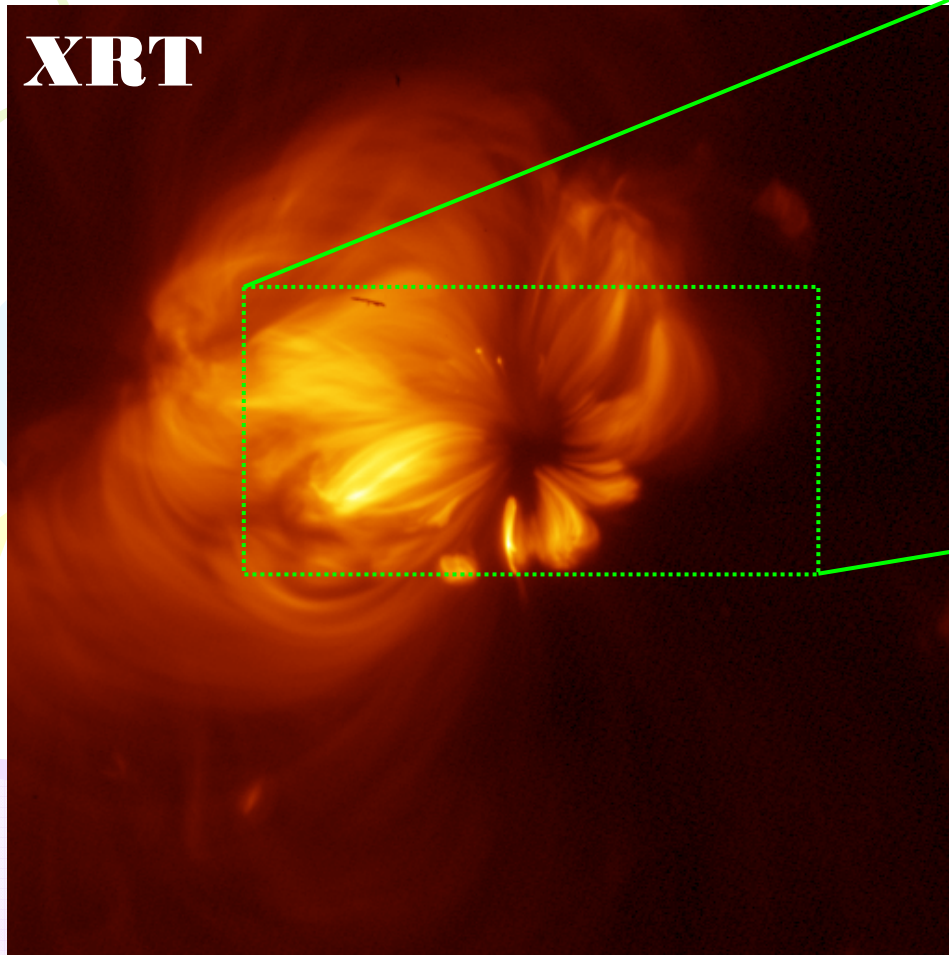


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# Dataset

- Active Region: **NOAA 10923**
- **XRT**
  - Date/Time: 2006-Nov-14, 11:00~11:30UT
  - Filter: Al/Poly. only
  - Note: Fast (3~6s) cadence observation.
- **SOT-FG**
  - Stokes-IV (FeI 6303Å), CaII H, G-band etc.
  - 5min cadence
- **TRACE**
  - 171Å etc.

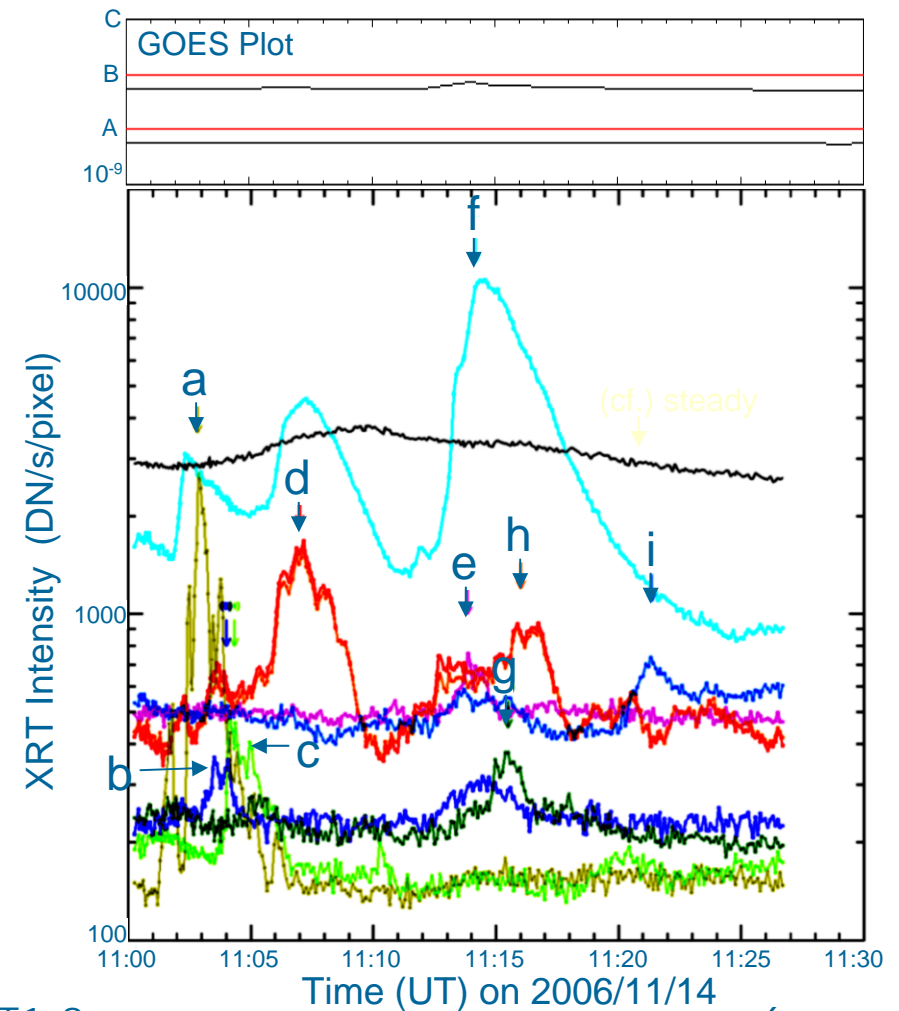
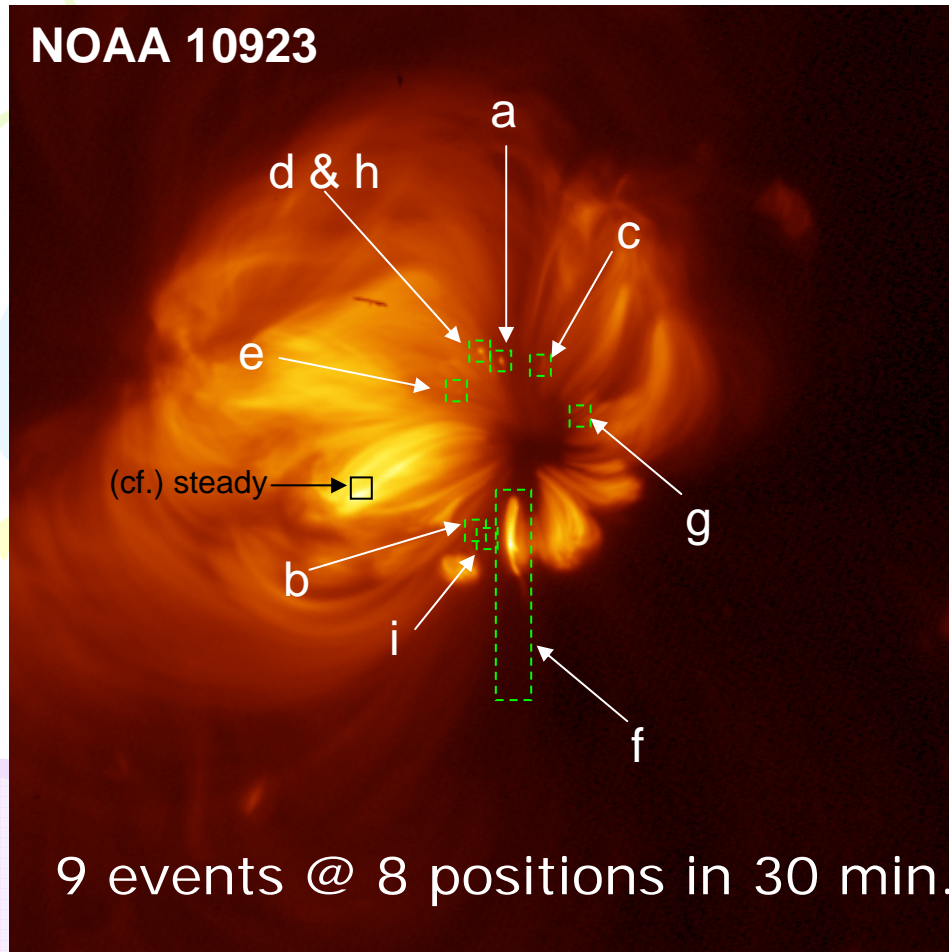
# Micro-flares observed with Hinode



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Hinode II, T1-8

# Micro-flares observed with XRT

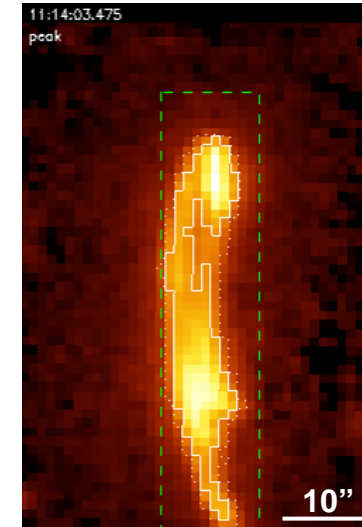
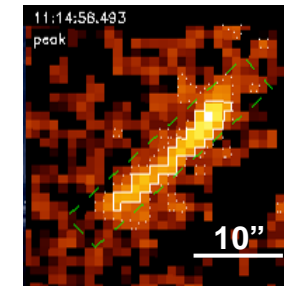
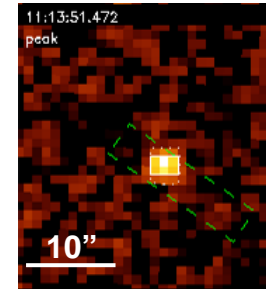


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Hinode II, T1-8

# (sized) Event List

#	Life Time min	Size Mm	Density* $10^{10}\text{cm}^{-3}$	Thermal Energy* $10^{26}\text{erg}$	Energy Loss* $10^{26}\text{erg}$	XRT
						Configu- ration
e	0.6	<b>S</b> 1.8	3.8	1.2	2.9	Point-like
d	2.2	1.8	6.3	2.0	10.7	Point-like
h	2.1	2.1	3.9	1.9	11.7	Point-like + Jet
a	0.8	2.2	8.0	4.7	4.5	Point-like + Jet?
c	1.0	2.3	2.5	1.7	6.2	Single Loop?
b	0.6	2.6	1.7	1.7	4.3	Single Loop
i	0.6	2.8	1.2	1.6	4.5	Single Loop
g	1.2	5.0	1.0	6.7	16.1	Multiple Loops
f	0.9	<b>L</b> 8.5	4.1	139.9	20.3	Multiple Loops + Jet



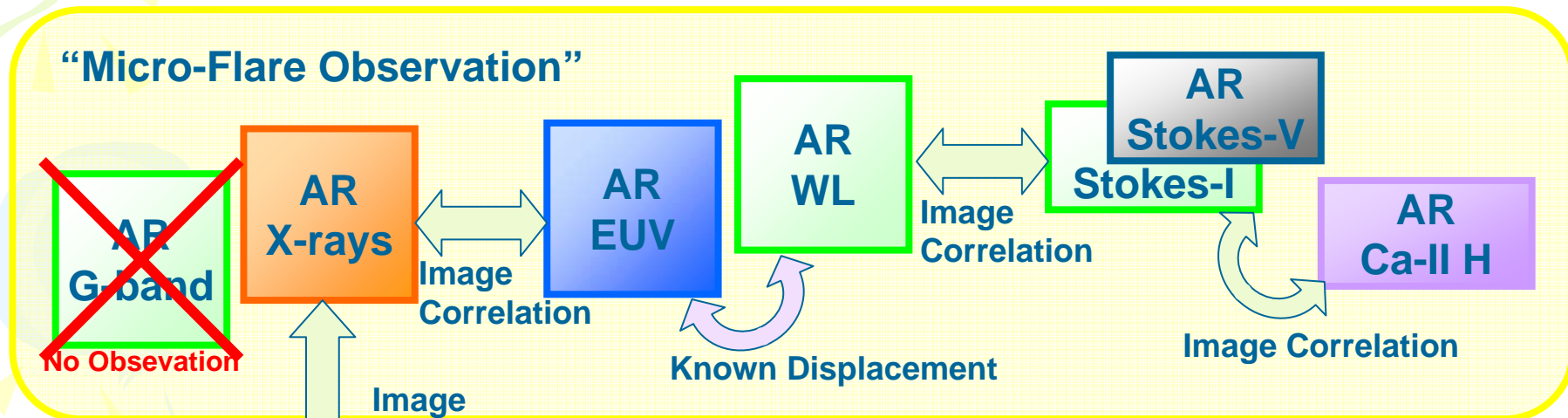
\* :  $T_e=2\text{MK}$  is assumed.

# Co-alignment of Images

**XRT**

**TRACE**

**SOT-FG**

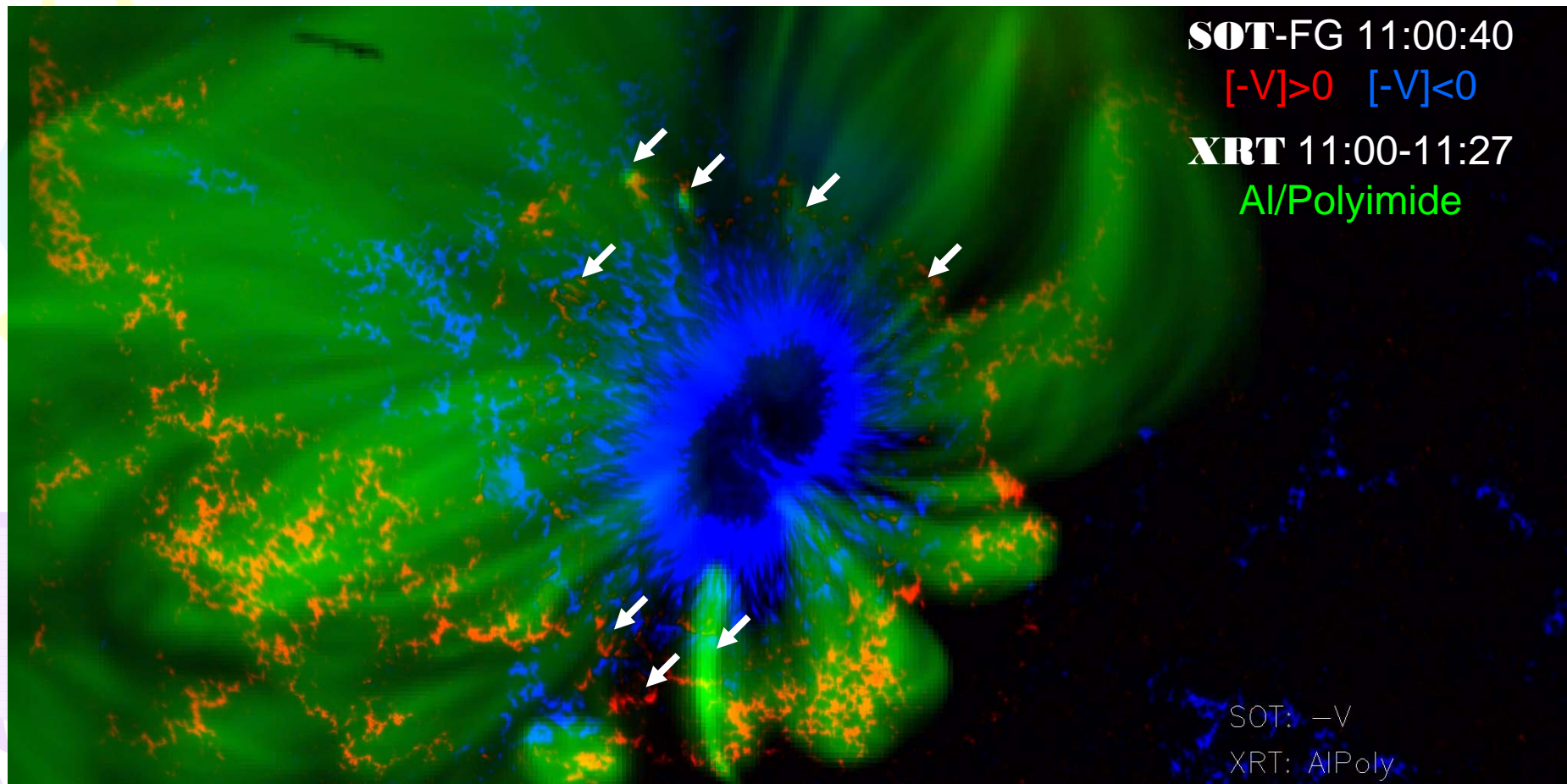


(Position Angles and Solar Rotation are considered.)

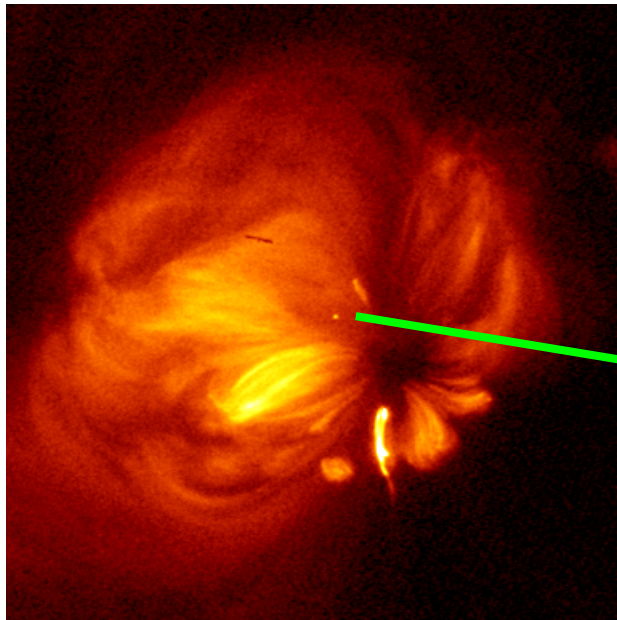


# Co-alignment of Images (cont.)

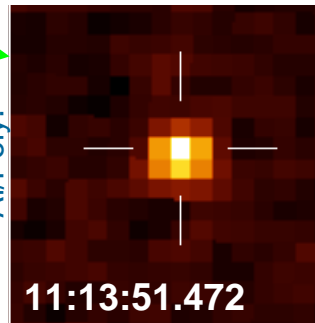
- We can find magnetic islands to each micro-flares.



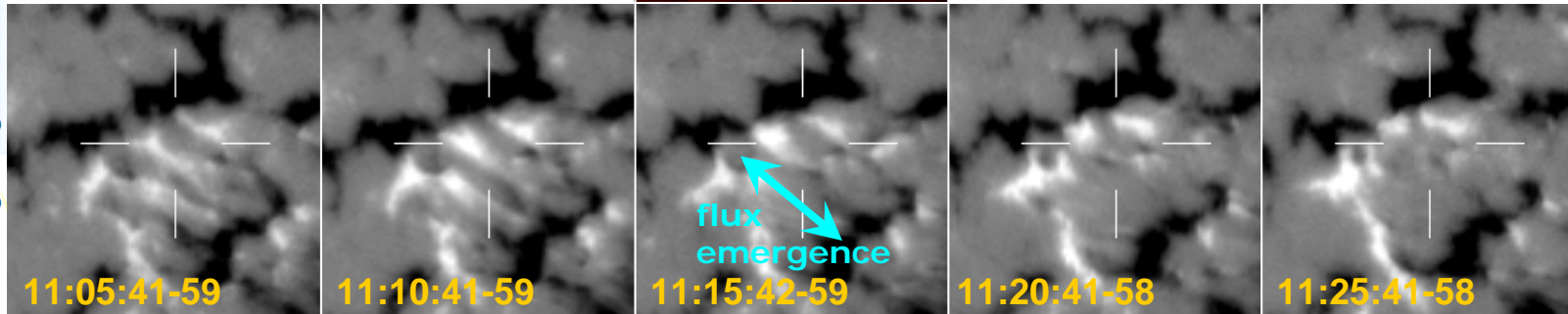
# event-(e)



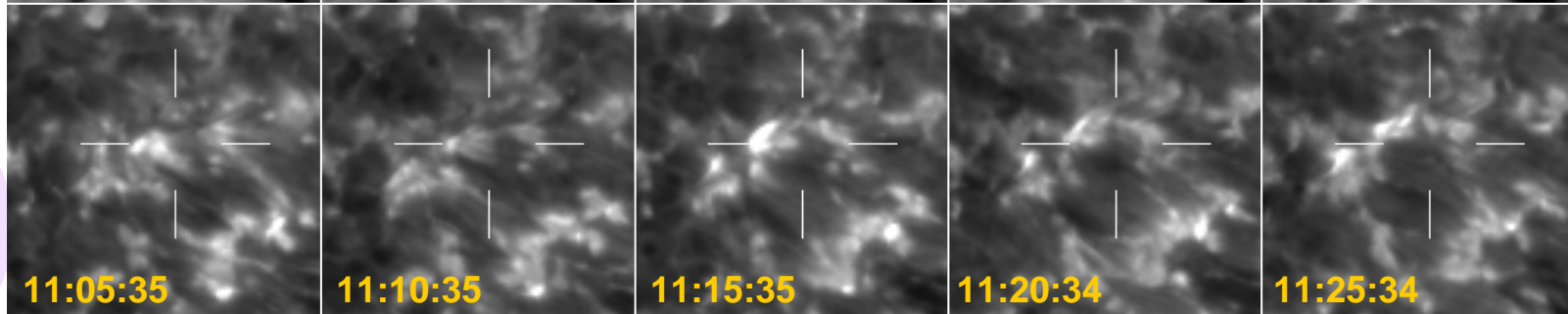
XRT  
Al/Poly.



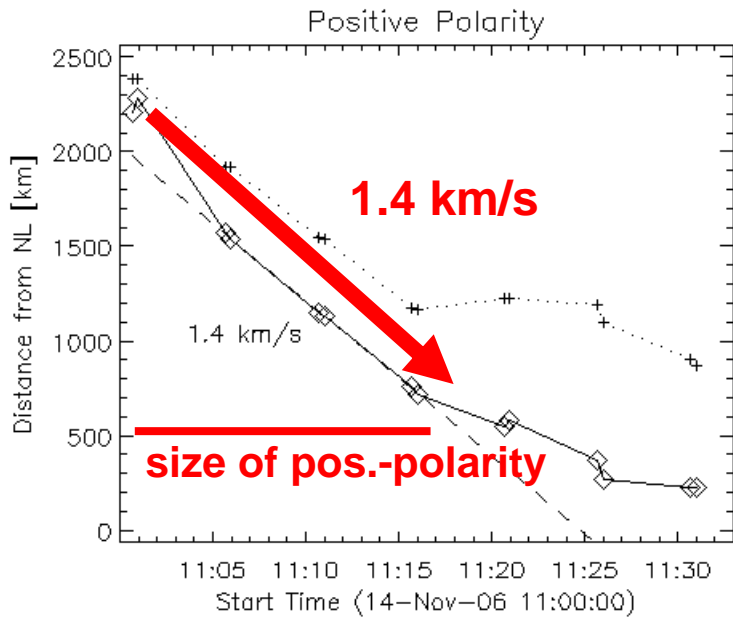
SOT-FG  
Magnetogram



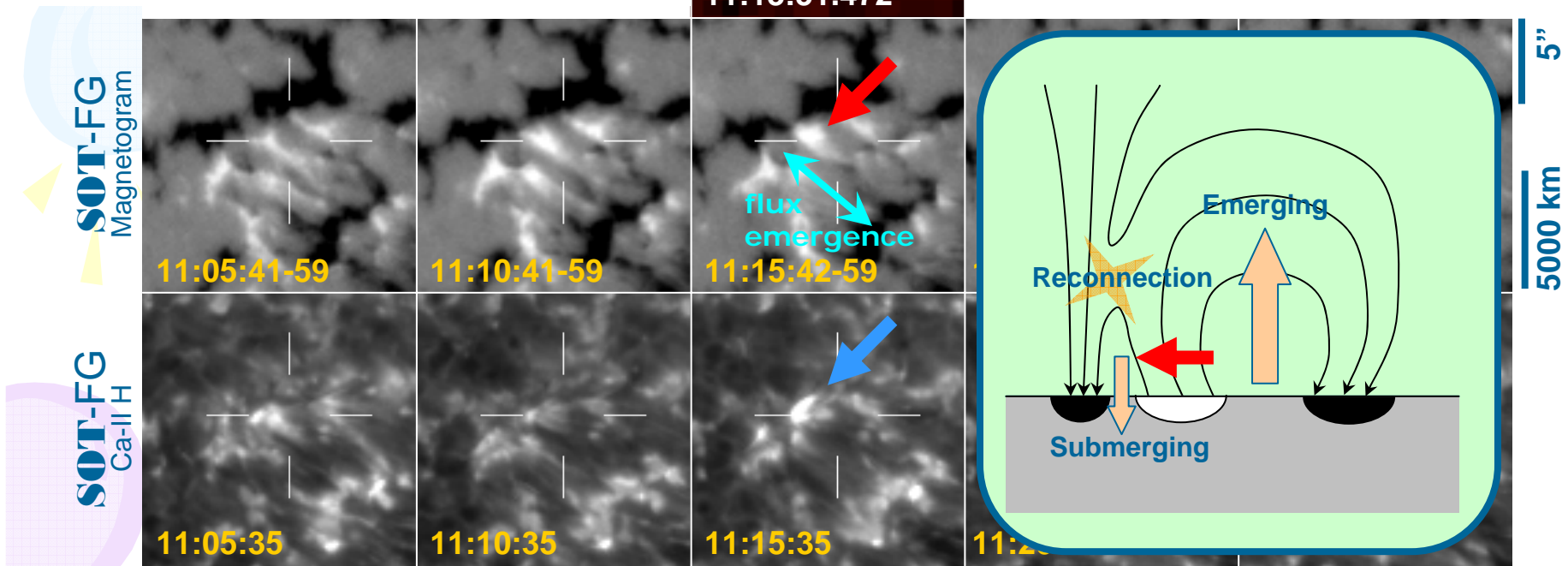
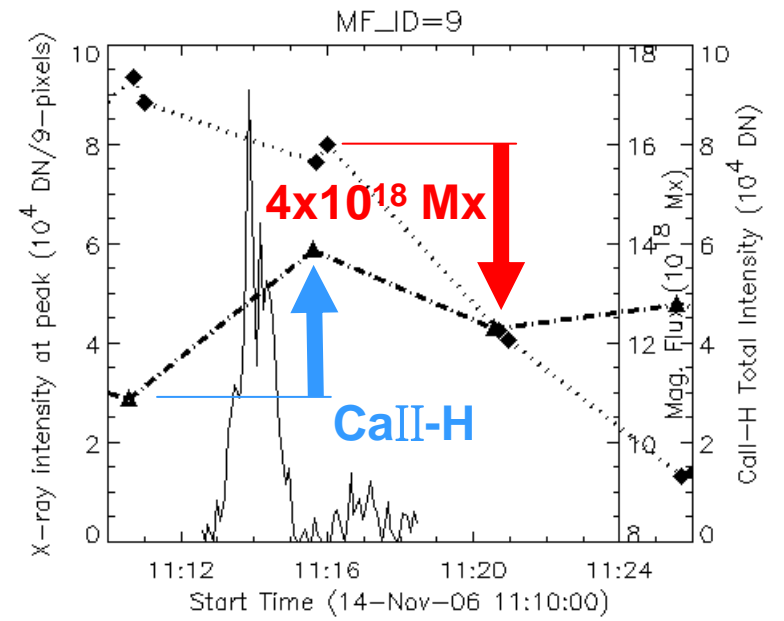
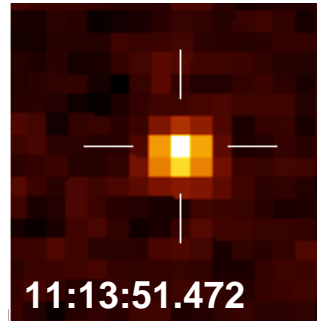
SOT-FG  
Ca-II H



5"  
5000 km



ment-(e

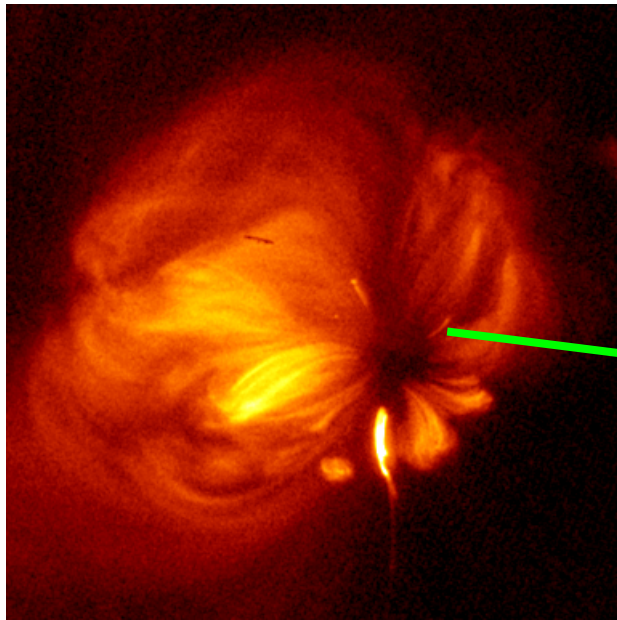


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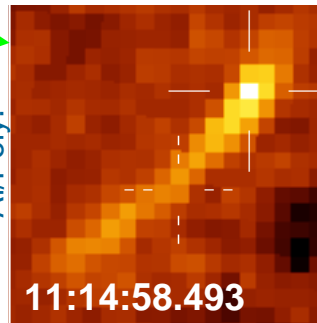
Hinode II, T1-8

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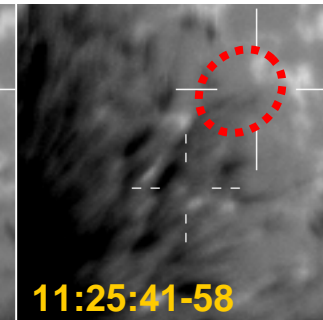
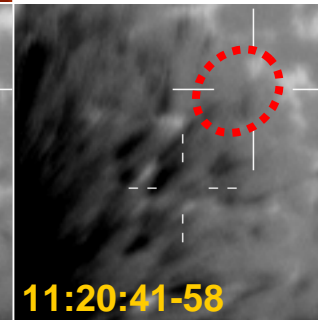
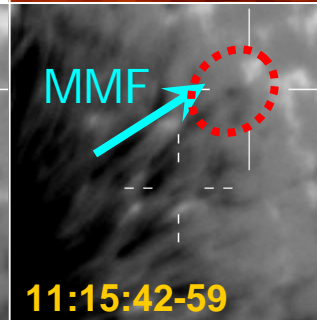
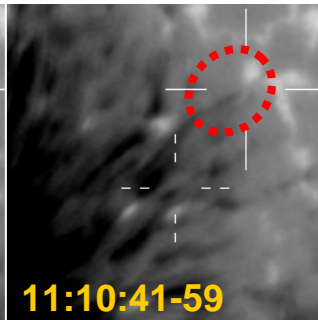
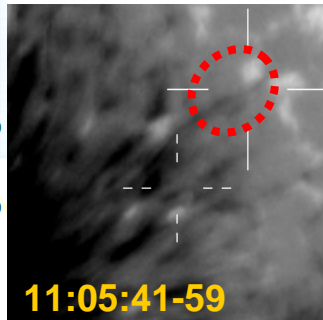
# event-(g)



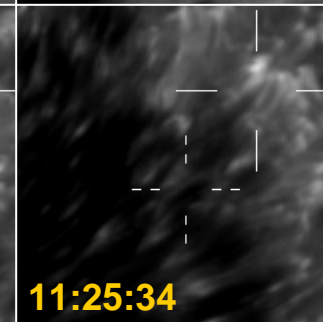
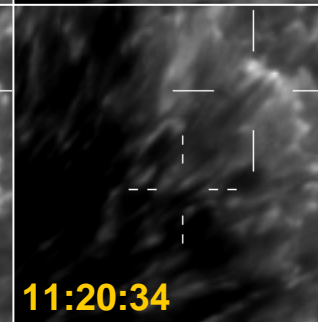
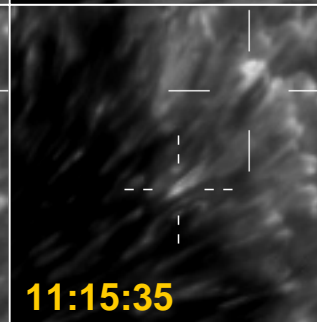
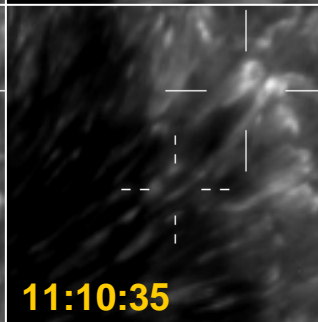
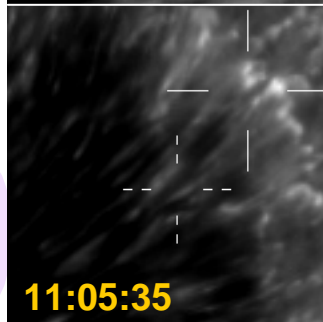
XRT  
Al/Poly.



SOT-FG  
Magnetogram



SOT-FG  
Ca-II H

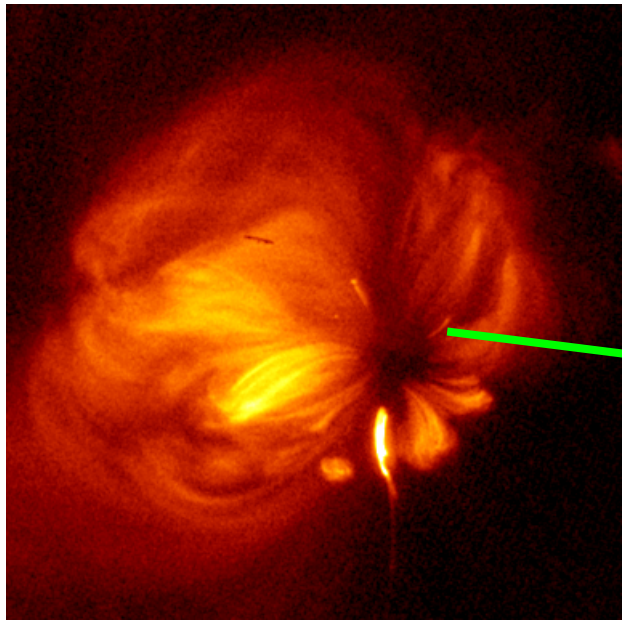


5"  
5000 km

2008/09/30

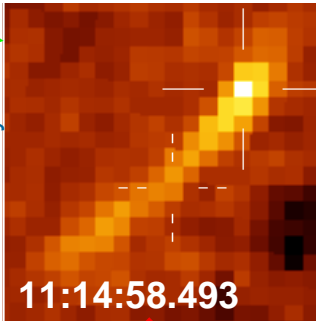
Hinode II, T1-8

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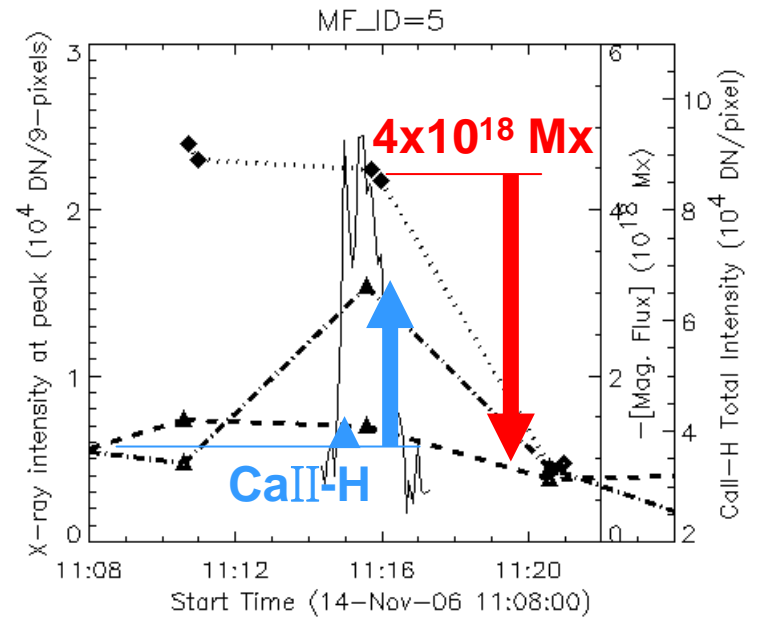


event-(c)

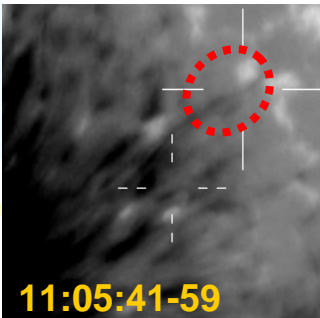
XRT  
Al/Poly.



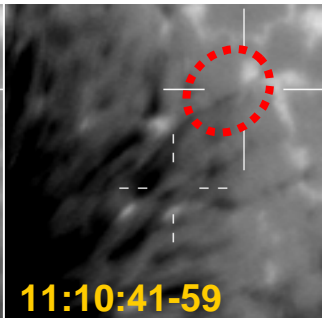
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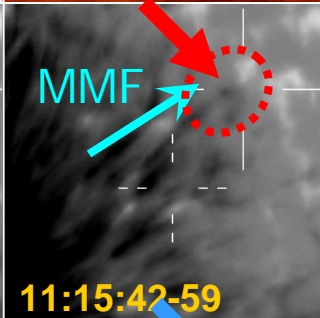
SOT-FG  
Magnetogram



11:05:41-59

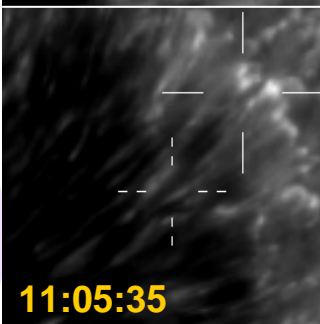


11:10:41-59

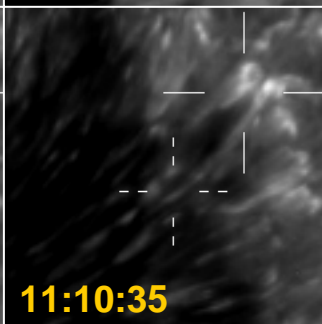


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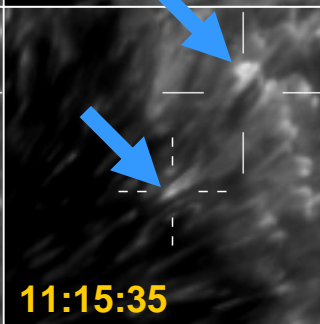
SOT-FG  
Ca-II H



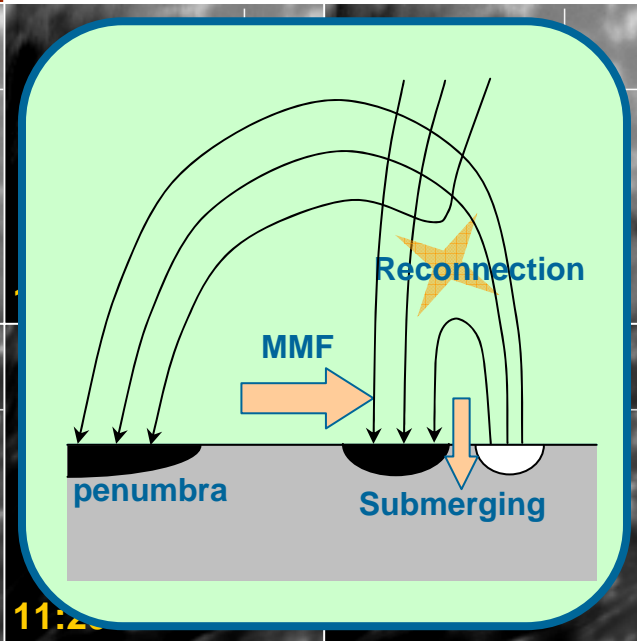
11:05:35



11:10:35



11:15:35



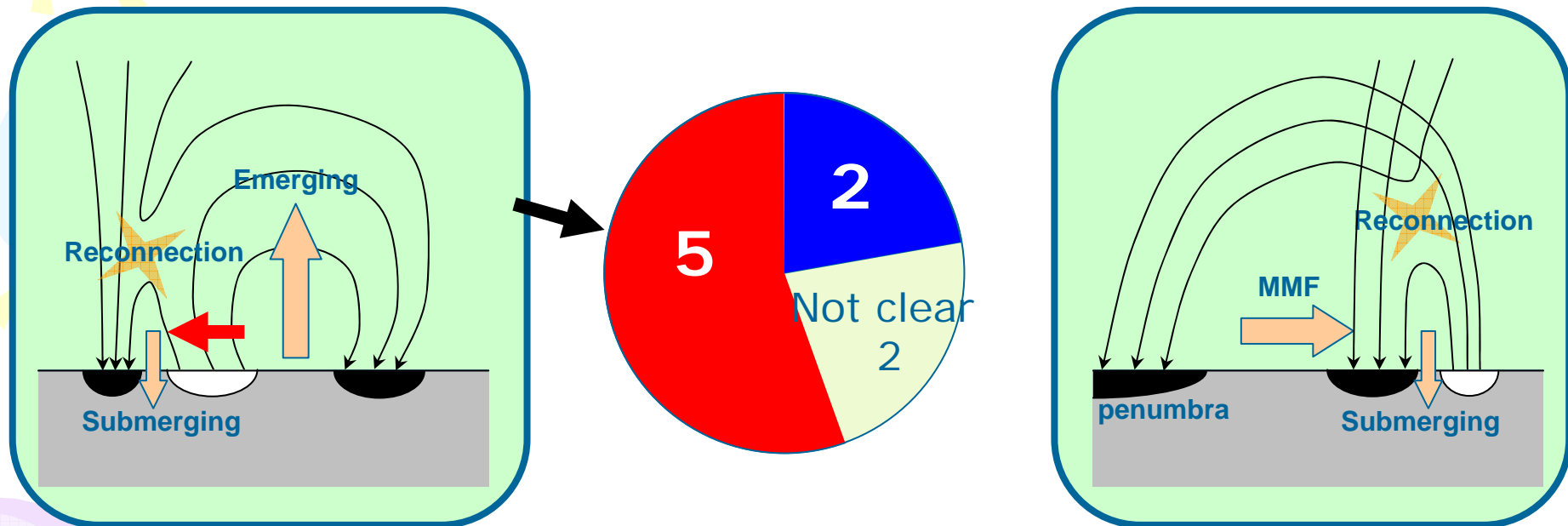
2008/09/30

Hinode II, T1-8

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# Summary

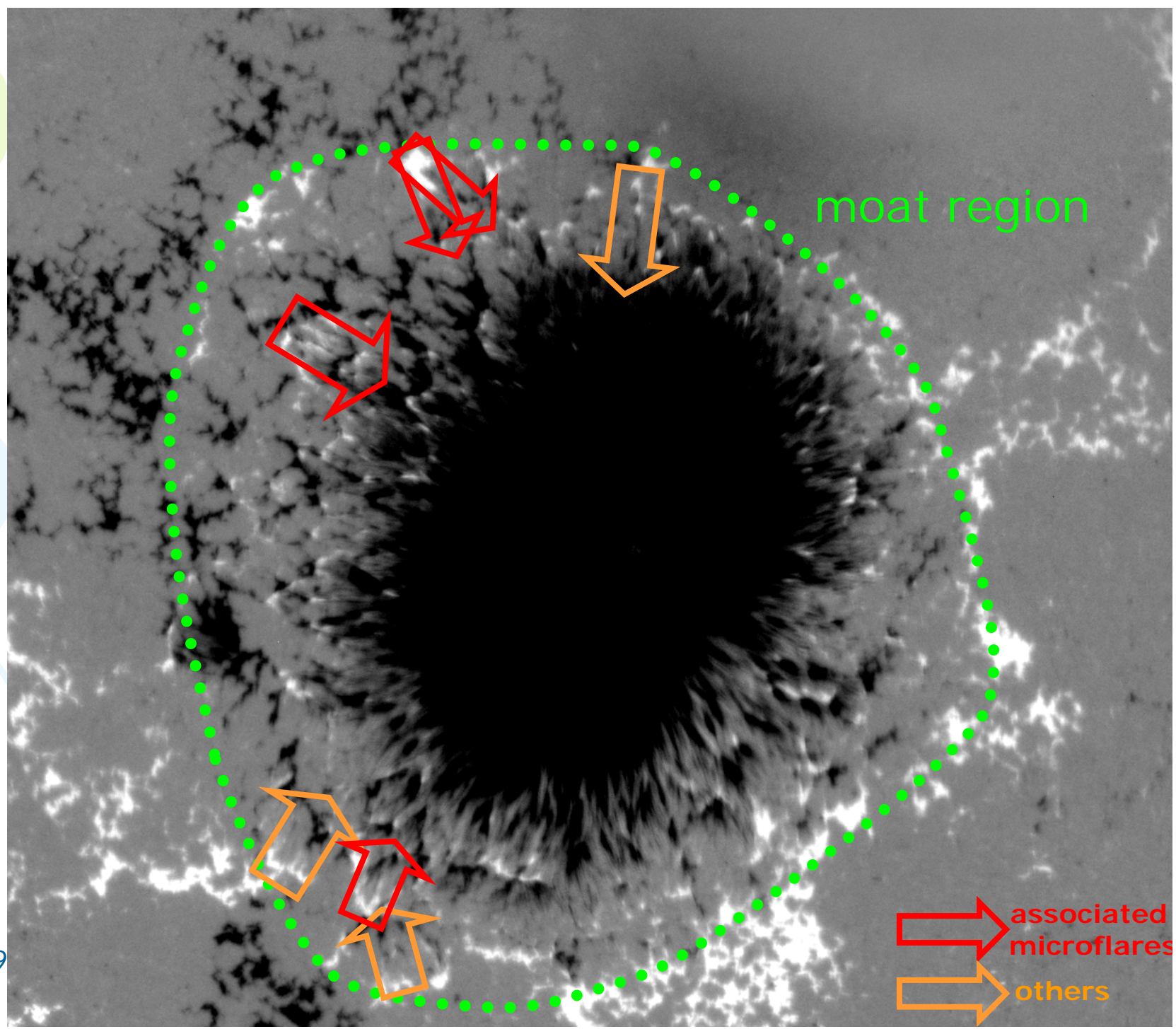
- Photospheric magnetic activities are identified for 7 micro-flares in 9.



- These 7 micro-flares have CaII-H brightening at the canceling point.

# Orientation of EFR

2008/09



# A speculation to the structure of spots from micro-flare observations

