Recurrent Chromospheric Jets at a Magnetic Flux Cancellation Site

M. Kubo, S. Toriumi (NAOJ),
C. Beck, S. Criscuoli, H. Uitenbroek (NSO)

IRIS-9, Göttingen, 25-29 June 2018

Contributed Talk

2. Chromospheric heating and dynamics

Recurrent chromospheric jets at a magnetic flux cancellation site

M. Kubo[1], S. Toriumi[1], C. Beck[2], S. Criscuoli[2], H. Uitenbroek[2]

[1] *National Astronomical Observatory of Japan*
[2] *National Solar Observatory*

Chromospheric activities associated with a magnetic flux cancellation in emerging active region NOAA 12654 were successfully observed with IRIS, IBIS and FIRS at the DST, and Hinode on May 2, 2017. IRIS observed the cancellation site with a 4-slit raster mode at a cadence of 12s. Spectro-polarimetric observations of the Ca II 854 nm line were done with IBIS/DST for three hours under good seeing conditions, and a time series of Stokes profiles of He I 1083 nm were also observed with FIRS/DST. We find that the core intensity of Mg II k is suddenly blue shifted and then gradually changes to red shift at the cancellation site. Such a phenomenon recurrently appears during the decrease of photospheric magnetic flux. Similar behavior is observed in the Ca II 854 nm line, as transitional dark threads over the polarity inversion line at the cancellation site simultaneously appear in the Ca II 854 nm images. The timescale of the transition from blue shift to red shift is of the order of minutes in Ca II 854 nm. In addition, more frequent transitions on a shorter timescale can be seen in Mg II k. A signature of magnetic reconnection in the lower atmosphere (UV bursts) is also obtained: the intensity of the Mg II 280 nm wing is enhanced when a sudden blue shift appears in the line core, while an enhancement of Si IV 139 nm with absorption features is sometimes observed simultaneously. These results suggest that the ejections of cool plasma due to magnetic reconnection in the lower chromosphere are recurrently happening at the cancellation site, after which the ejected plasma falls back due to gravity. The different behavior of the temporal evolution in Mg II 280 nm and Ca II 854 nm indicates that some disturbances at higher frequency develop along the ejected plasma.

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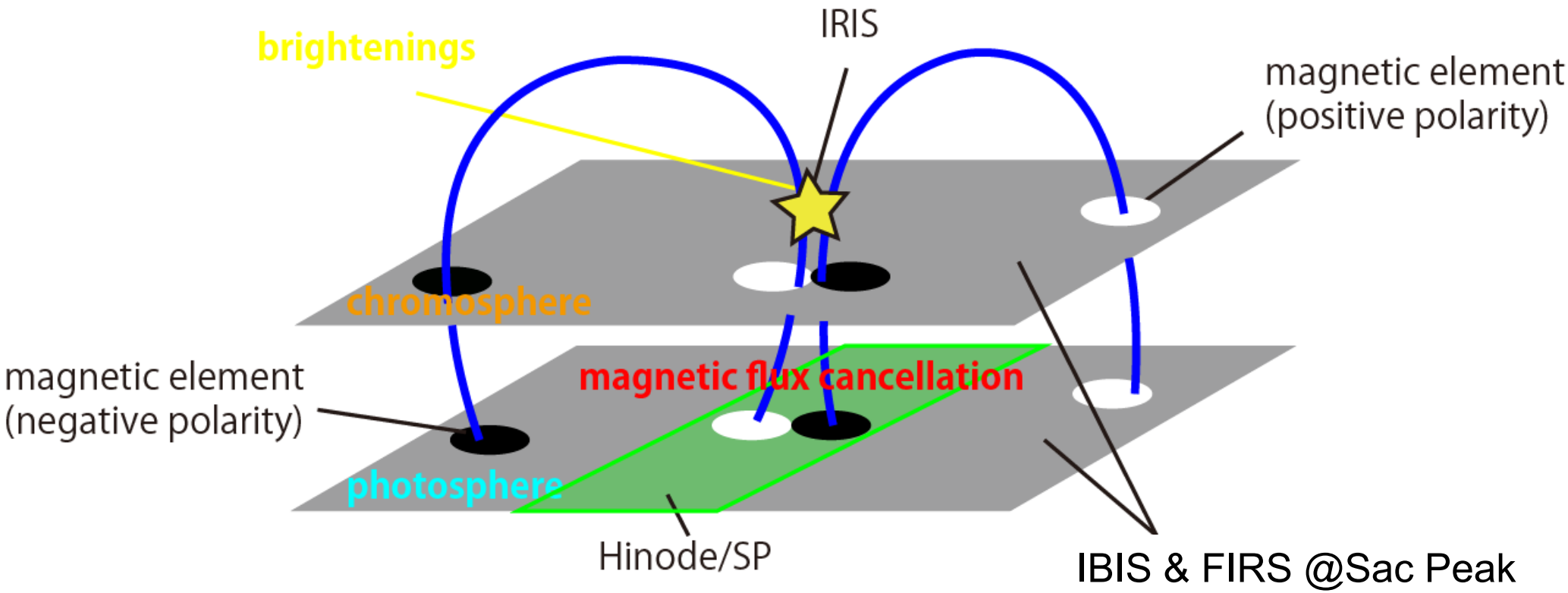
IRIS-Hinode-IBIS-FIRS- Campaign Obs. (IHOP311)

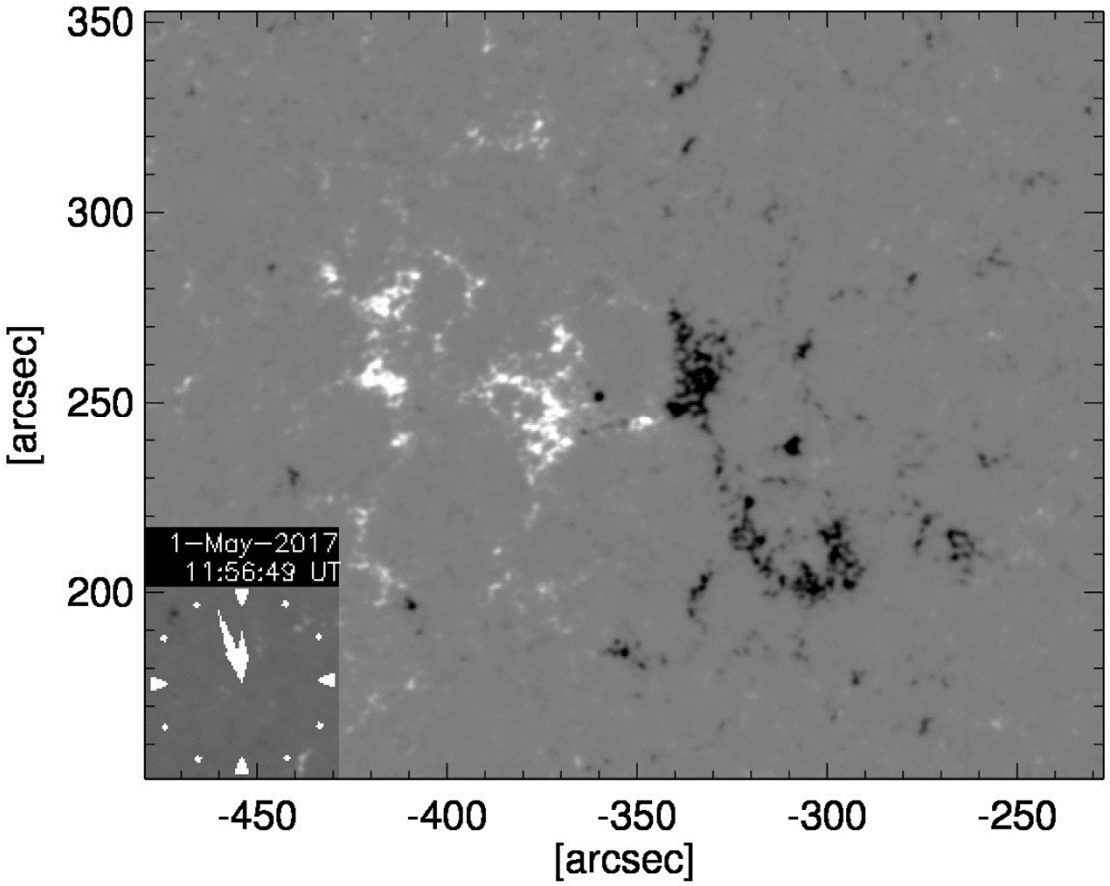


- Temporal change of 3D magnetic field structure at magnetic flux cancellation site.

- Two campaign observations were performed in 2016 and 2017.

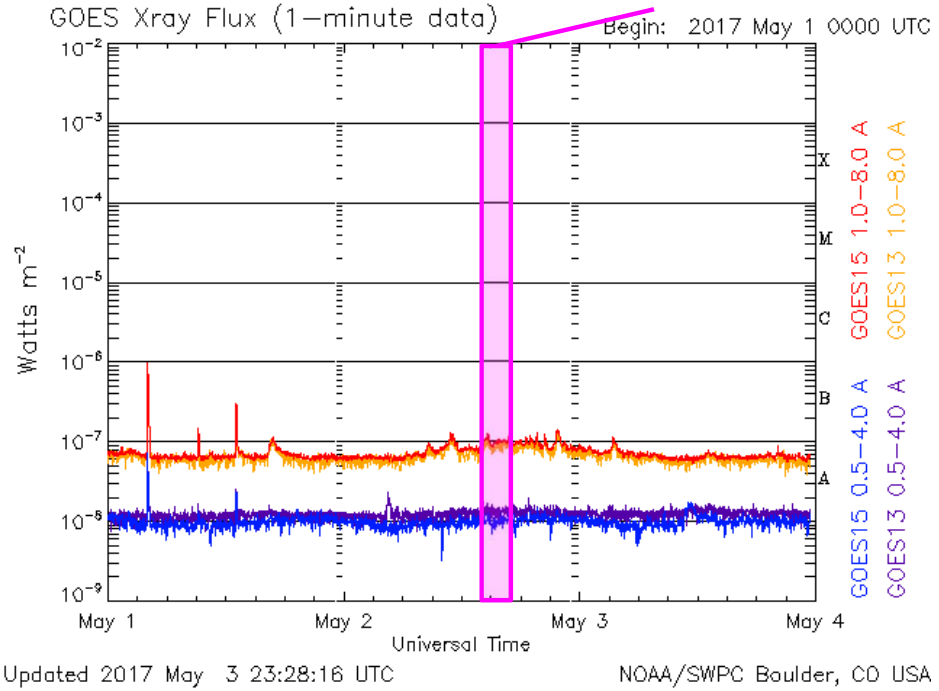
Active Region NOAA 12654

LOS magnetogram (SDO/HMI)



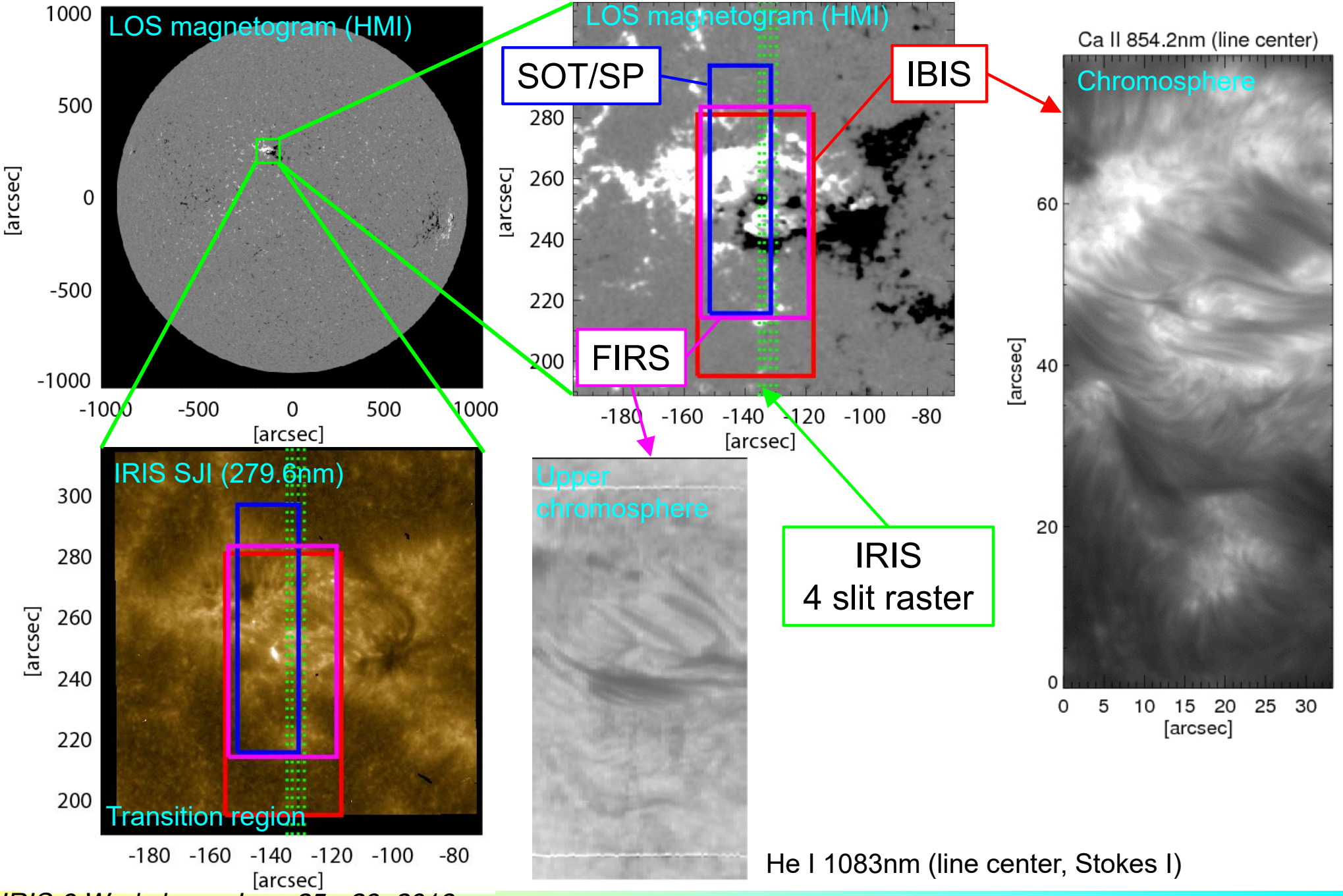
- The observation at Sac Peak was performed for 3 hours from 14UT on May 2, 2017.
- The flux emergence occured around the center of the bipolar region.

Observing period

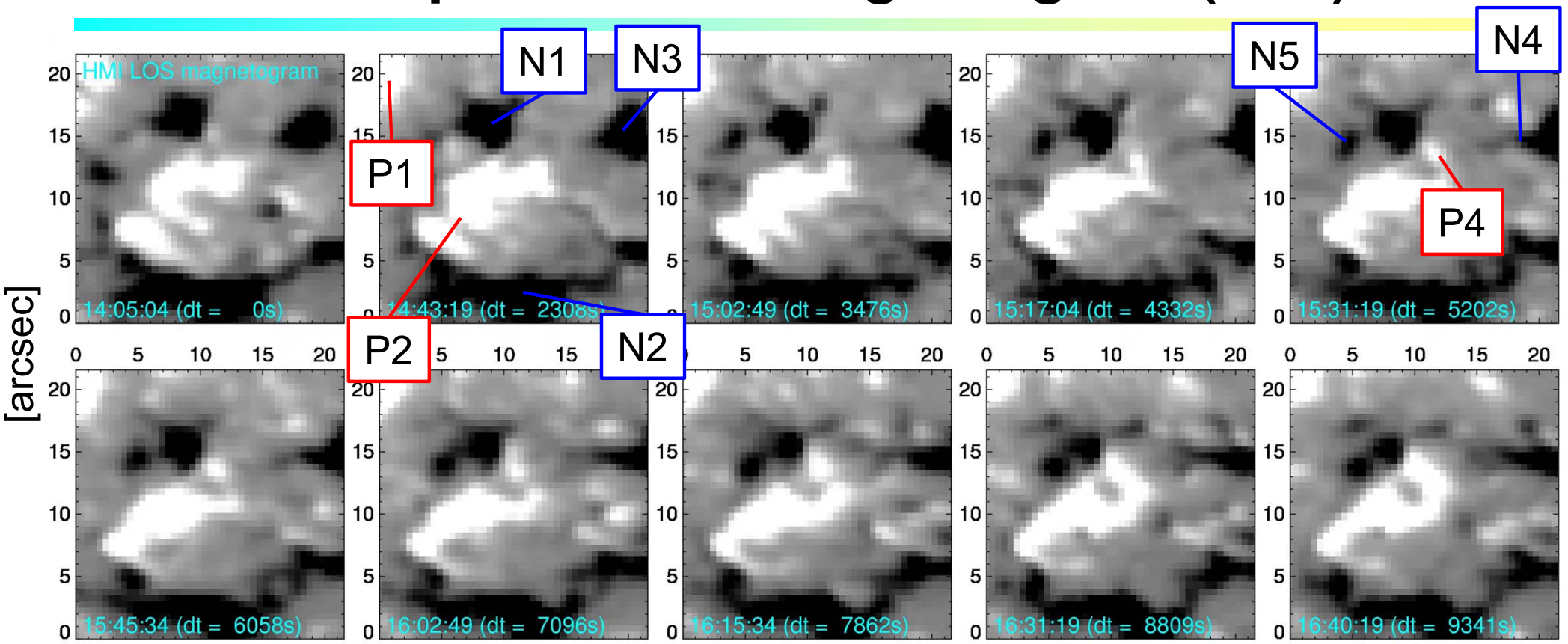


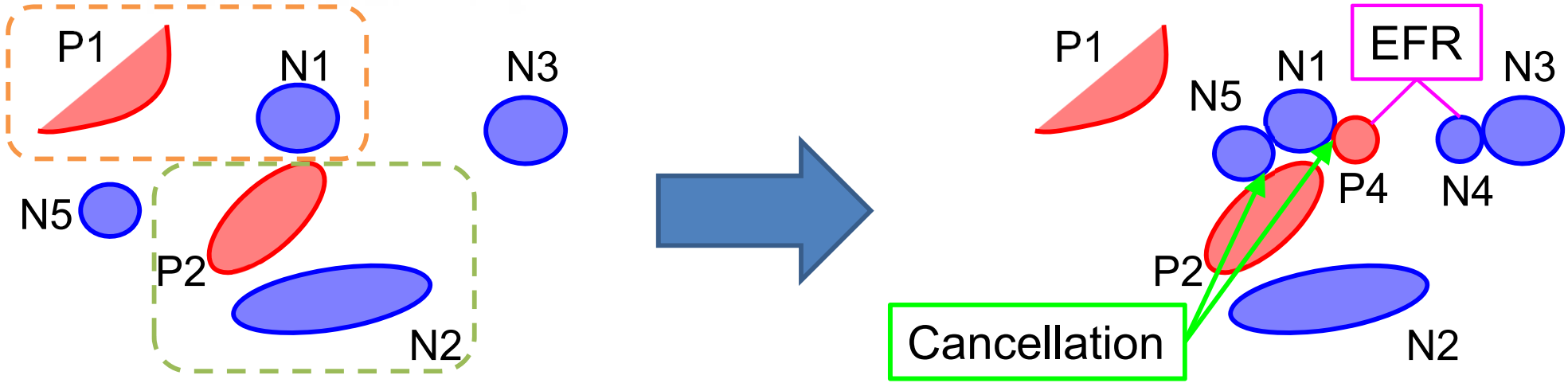
No flare (> C-class) during the observation.

Successful Coordinated Observations

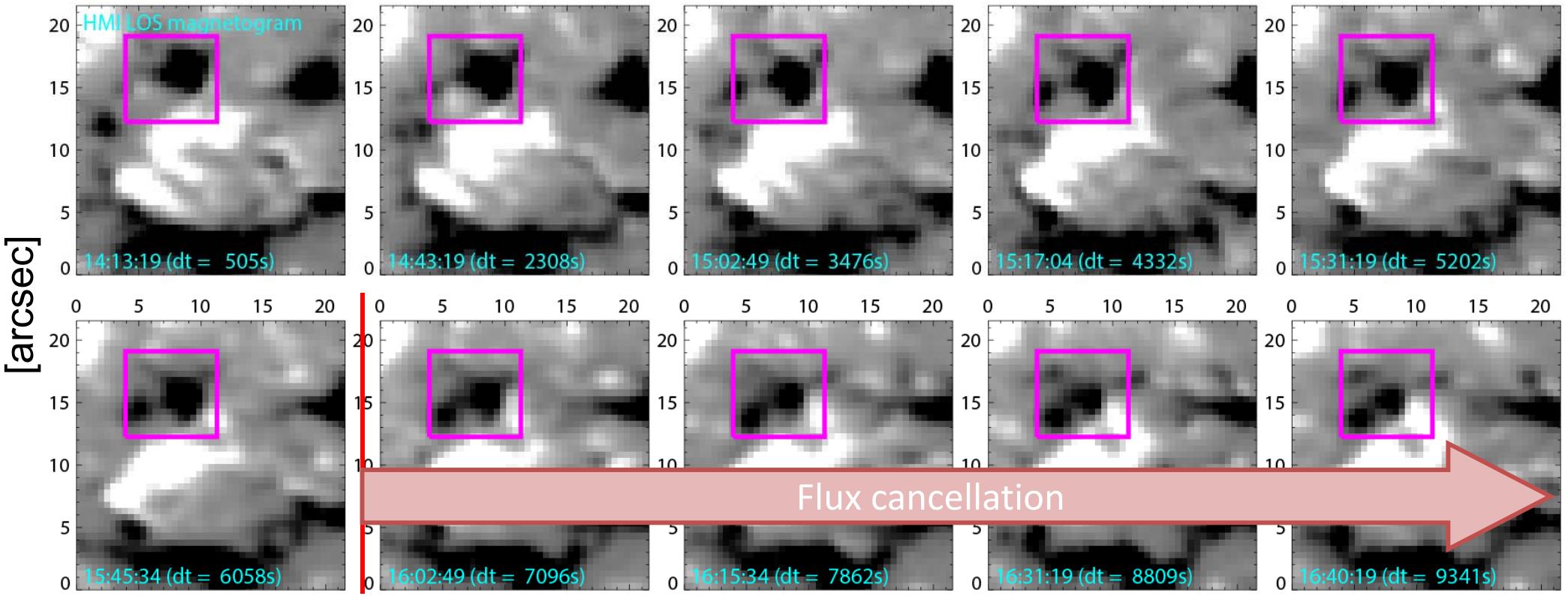


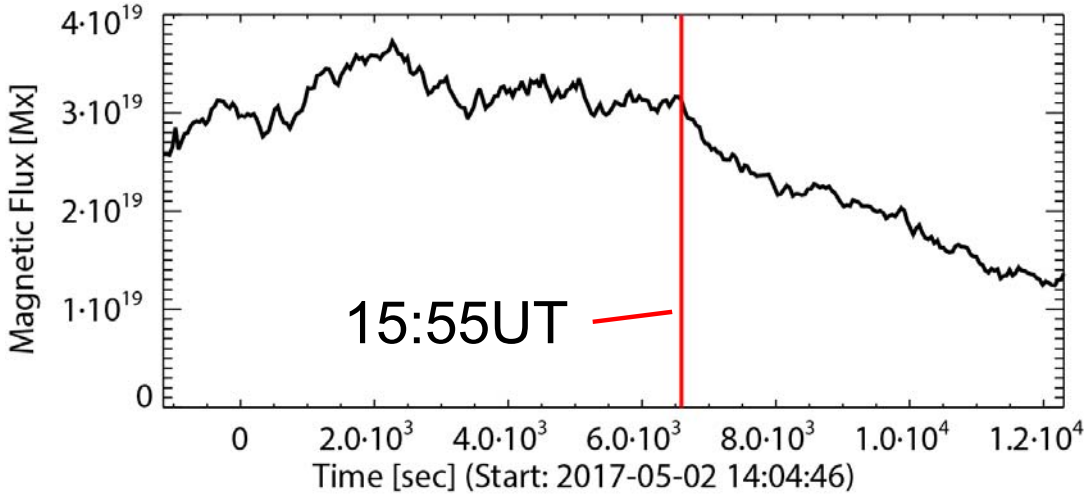
Photospheric LOS magnetogram (HMI)





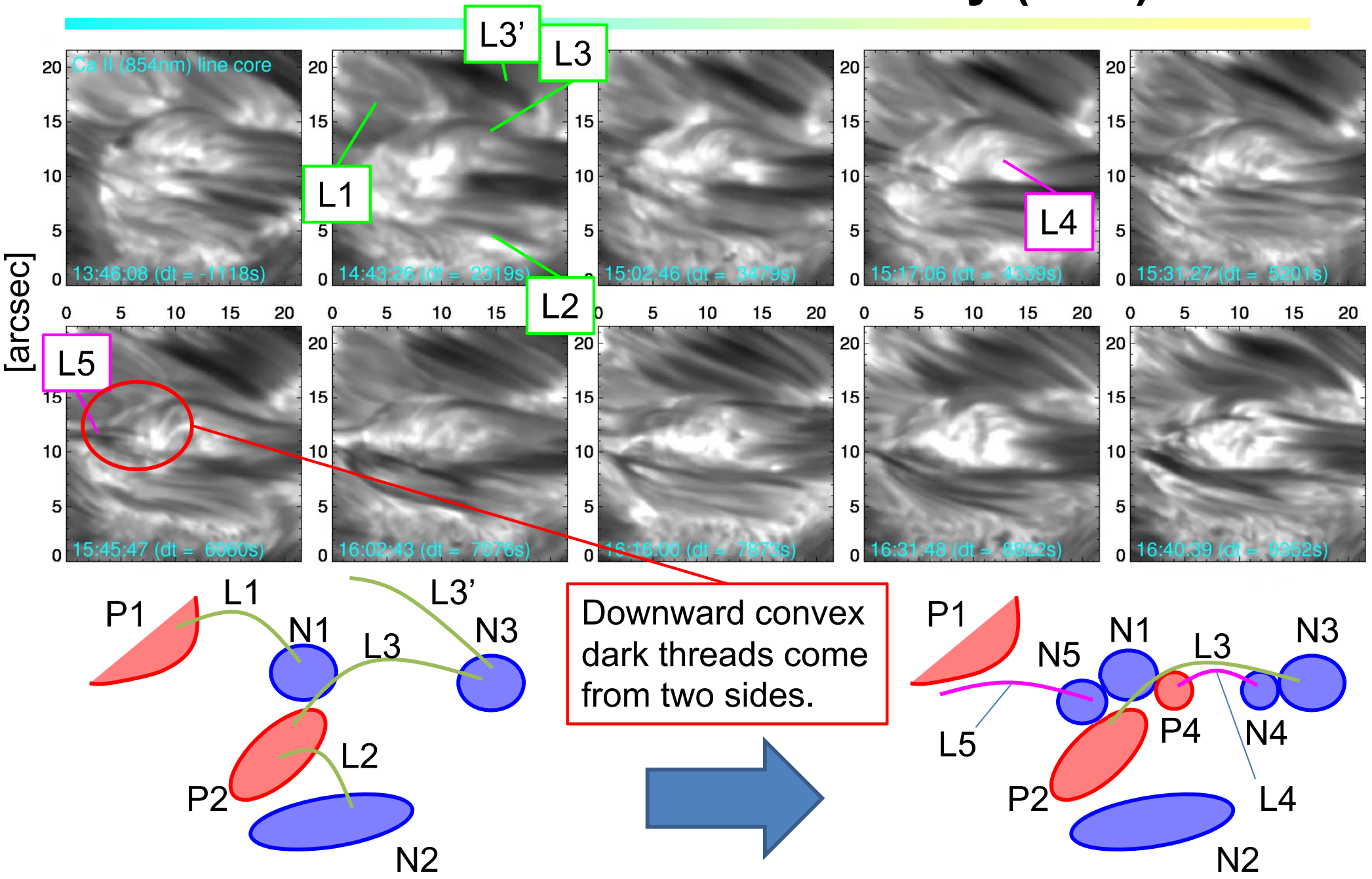
Photospheric LOS magnetogram (HMI)



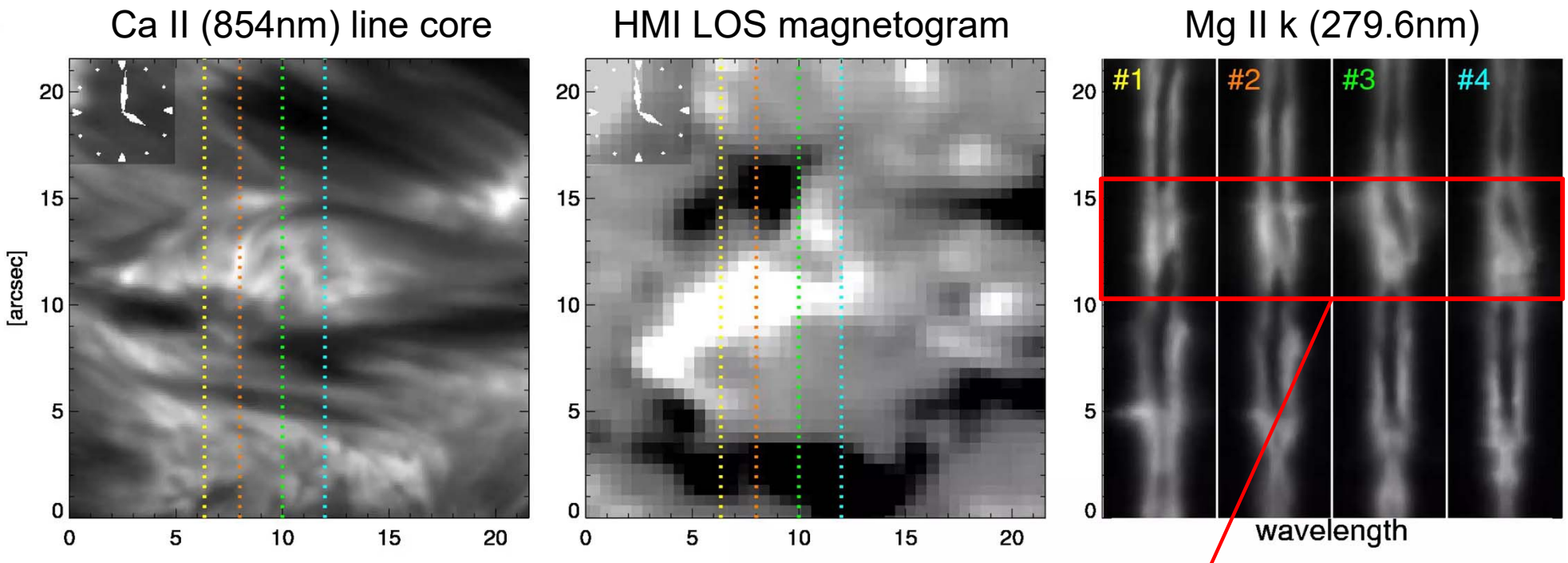


- The magnetic flux with negative polarity decreases in the cancellation site.
- The negative elements (N1&N5) within the box completely disappear by the end of May 2.

Ca II 854nm line core intensity (IBIS)



Temporal evolution Mg II k line (IRIS)

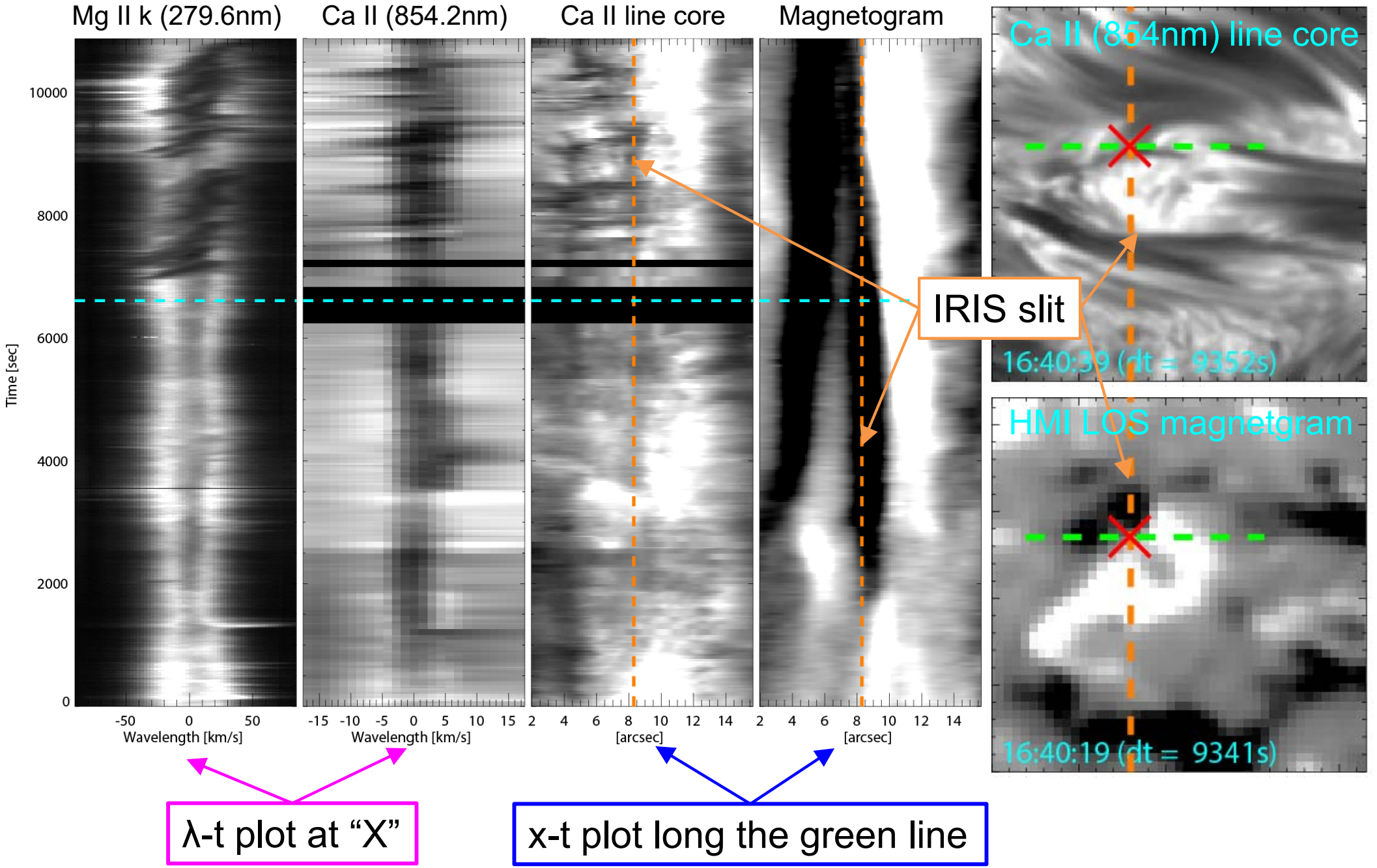


IRIS
- ✓ Scan step: 4x2“
- ✓ Step cadence: 3.2s
- ✓ Raster cadence: 12s

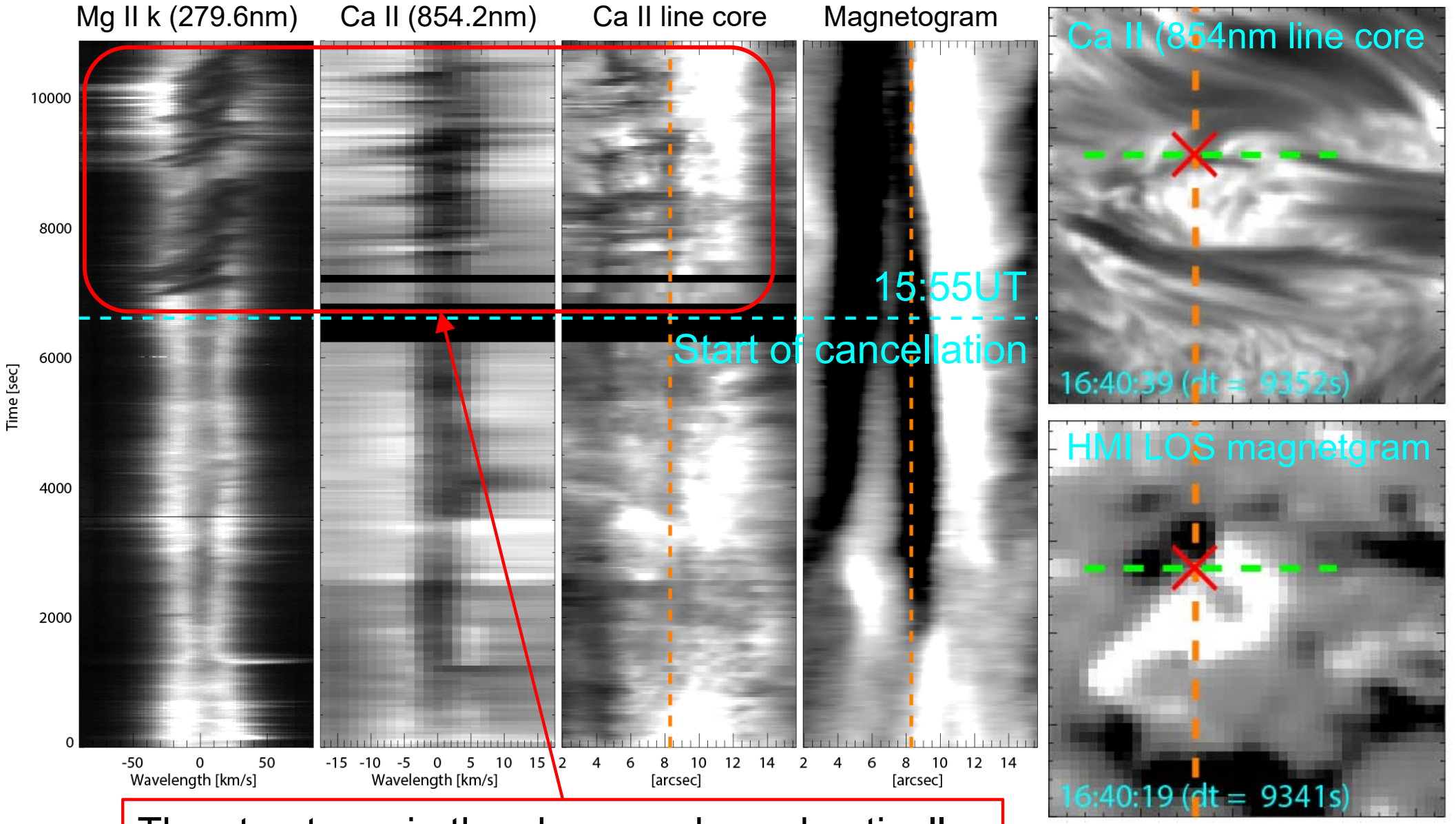
Ca II 854 obs.
- ✓ 17 wl points
- ✓ 30s/set

- The core intensity of Mg II k is suddenly blue shifted and then gradually changes to red shift at the cancellation site.
- Such a phenomenon recurrently appears.

Temporal evolution of chromosphere

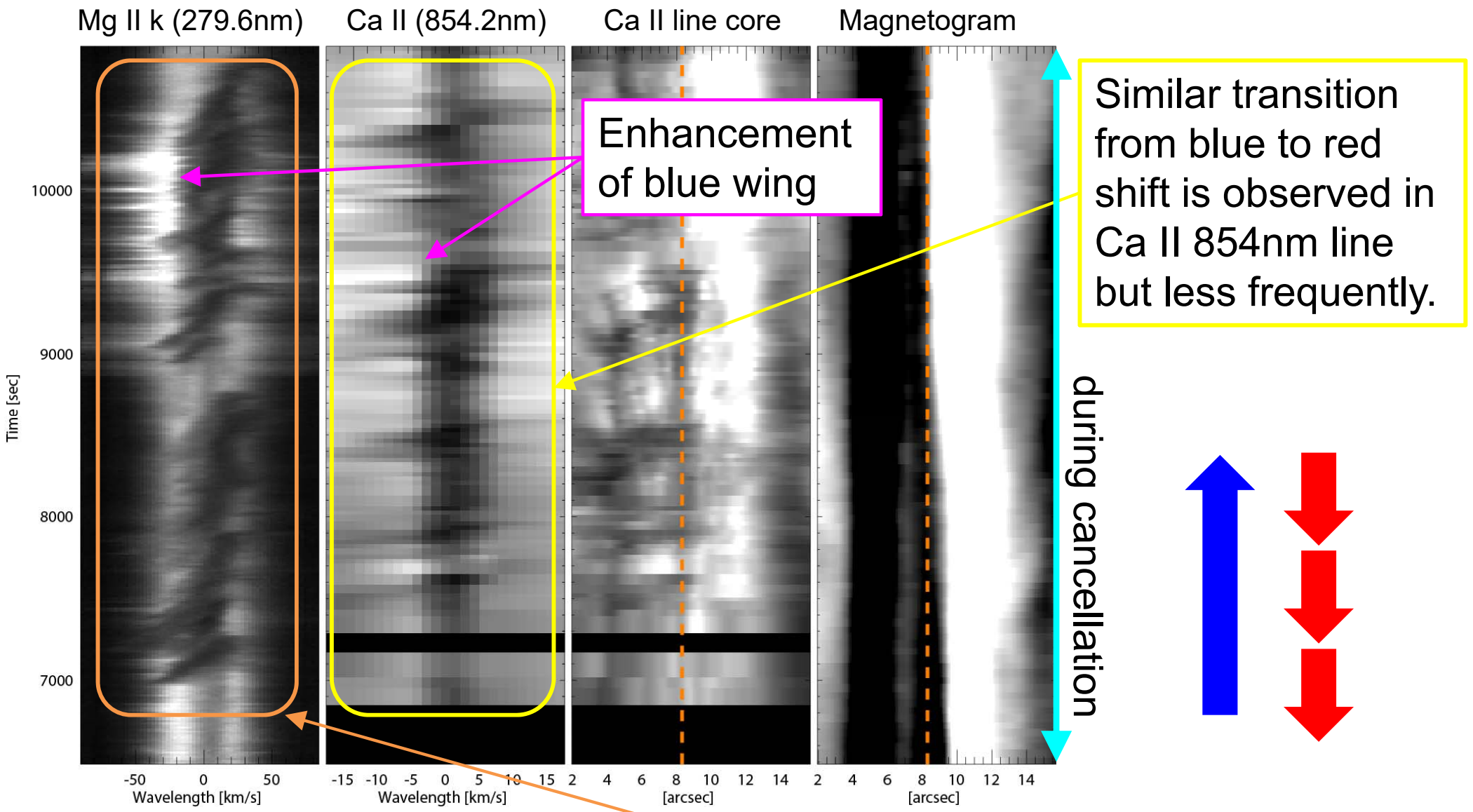


Temporal evolution of chromosphere



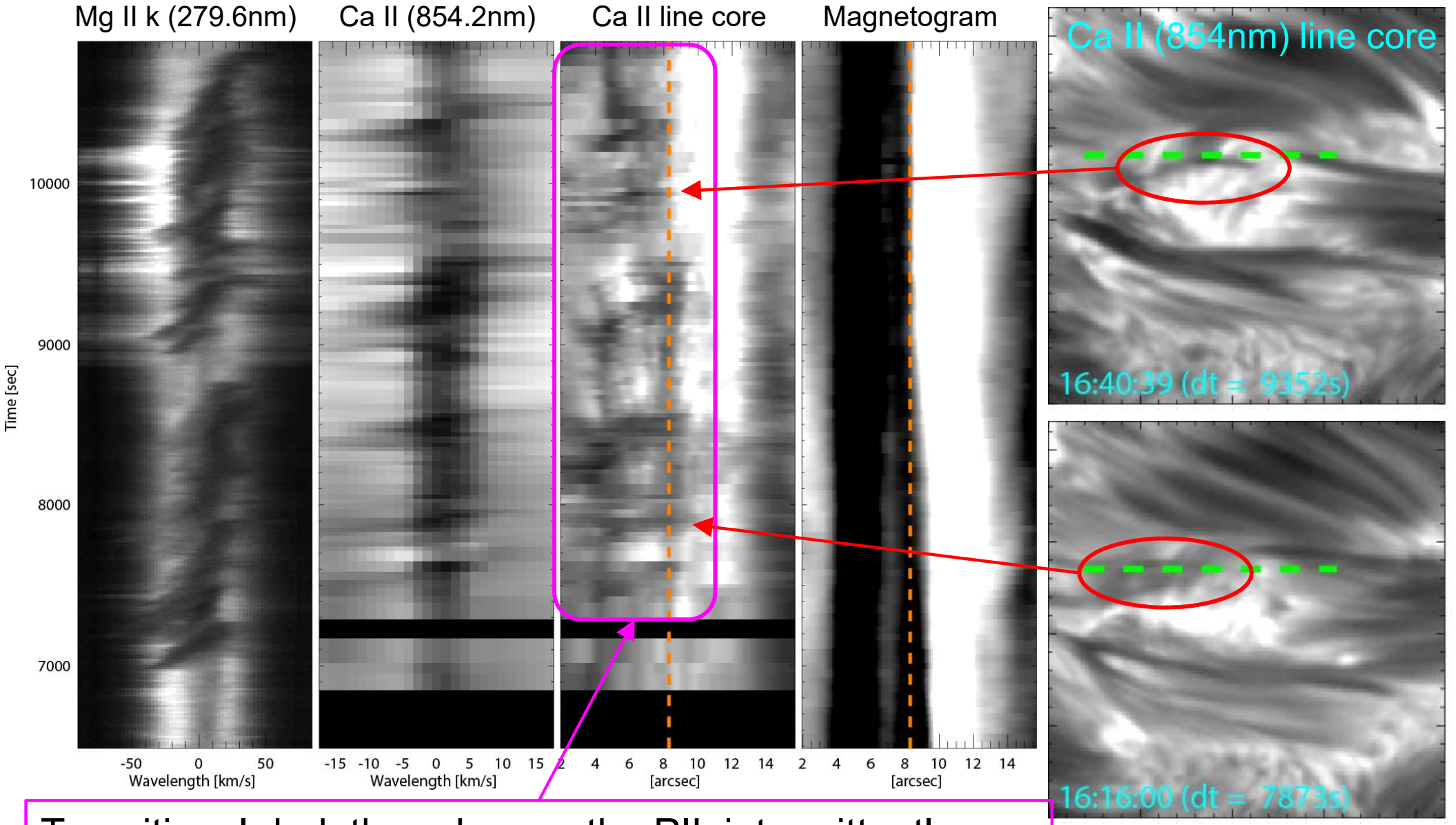
The structures in the chromosphere drastically change with the start of the flux cancellation.

Recurrent blue → red transition (Mg II k)



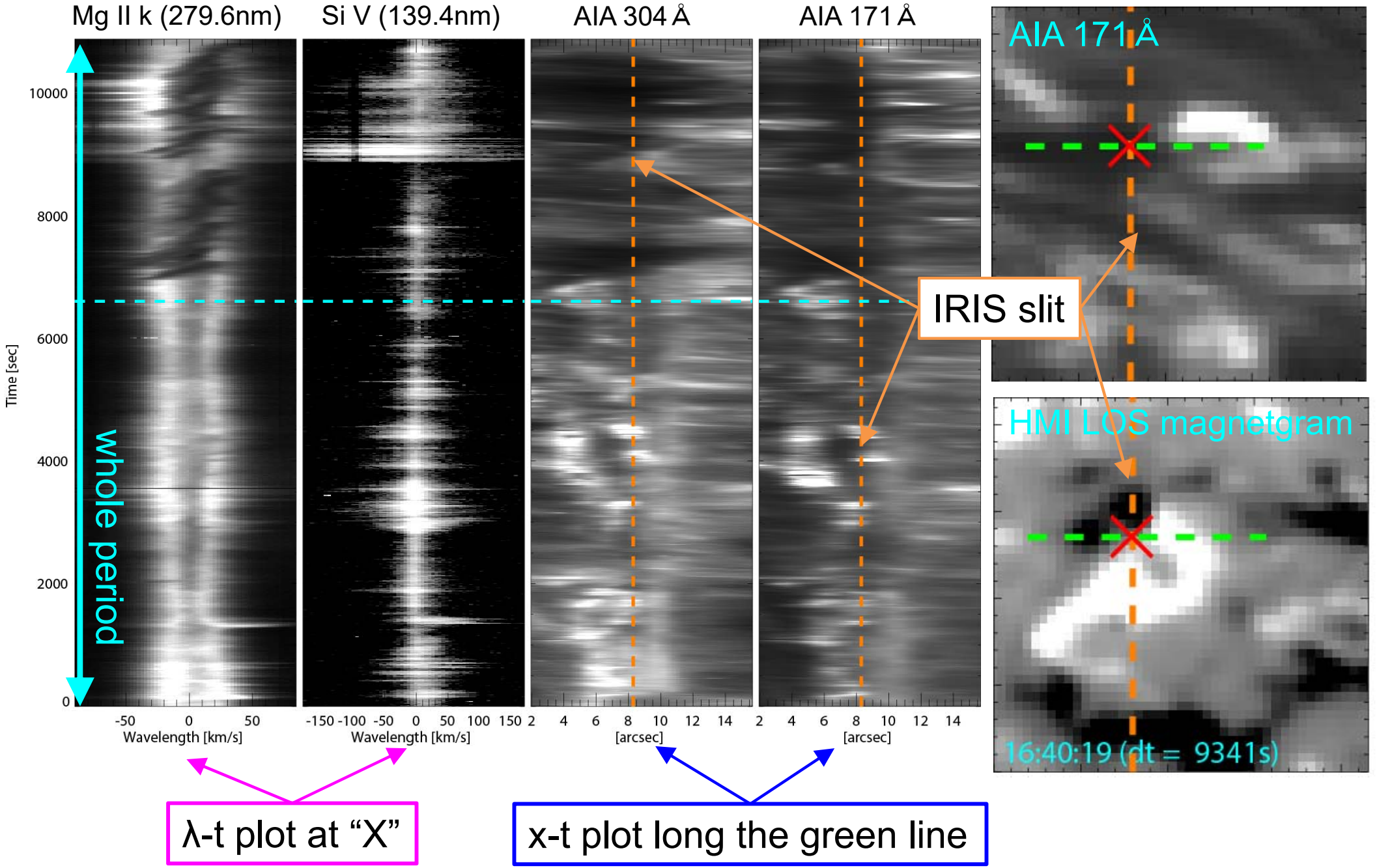
The sudden blue shift and then gradual transition to red shift is recurrently observed →Reccurent chromospheric jets

New dark threads over the PIL (Ca II 854nm)

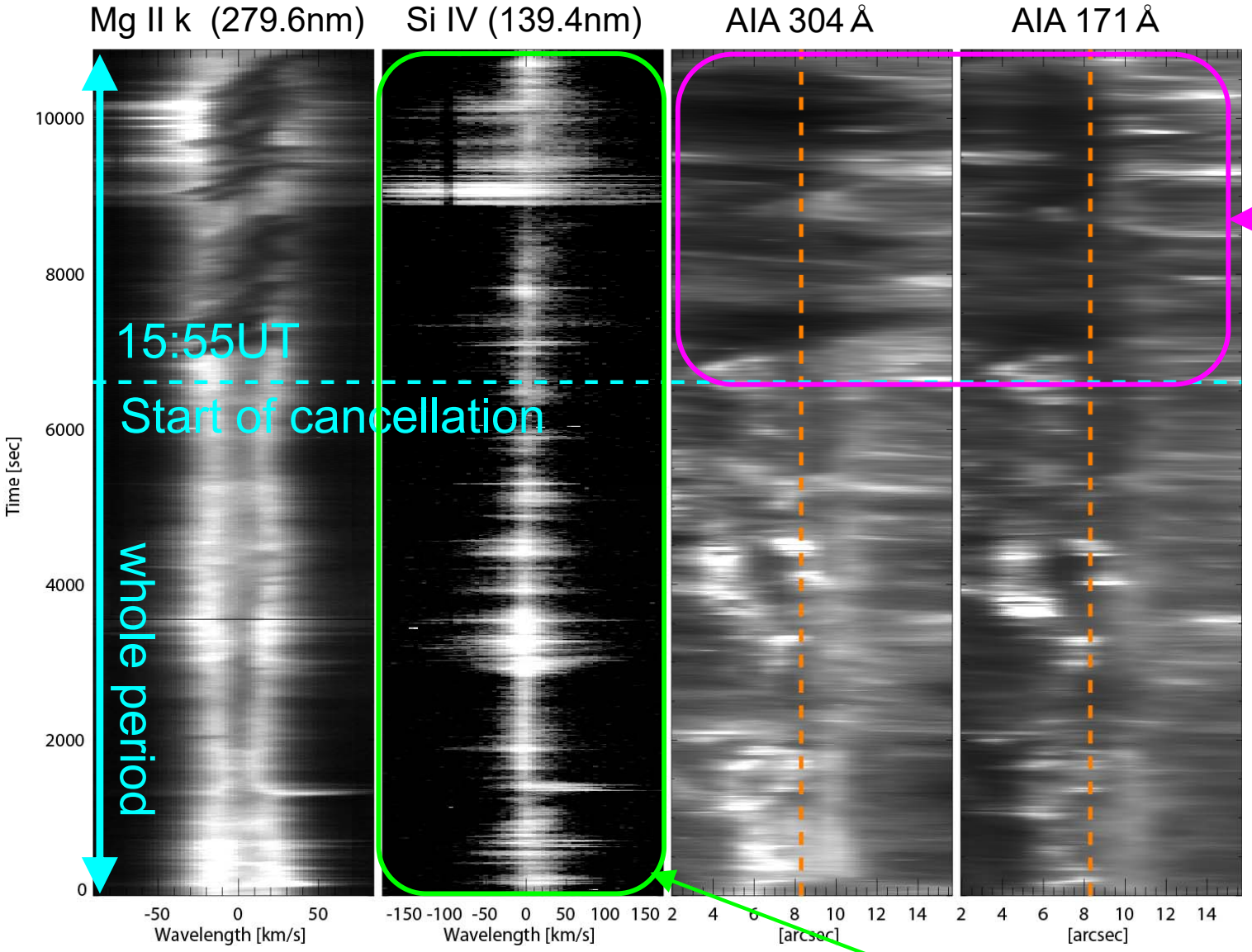


Transitional dark threads over the PIL intermittently appear in Ca II line core images. → Reconnected loops

Temporal evolution of TR & corona



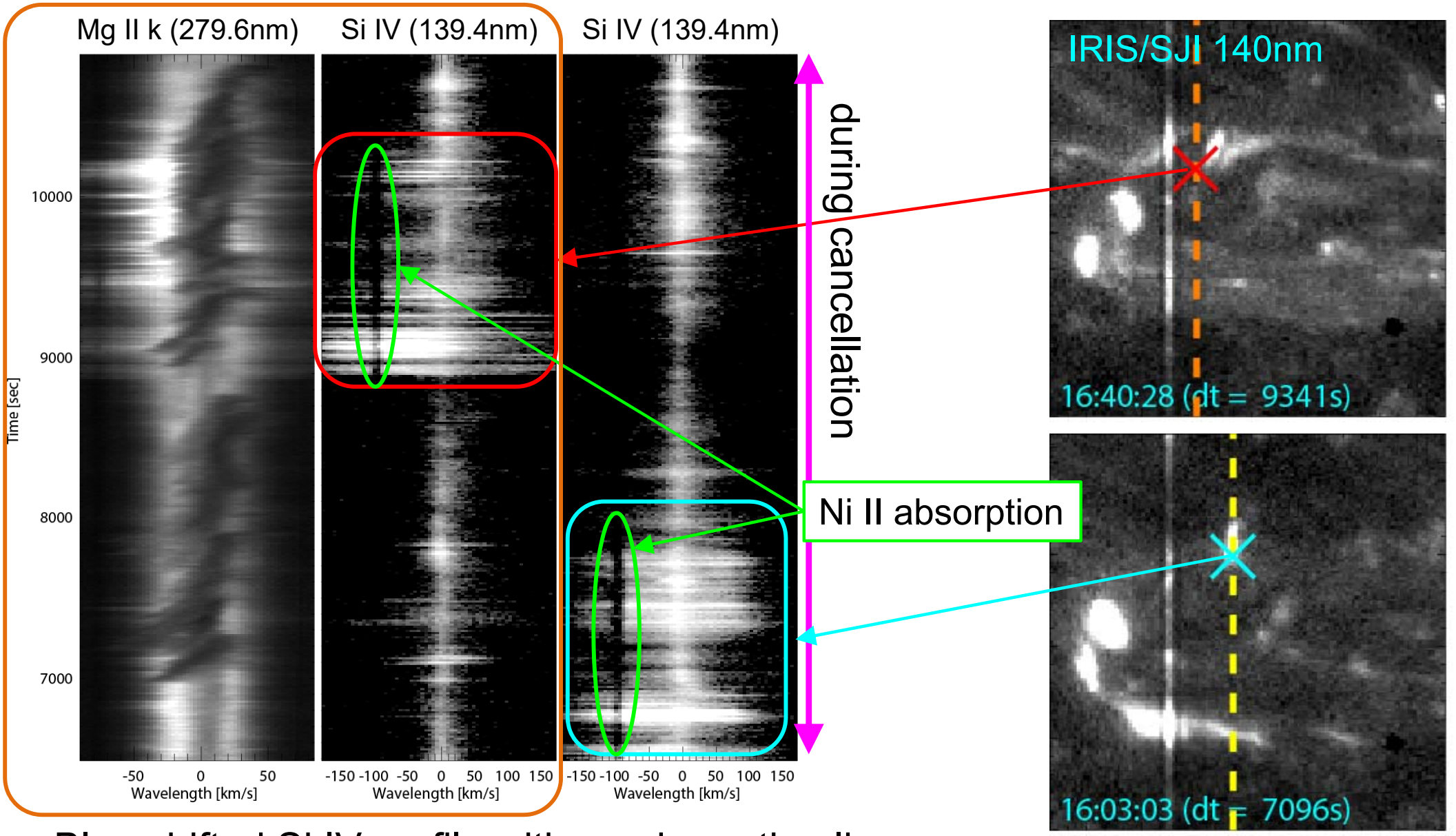
Temporal evolution of TR & corona



- The dark loops over the PIL recurrently appears in the AIA 304 Å & 171 Å images from the start of the flux cancellation.
- They tend to be elongated from left to right.

The brightenings are often observed in Si IV 139nm line not only during the decrease of magnetic flux (→ small flux cancellations?)

IRIS bombs (Si IV)

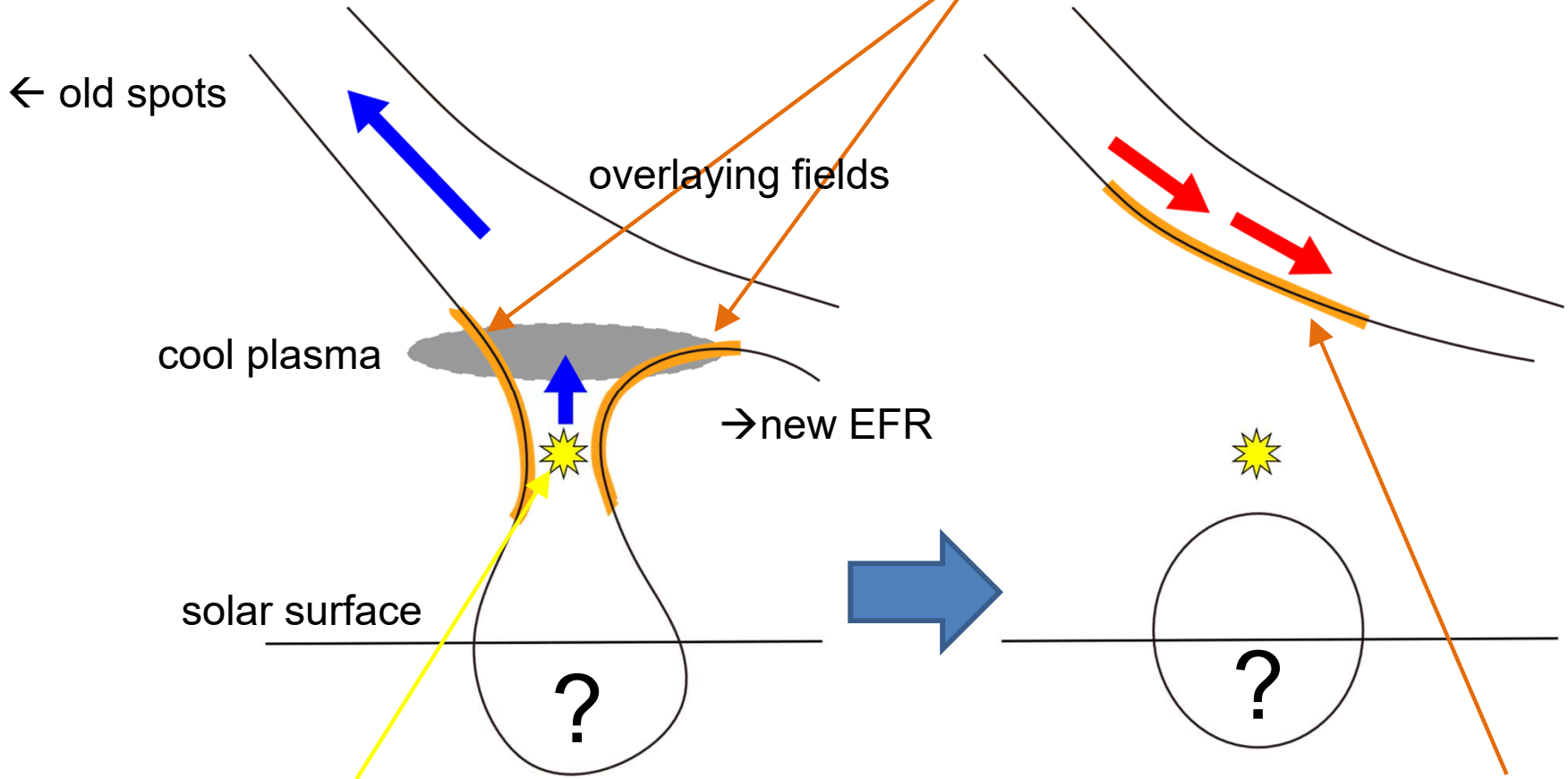


Blue shifted Si IV profile with an absorption line implies cool material on the top of hot material. → IRIS bombs (UV bursts)

Summary

Repeated transition from blue shift to red shift in Mg II k & Ca II.
→ Recurrent ejections of cool plasma (jets) & falling back due to gravity.

Downward convex dark threads from the two sides.
→ U-shaped magnetic configuration



Blue-shifted Si IV profile with Ni II absorption
→ Chromospheric or photospheric magnetic reconnection（Ellerman bomb, IRIS bomb）

Dark threads and dark loops overlaying the PIL
→ Reconnected loop