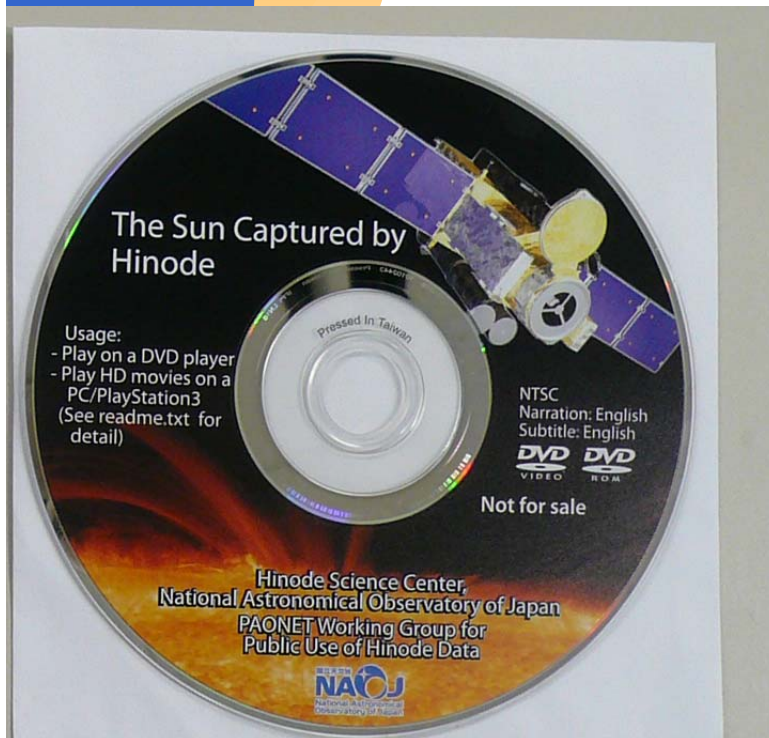


Hinode DVD (for Public Outreach)



2008/10/01

Hinode DVD for public outreach

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Abstract:
 Hinode Science Center (HSC) of NAOJ and PAONET Working Group for Public Use of Hinode Data (PAO-Hinode) published a DVD introducing the background and the initial observations of Hinode for public outreach. The DVD was released on March 2008 for Japanese version, and will be released on September 2008 for English version. This was aimed at interplanetary scientists of science, i.e. a science museum person or a science teacher. The English version of the DVD contains two video programs, the 3 minutes short version and the 16 minutes long version, both of which can be played on a DVD player. Full HD version of the video programs are also available in DVD-ROM, demonstrating the excellence of large format detectors of Hinode, which can be played on SONY PlayStation3.

Please take a copy of just pressed English version DVD

1. Introduction
 The importance of public outreach is higher than that of in Yohkoh's era. Scientists have to appeal their output to the public people for satisfying their interest on science more than before.
 People of scientific educational facilities are interested in the solar data. The daily data of the sun is good for such facilities since the sun is the most familiar star and can be seen in the daytime. The phenomena on the sun is easier to be recognized than other astronomical ones because the most of the observational data can be made up with movies.
 "PAONET" is the association of public astronomical observatories in Japan, consists of not only public astronomical observatories but also scientific museums and scientific educational facilities, to share astronomical pictures for educational materials. Some of the PAONET members organized a working group for SOLAR-B data, "PAONET Working Group for Public Use of SOLAR-B Data" on June 2006, before launching of SOLAR-B. They expected the data of SOLAR-B would be excellent and useful for the education. SOLAR-B Science Center of NAOJ committed ourselves to collaborate with them.
 Newer telescopes often have the latest features, such as large format or the resolution. Hinode also has large detectors in SOT and XRT. The CCD pixel number of SOT FG is 4356 x 2048, which is almost 4 times larger than the number of High Definition (HD) TV (1920x1080). XRT CCD size (2048 x 2048) is also larger than that. It means that HD video program using Hinode data is good application to show the excellence of the telescopes aboard Hinode.
 After almost 1 year of production period, Japanese version DVD was published in March, 2008. English version was just released on 24 September, 2008. This is the first meeting to announce and distribute English version DVD.
 Right: The label of two DVD: Japanese version (left) and English version (right).

2. The purpose of the DVD
 This DVD was aimed at those who are engaged in SPO activities to introduce Hinode itself and its initial results.
 We made two movies, both of which we expect the educators to play at their facilities for the visitors and for themselves. One movie is the short version, 2 minutes 36 second. It is good for playing at the exhibit space intending to watch. Another is the long version, 16 minutes 21 second movie. It includes the aim of Hinode and the initial observations of 3 telescopes. We expect this to be played at the tail of their facilities, but actually this movie is a little difficult for the visitors.

3. Contents of the DVD
 This DVD contains 2 video programs, "Hinode: Prologue" and "The Sun Explored by Hinode". Both video programs are in the DVD video format which can be played on a DVD player and also in the High Definition (HD) MPEG-2 format. HD version of video are in HD_Video folder of DVD-ROM.

4. Highlights of the movies
a. Hinode: Prologue (Short movie)
 Left: The movie is starting with the launch of Hinode.
 Below: X class flare of 13 December 2006.
 Left: The activity of quiet corona in X-ray. It is not "quiet" any more.
b. The Sun Explored by Hinode (Long movie)
 Left: Introducing 3 telescope aboard Hinode.
 Below: The close up view of solar granule. Sometimes we feel sick when watching the granule movie.
 Below: The quiet section was a hit with children, but not with their parents.
 Below: EIS pseudo 3D view of the active region.
 What's moving?

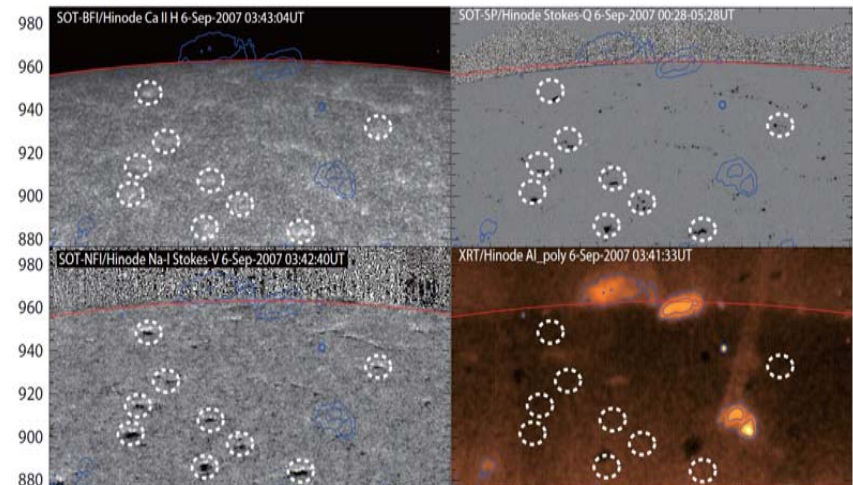
5. Contact information
 Contact Mr. Tonooka (tonooka@solar.mtk.nao.ac.jp) or Dr. Shimojo (shimojo@nro.nao.ac.jp) to request the DVD after the meeting.

Hinode2@HAO, Boulder

THE RELATIONSHIP BETWEEN THE MAGNETIC FIELD AND THE CORONAL ACTIVITIES IN THE POLAR REGION

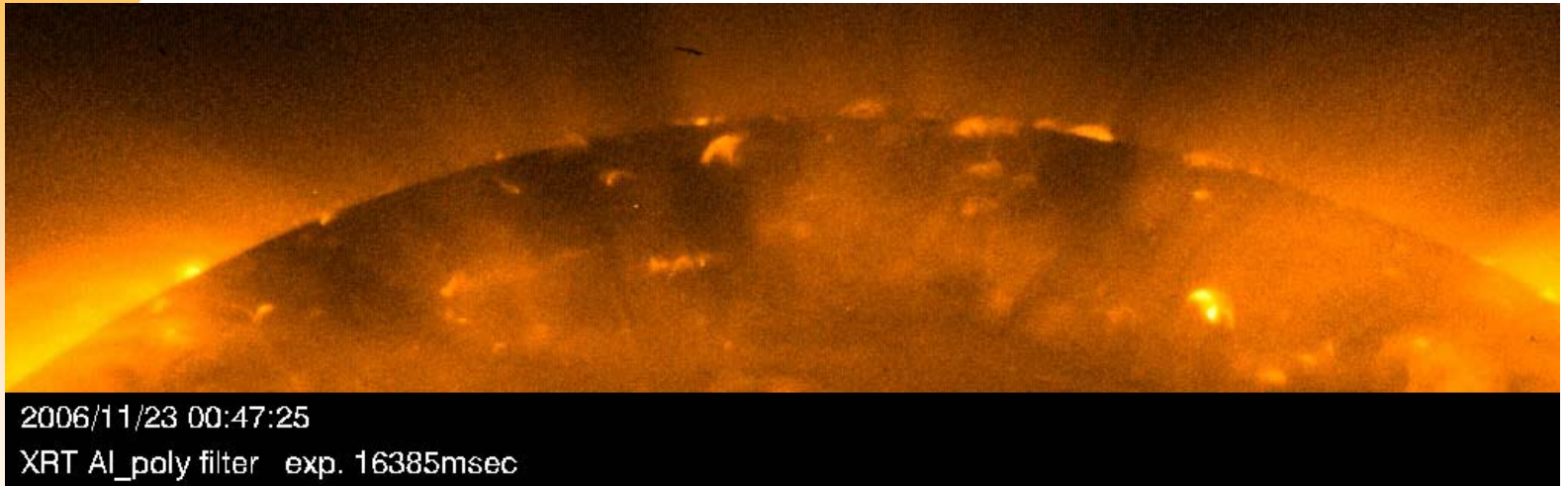
Masumi Shimojo

Nobeyama Solar Radio Observatory, NAOJ/NINS
and SOT&XRT/*Hinode* Team



Introduction:1

Hinode shows the coronal activities around the pole.



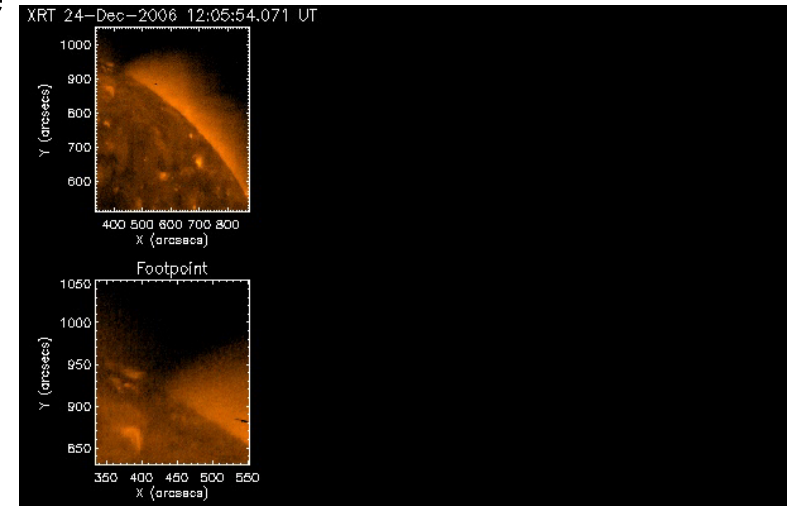
- X-Ray Telescope (XRT) aboard *Hinode* showed us that numerous X-ray jets occur in the polar coronal hole.
- The occurrence rate of jets in the polar CH is **60 jets/day**.
(Savcheva et al., 2007 PASJ, 59, S771)

Introduction:2

Hinode observed waves in X-ray jets

- **Two velocity components in the X-ray jets.**
 - Slow component (Ave. $200\text{km/s} \leq$ Sound speed)
 - Fast component ($\geq 500\text{km/s} \sim$ Alfvén speed)X-ray jets produce Alfvén wave or/and Alfvénic jets.
(Cirtain et al., 2007 Science, 318, 1580)
- **The thread structures in the X-ray jets**
 - The thread structures move across the jet's.(Shimojo, et al., 2007, PASJ, 59, S745)

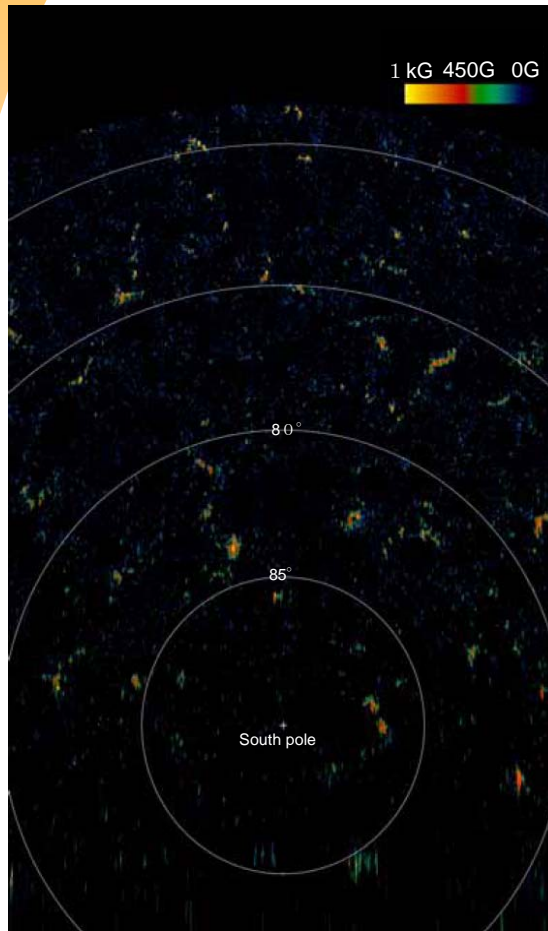
The results suggest that waves are generated in X-ray jets.



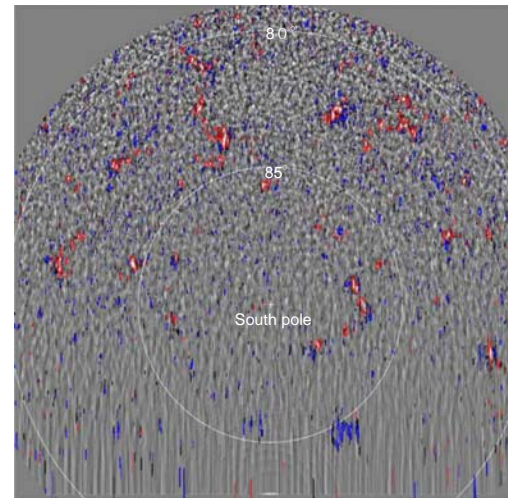
Introduction:3

The kG-patches and horizontal fields around the pole.

The south pole view of magnetic field strength



- There are intense (> 1 kG) vertical patchy magnetic fields (kG-patch) in the polar region.
 - Lifetime : 5~10 hours
 - Weak horizontal fields covered the polar region.
- (Tsuneta et al., 2008, in press)



Red contours:
 Vertical field ($>65^\circ$)

Blue contours:
 Horizontal field ($<25^\circ$)

- **Summary of the previous *Hinode* Observations**
 - X-ray observations of the polar region
 - Numerous X-ray jets occur in the polar CH. (60 jets/day)
 - X-ray jets generate the Alfvén waves.
 - The wave generation is very interesting from the point of view of the solar wind acceleration.
 - Magnetic field in the polar region
 - There are strong patchy-magnetic fields (kG-patches) in the polar region.
 - The polar region is covered with ubiquitous weak horizontal fields.

- **Questions**

Relationship between the strong patchy-magnetic fields (kG-patches) and the coronal structures/activities (XBP, X-ray Jets) in the polar region ?

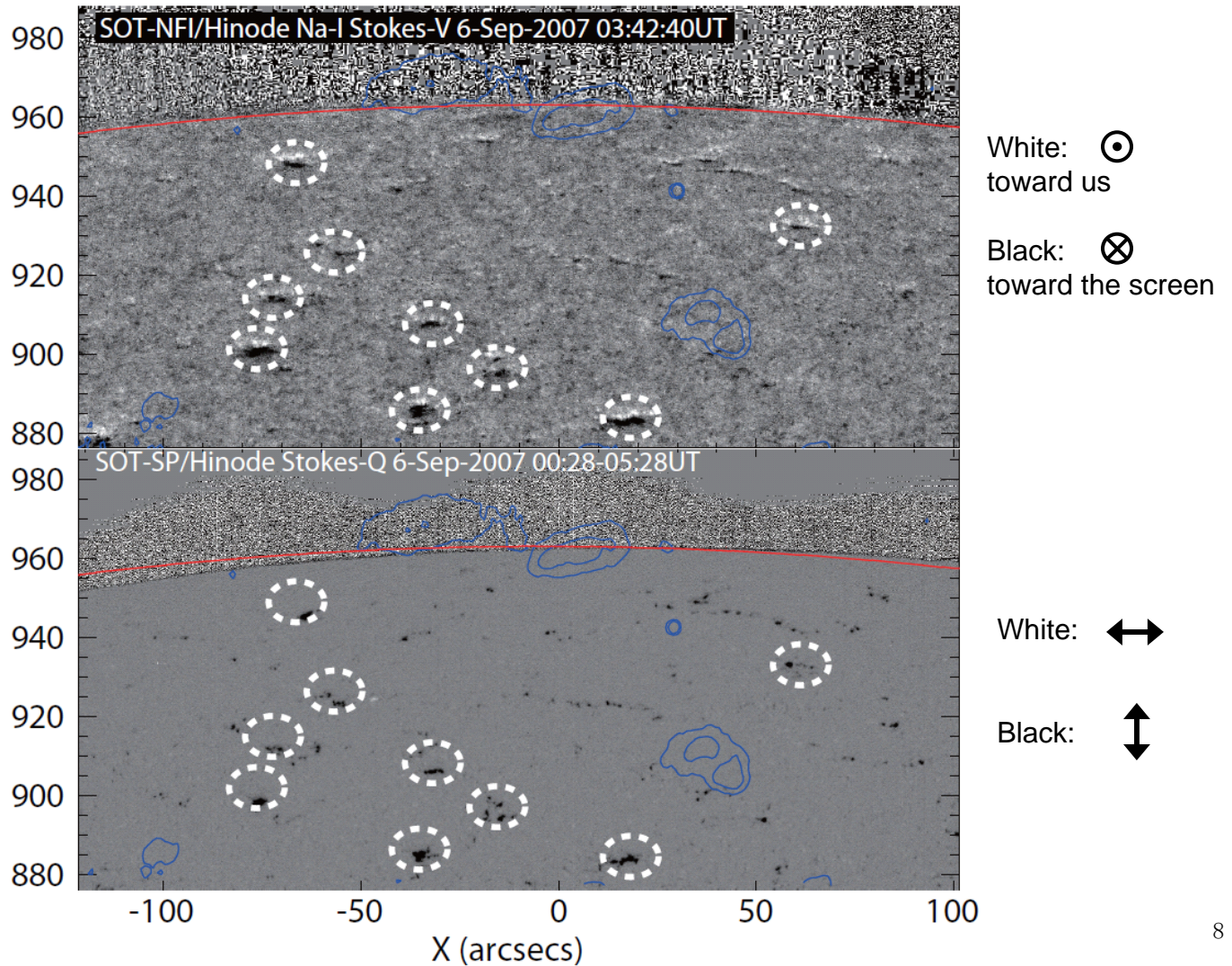
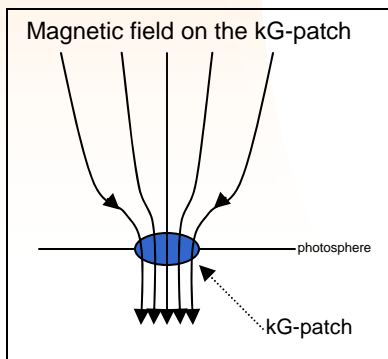
Observation

- **HOP02:” Polar Region Observation Campaign**
 - North Pole Observations in September, 2007.
- **Data**
 - SOT Filtergram
 - G-band (Photosphere)
 - Ca II H (lower Chromosphere)
 - Stokes-V of Na I [5896 Å]
(Indicate the line of sight magnetic field)
 - SOT Spectro-Polarimeter
 - Stoke-I, Q, U, V of Fe I (Photospheric Magnetic field)
 - XRT
 - Al_poly filter image (> 2MK)
 - SOHO/EIT
 - 195Å band image (~1MK)

Result:1 Polar Magnetic Field and Coronal Structure

■ Stokes-V of Na I and Stokes-Q of Fe I

The white dashed circles indicate the relatively large kG-patches.



Result:1 Polar Magnetic Field and Coronal Structure

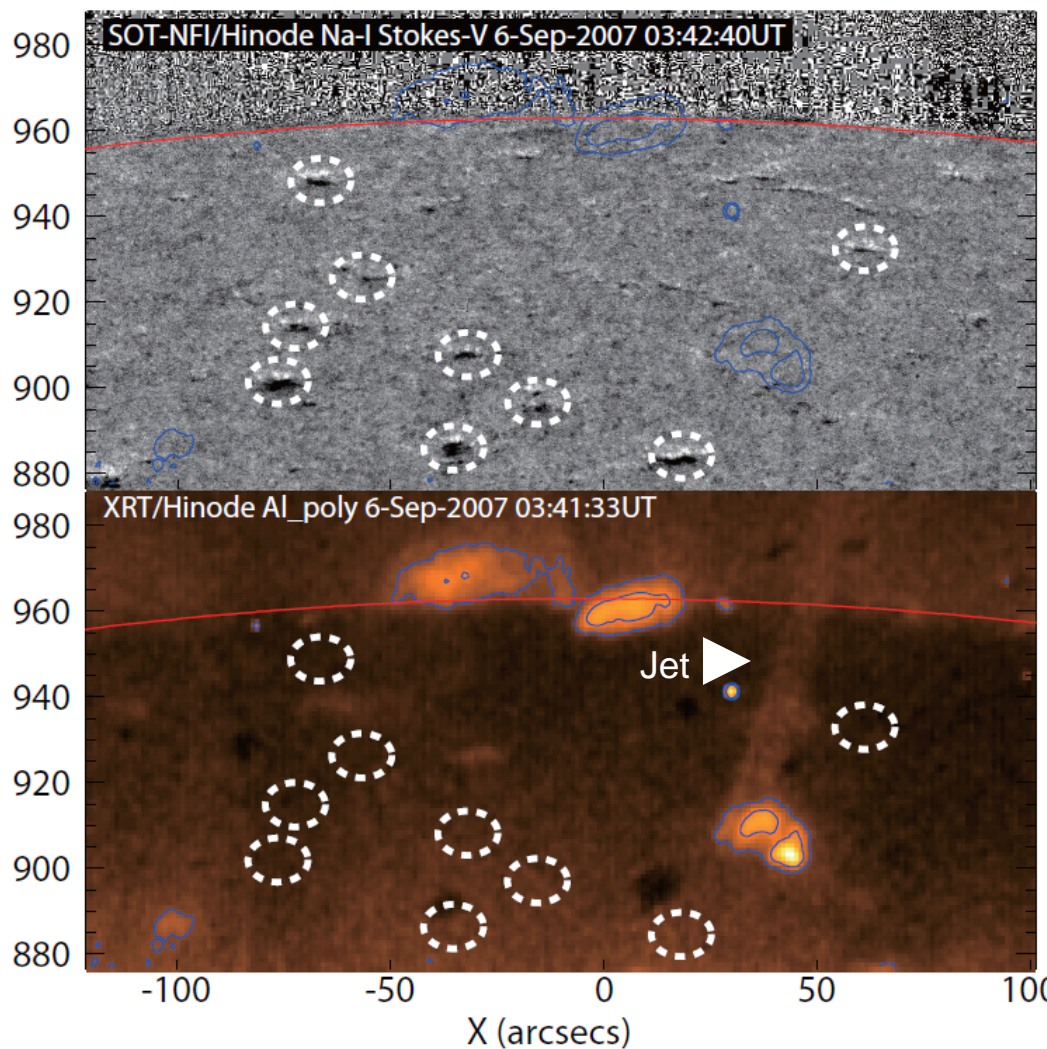
■ Stokes-V of Na I and X-ray (XRT/thin Al-poly)

The white dashed circles indicate the relatively large kG-patches.

Co-align accuracy:
 ~ a few arcsec

The black dots in X-ray are not solar features. It is effect by the contamination.

The relatively large kG-patches do not always associate with the coronal structure.



White: ⊙
 toward us

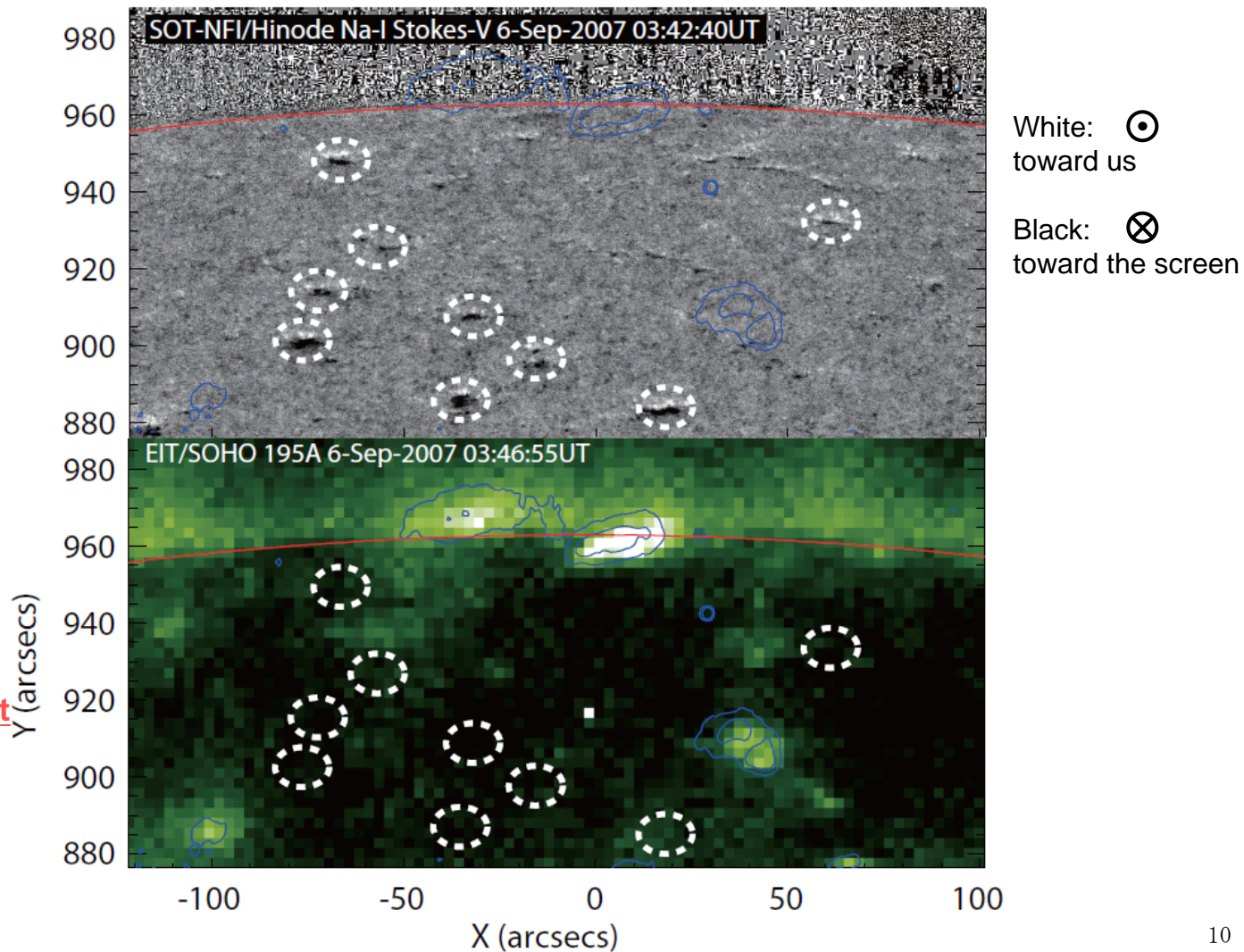
Black: ⊗
 toward the screen

Result:1 Polar Magnetic Field and Coronal Structure

■ Stokes-V of Na I and EUV (EIT 195Å)

The white dashed circles indicate the relatively large kG-patches.

In EUV (195 and 171) image, the relatively large kG-patches do not always associate with the coronal structure, too.



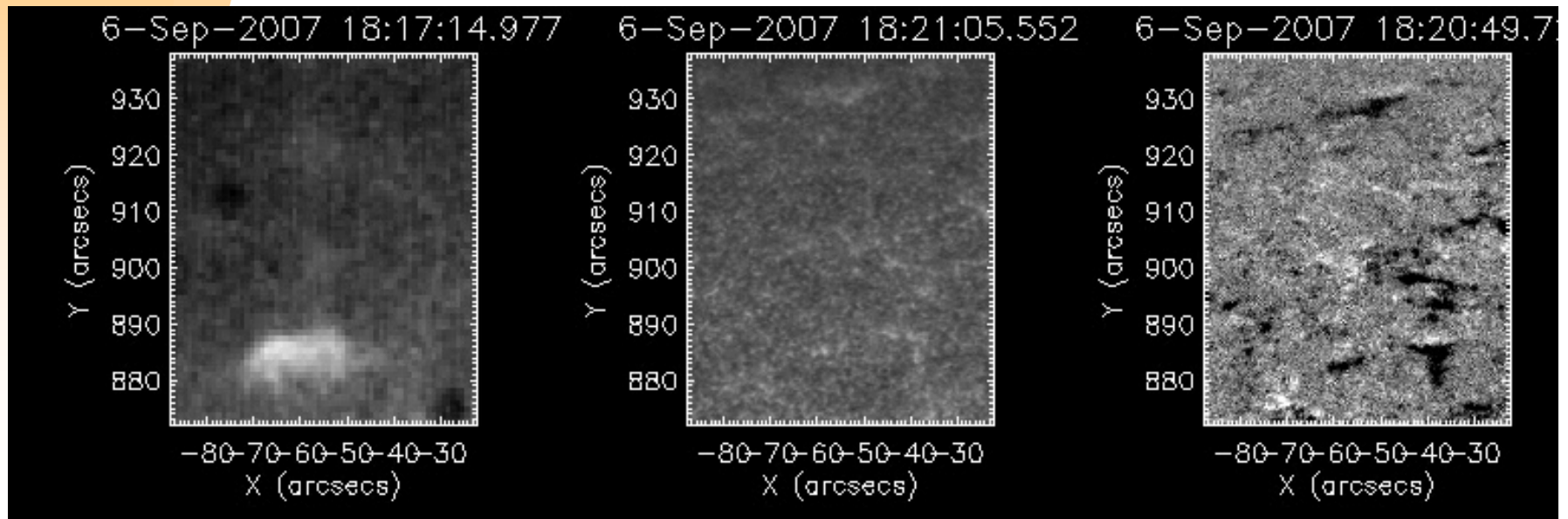
Result:2

The magnetic fields of the jet regions around the pole.

- An X-ray jet associate with EFR in the polar region

White: \odot
toward us

Black: \otimes
toward the screen



X-ray

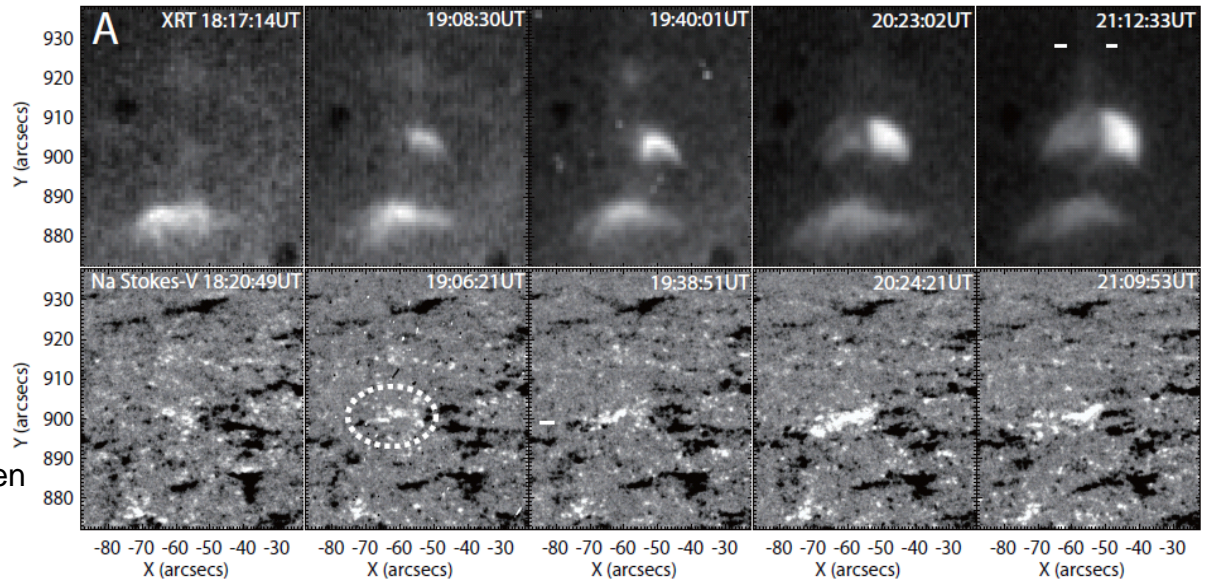
Ca II H

Stokes-V (Na)

Result:2

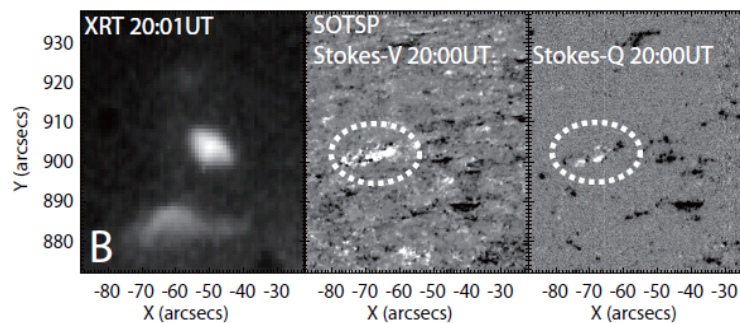
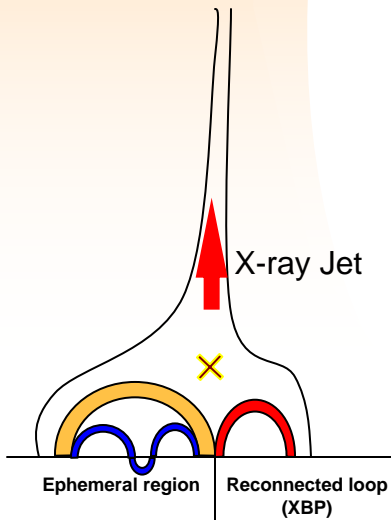
The magnetic fields of the jet regions around the pole.

- An ephemeral region in the polar region with an X-ray jet



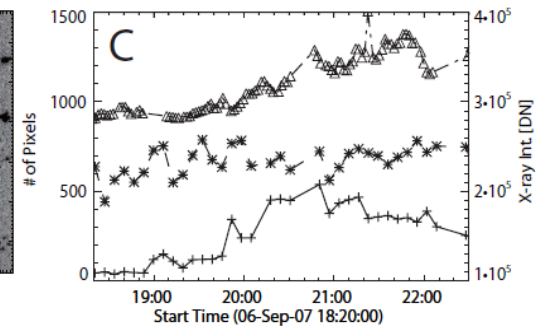
White: \odot
 toward us

Black: \otimes
 toward the screen



White: \longleftrightarrow

Black: \updownarrow



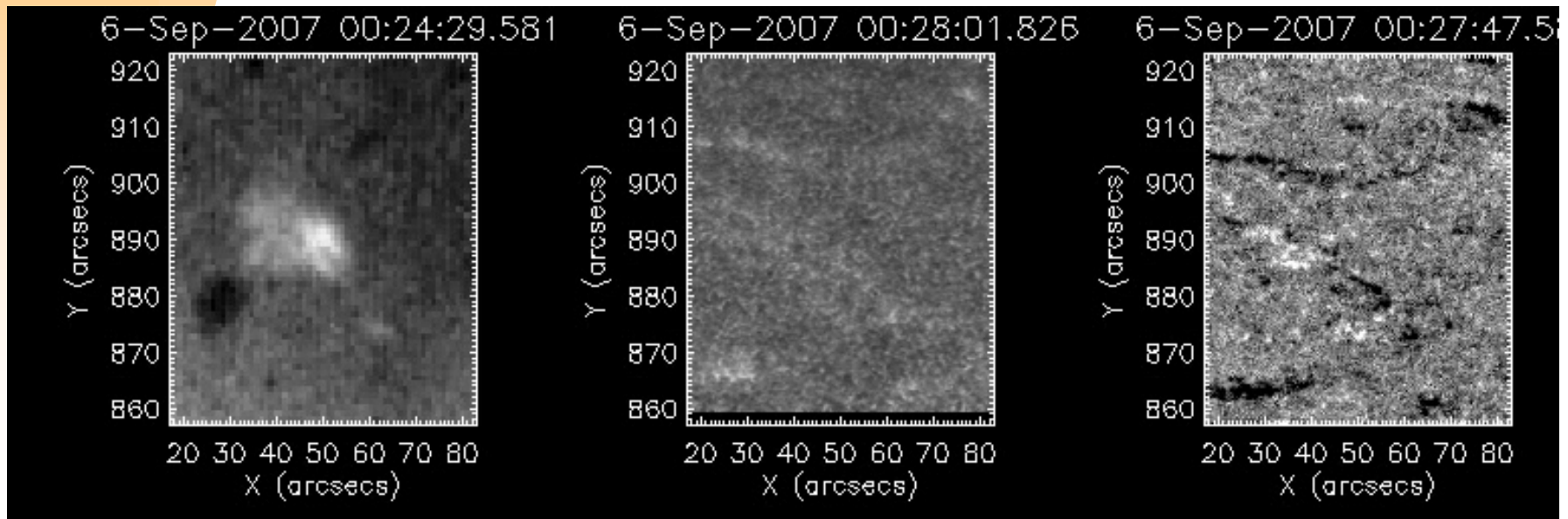
Result:2

The magnetic fields of the jet regions around the pole.

- X-ray jets associate with cancelling flux in the polar region

White: \odot
toward us

Black: \otimes
toward the screen



X-ray


Ca II H


Stokes-V (Na)

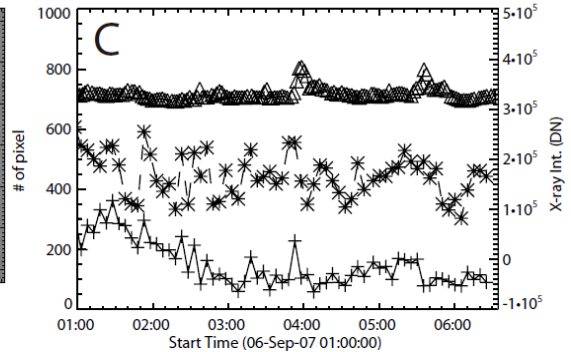
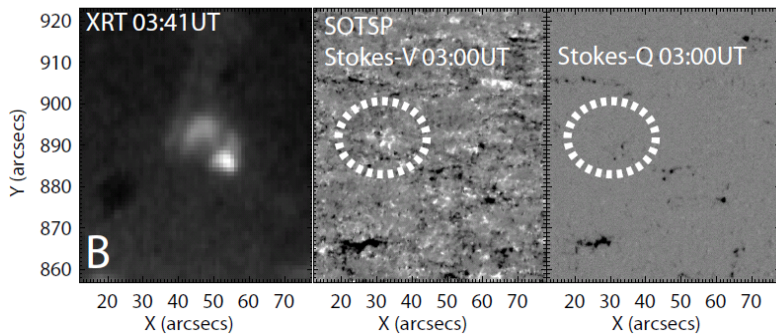
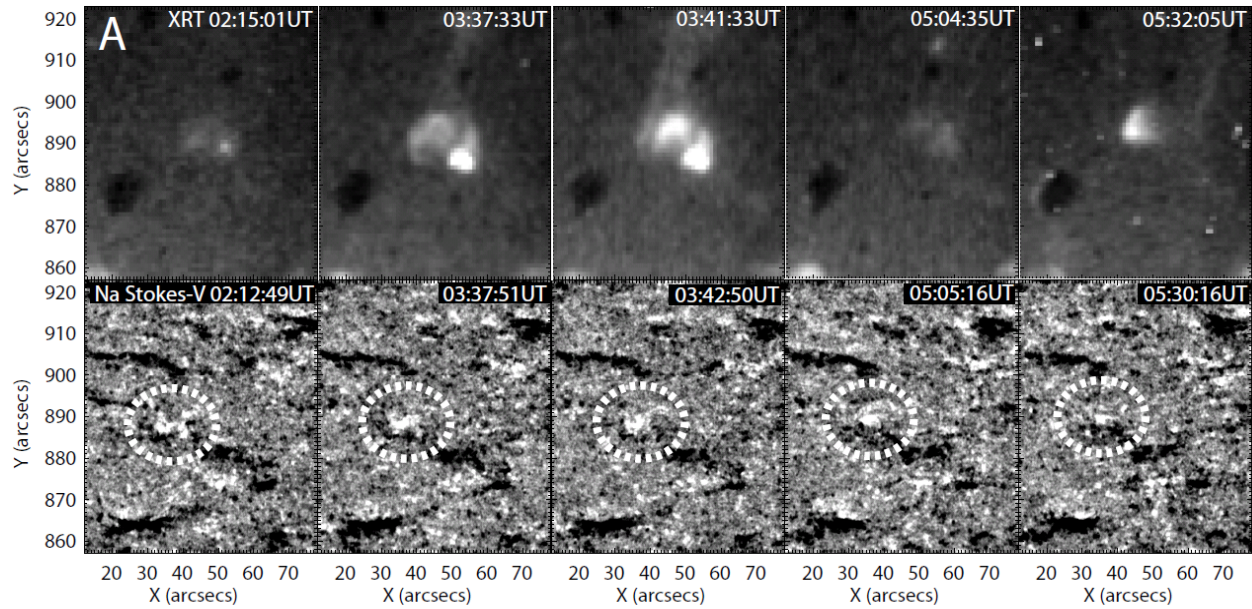
Result:2

The magnetic fields of the jet regions around the pole.

- The X-ray jets associate with cancelling flux in the polar region.

White: 
 toward us

Black: 
 toward the screen



Result:3 Summary of Results

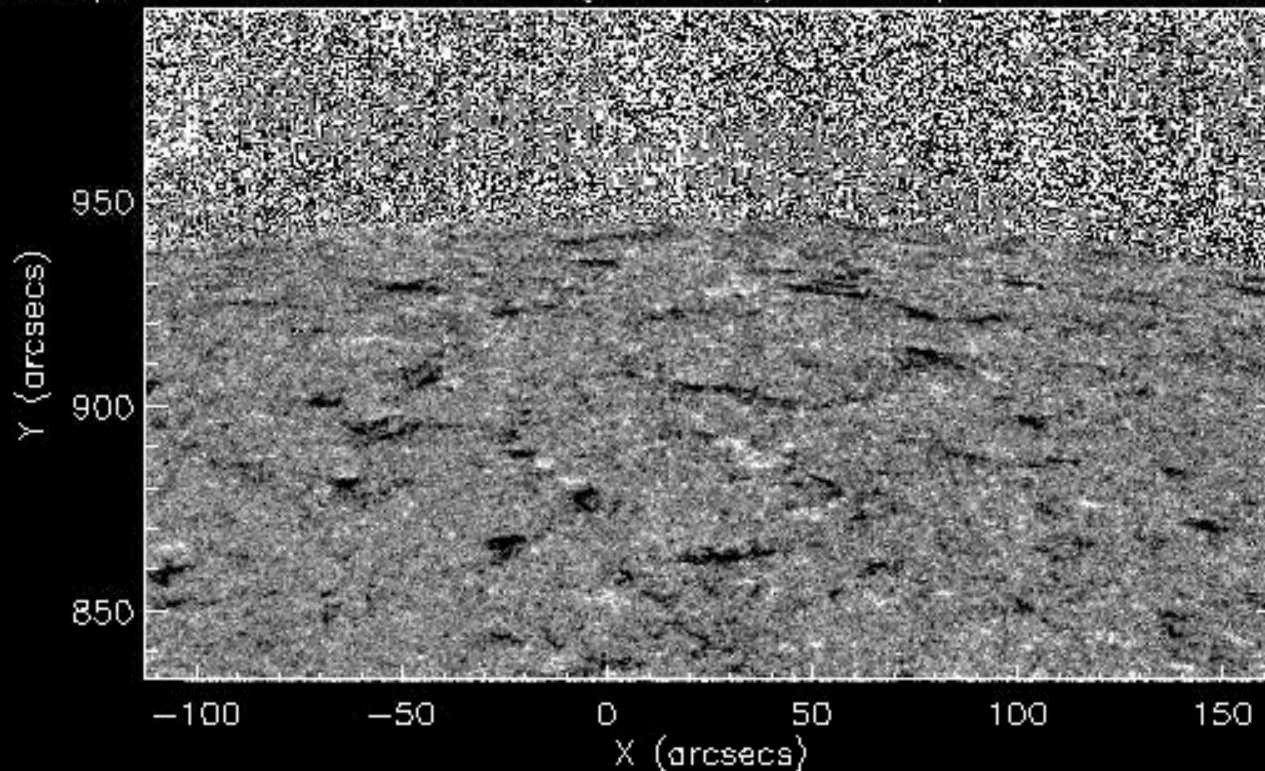
- **The relation between patchy magnetic fields and coronal structures.**
 - The coronal structures associated with the weak kG-patches. However, **the relatively large kG-patches does not always associate with the coronal structure/activities.**

- **Magnetic environments of X-ray jets in the polar region**
 - The jets occur above the ephemeral region (EFR) and the cancelling flux region.
 - We investigated the 8 sites that produced the X-ray jets
 - 3 sites with the magnetic enhancement (EFR)
 - 4 sites with the cancelling flux
 - 1 site is unclassified.
 - The feature is same as that of the jets around ARs.
 - **The ephemeral region appear in the polar region !!**

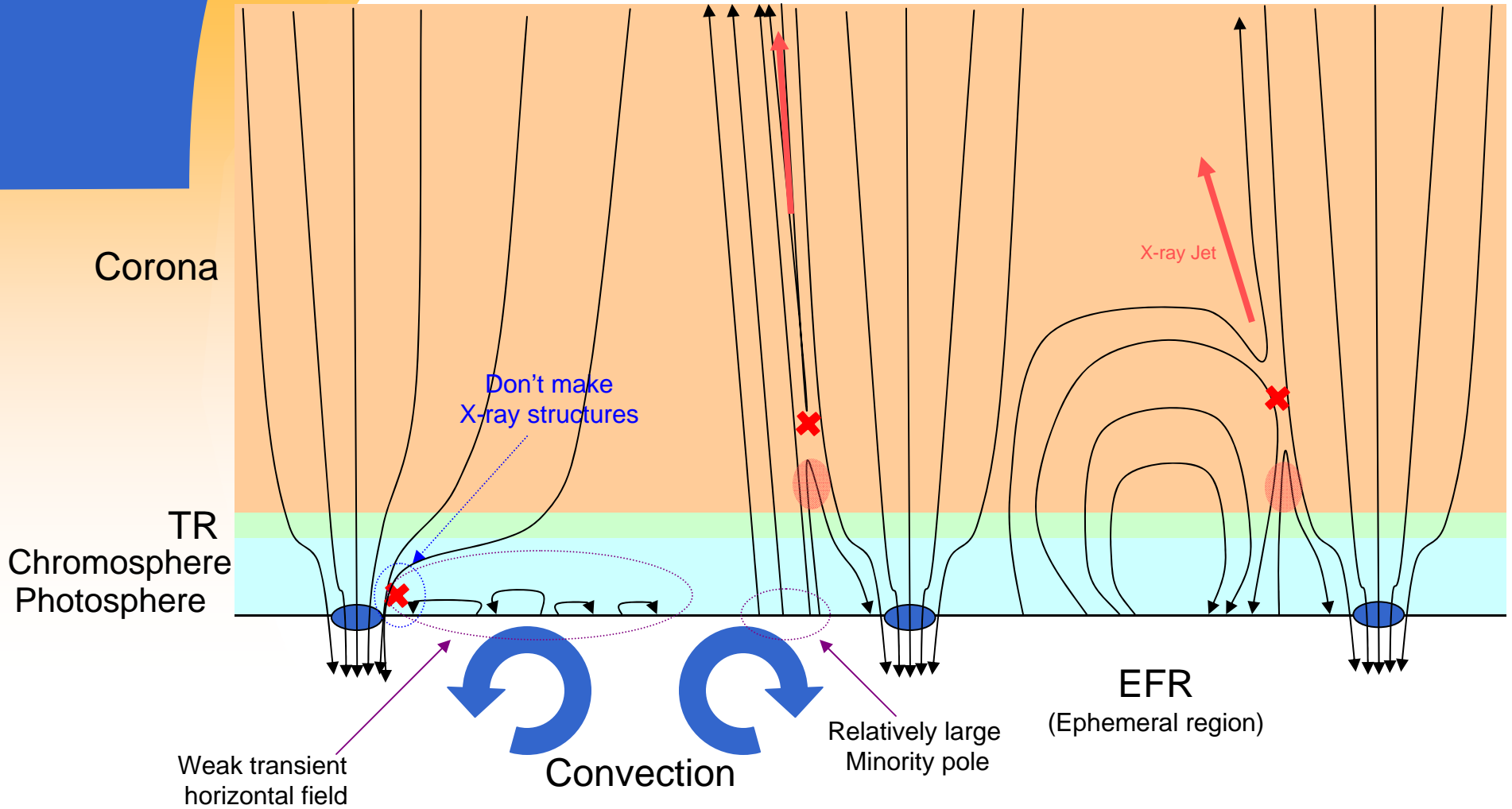
Discussion

- **Wang et al., 1997, ApJ, 484, L75**
 - “polar plume occur where minority-polarity flux is in contact with flux of the dominant polarity”

Hinode/SOT-FG Na Stokes-V(off: 124) 6-Sep-2007 00:27:47.586 UT



The magnetic environments in the polar region



Conclusion

- **Observational results**
 - The coronal structures associated with the (weak) kG-patches. However, **the kG-patches does not always associate with the coronal structure/activities.**
 - The jets in the polar region occur above the ephemeral region (EFR) and the cancelling flux region. **The feature is same as that of the jets around ARs.**
 - **The ephemeral region appear in the polar region.**
- **Speculation**
 - Coronal activities in the polar region are produced from the interaction of the kG-patches with the relatively large minority-polarity fluxes (EFR, cancelling flux)
 - The weak transient horizontal fluxes also interact with the kG-patches, but they does not produce coronal plasma. However, the small interaction may be important from the energy input to kG patches. (Fast solar wind)
 - The magnetic fields in the polar region may have two components. One is the magnetic fields come from the active region. The other one is the EFR at the polar region.

Back Up Slides

Observation

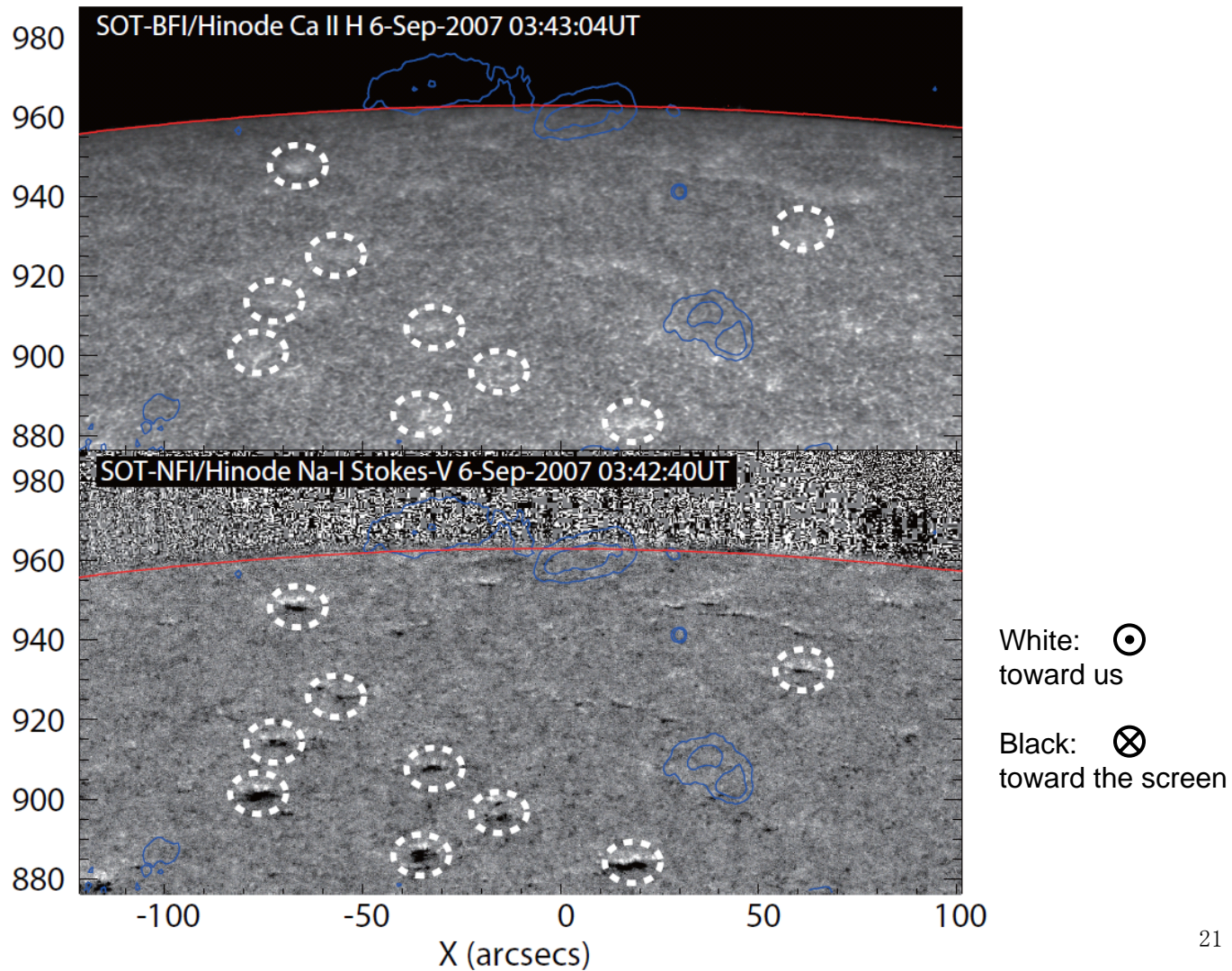
- **HOP02 (old): Polar Region Observation Campaign**
 - One of the core Campaigns of the Hinode project.
 - North Pole Observations in September, 2007.
 - 2007/09/01 -- 28
- **Dataset**
 - SOT-FG (G-band, Ca II, Stokes-I and V of Na I [5896 Å])
 - SOT-SP (Stokes-I, Q, U and V of Fe I [6301.5 Å, 6302.5 Å])
 - XRT (thin Al-poly filter)
- **Requirements**
 - SOT : Large Field of View (> 200" x 100")
 - XRT : include the synoptic Images
- **Selected Data**
 - #06 09/06 00:22 – 07:00 : 7 hours / X-ray Jet site : 1
 - #07 09/06 18:15 – 00:00 : 6 hours / X-ray Jet site : 1
 - #14 09/10 01:10 – 06:40 : 6 hours / X-ray Jet site : 1
 - #15 09/10 15:51 – 21:30 : 6 hours / X-ray Jet site : 2
 - #39 09/16 01:17 – 07:08 : 6 hours / X-ray Jet site : 3

Result:1 Polar Magnetic Field and Coronal Structure

■ Ca II H Intensity and Stokes-V of Na I

The white dashed circles indicate the relatively large kG-patches.

The kG-patches correspond with Ca bright points (and G-band BPs).

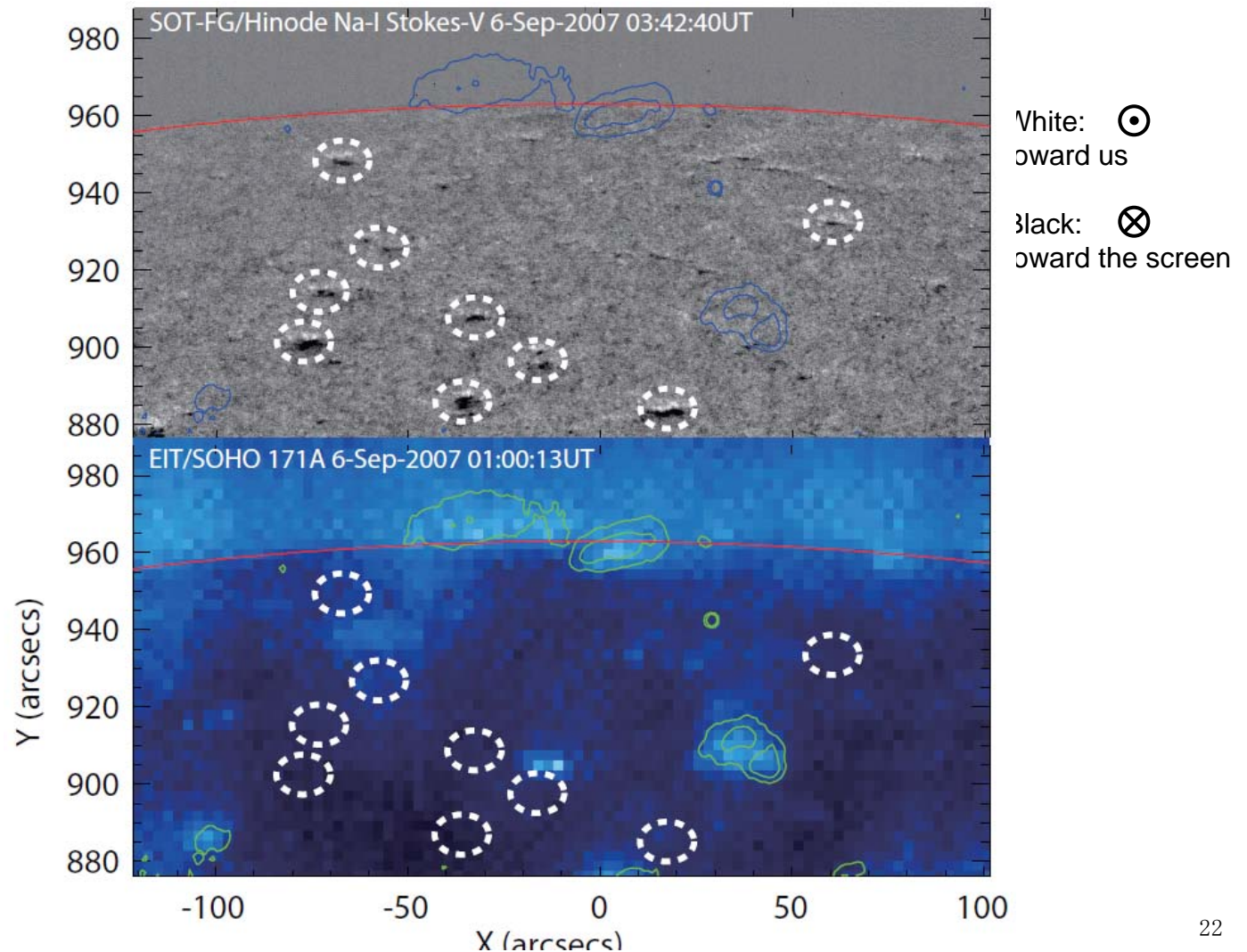


Result:1 Polar Magnetic Field and Coronal Structure

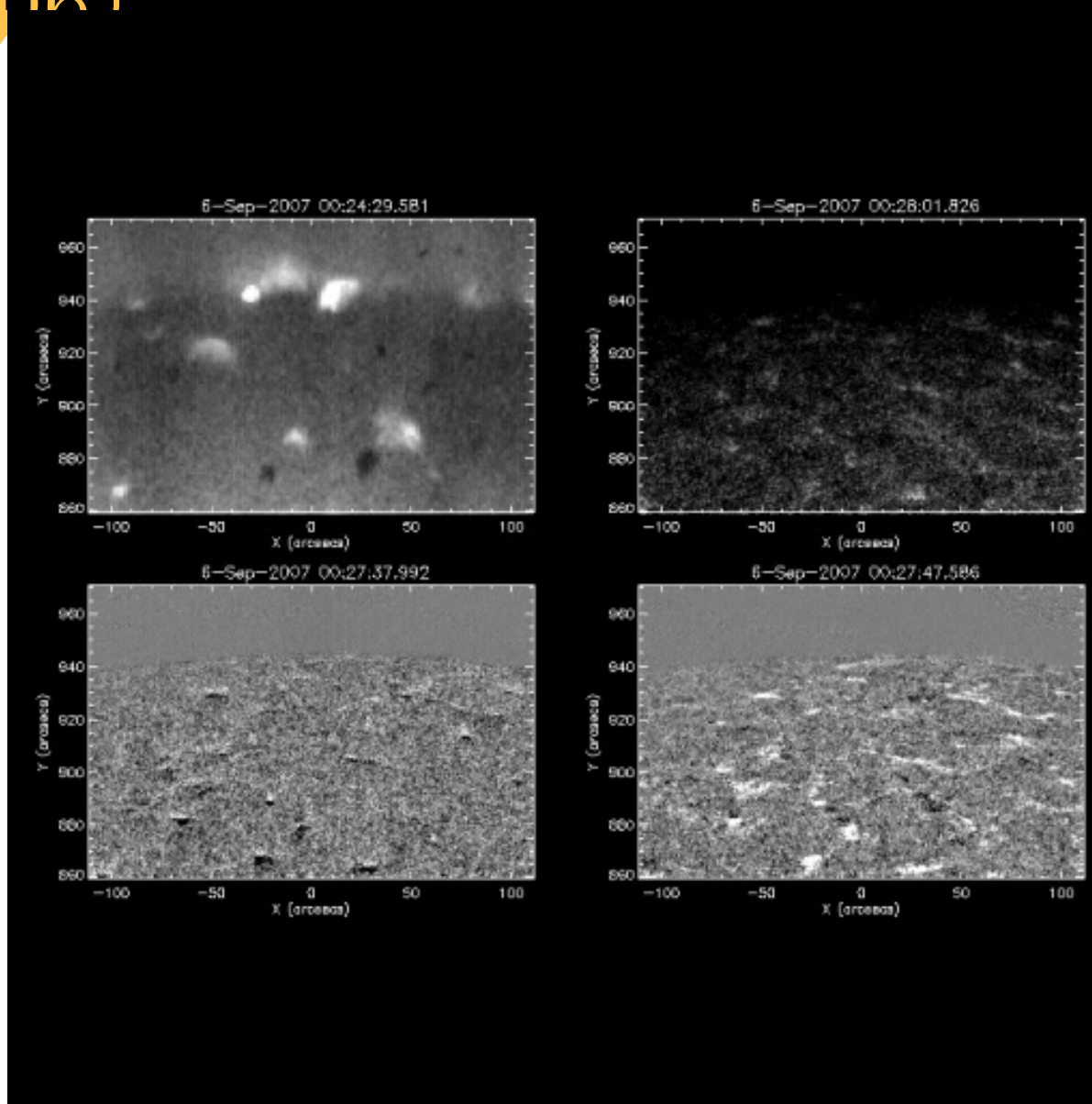
■ Stokes-V of Na I and EUV (EIT 171Å)

The white dashed circles indicate the relatively large kG-patches.

In EUV (195 and 171) image, the relatively large kG-patches does not always associate with the coronal structure, too.



Wide Field of view movies (#06)



Wide Field of view movies (#07)

