

Rosseland  
Centre  
for Solar  
Physics

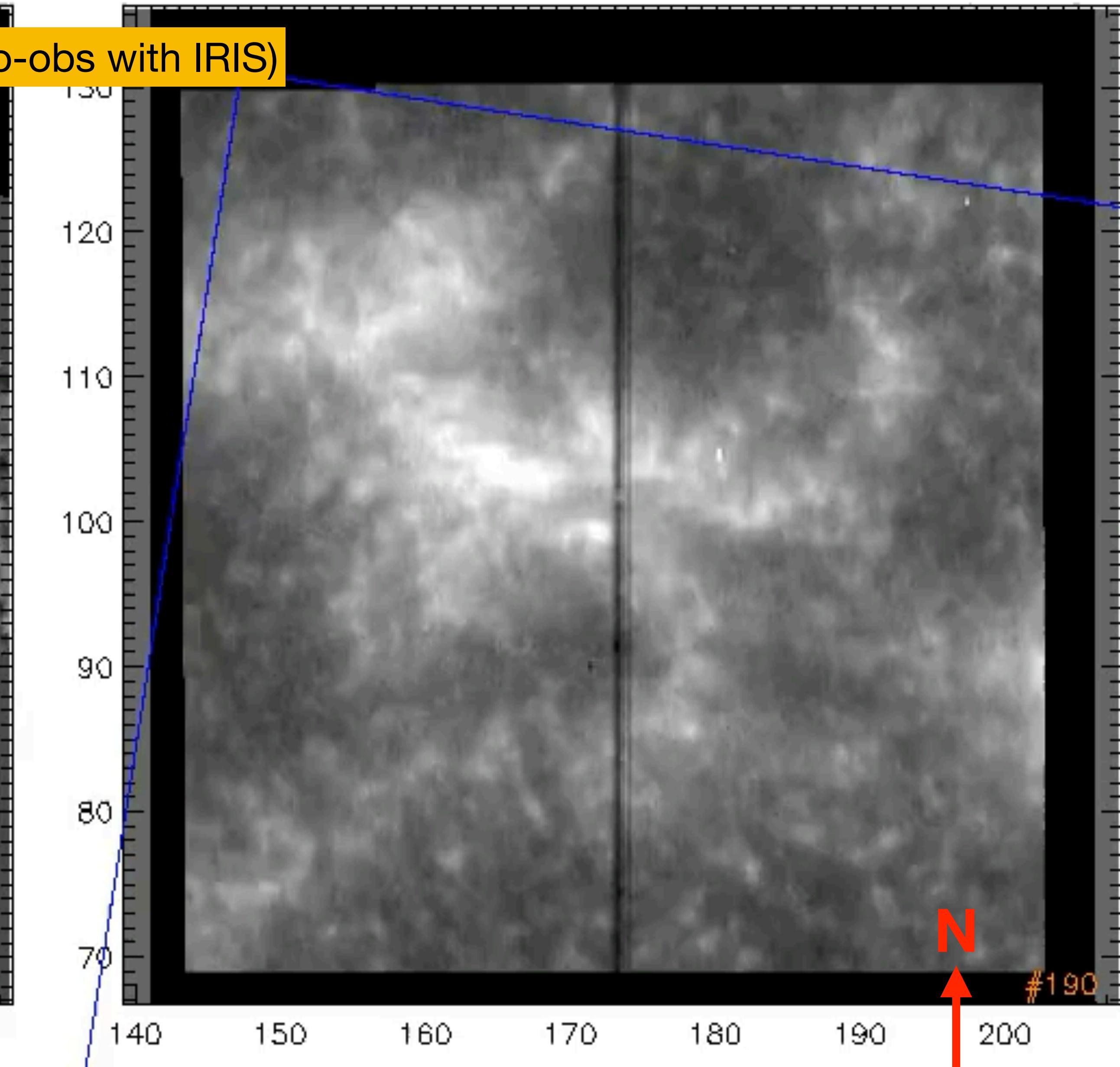
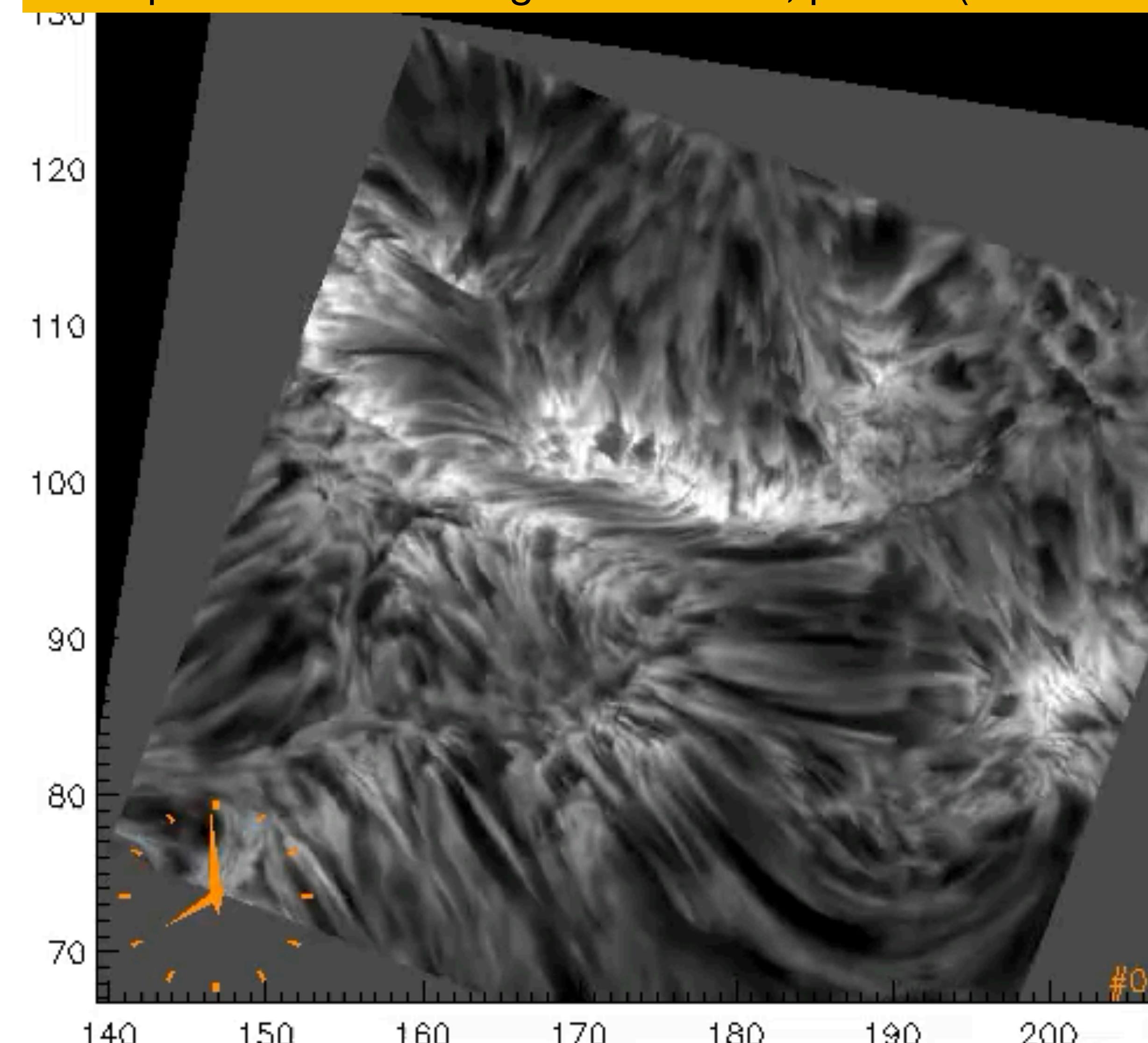
# High-resolution observations of chromospheric dynamics

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Rosseland Centre for Solar Physics, Univ Oslo  
RoCMI workshop, Svalbard, 27 Feb 2023

SST/CRISP H-alpha line core

IRIS SJI 2796 (Mg II k)

04-Sep-2019 : Active Region AR12748,  $\mu=0.98$  (03:38 h co-obs with IRIS)

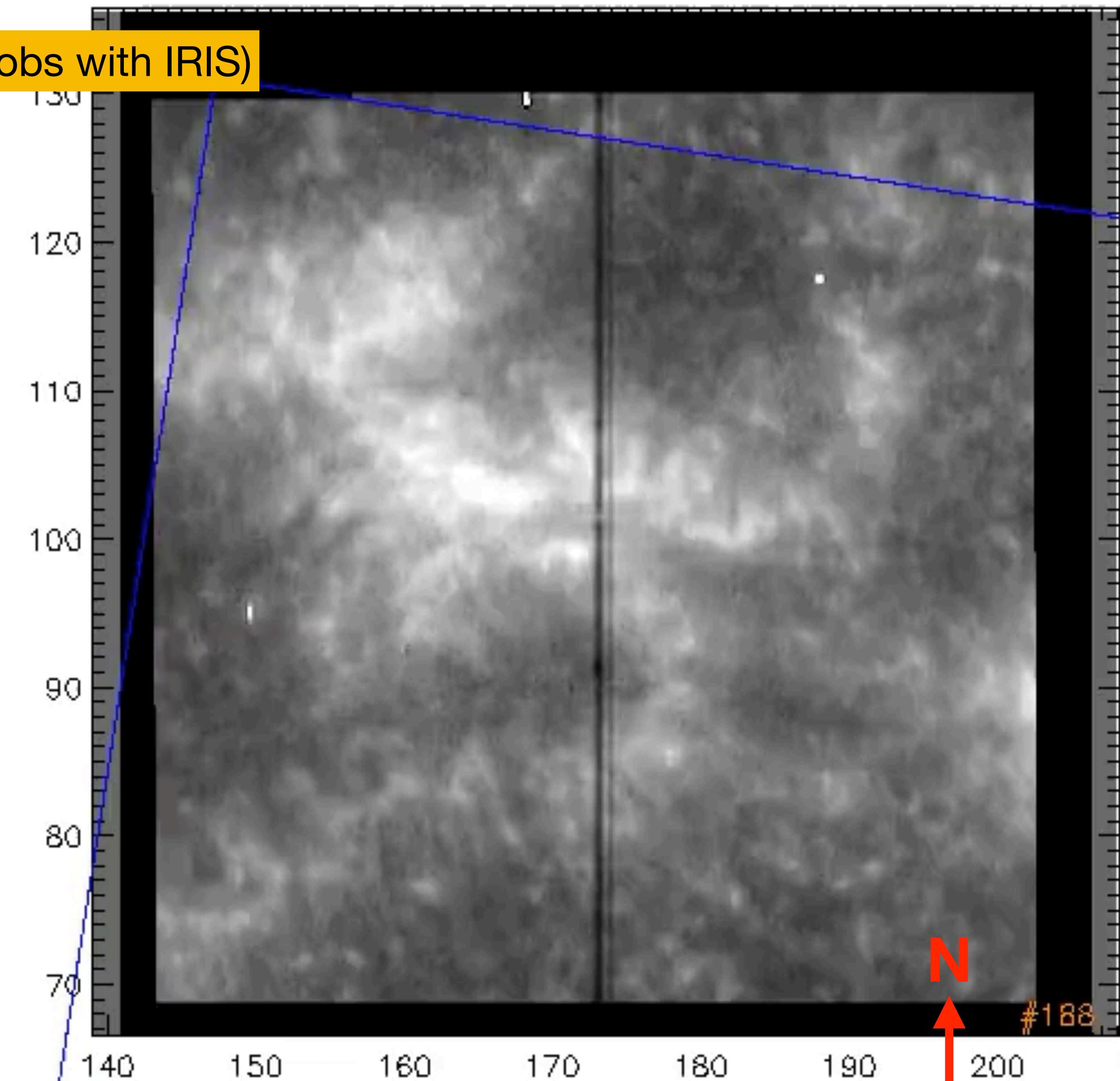
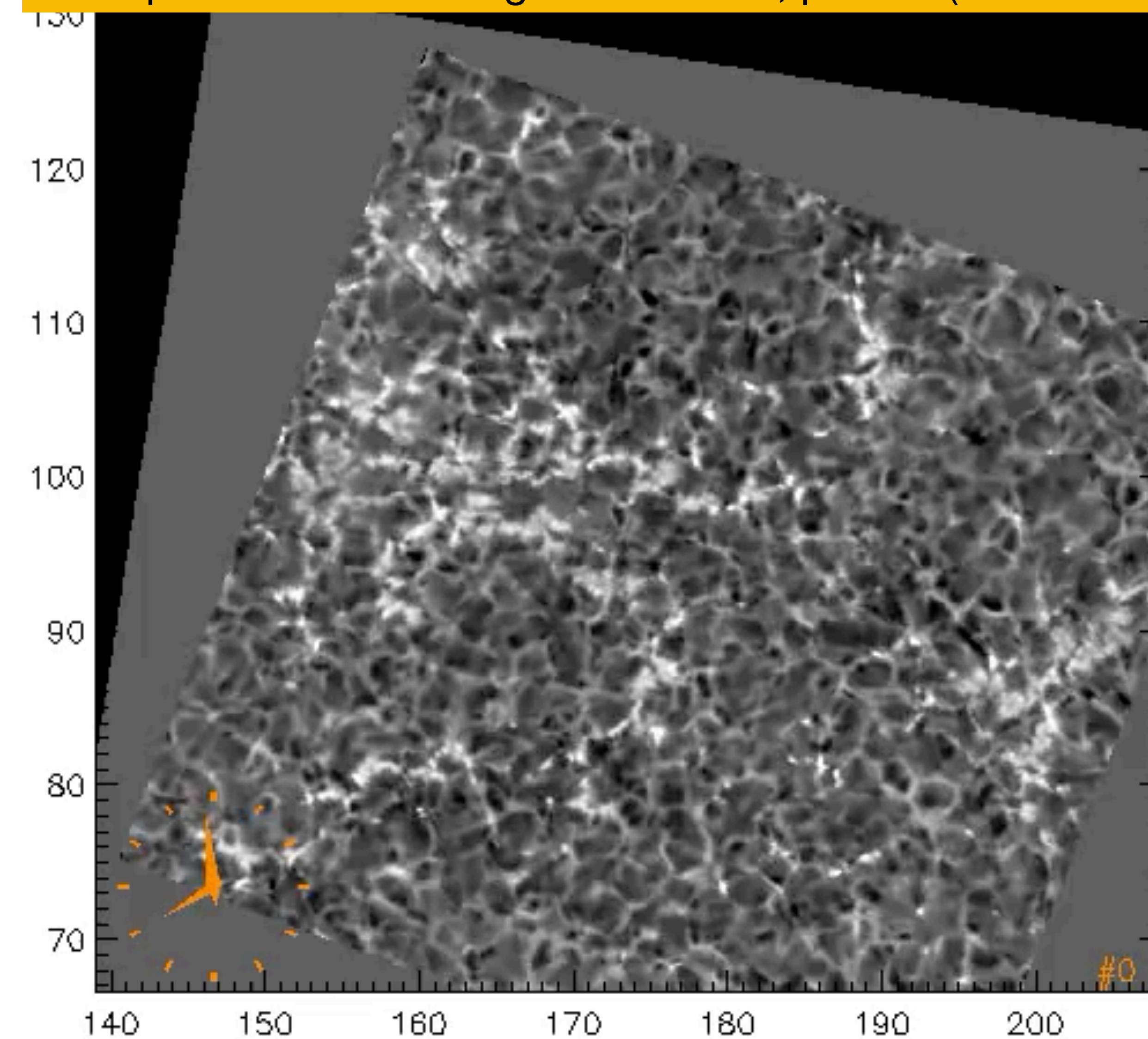


16-step dense raster, exposure time 1 s

SST/CRISP Ca II 8542Å -24 km/s

IRIS SJI 2796 (Mg II k)

04-Sep-2019 : Active Region AR12748,  $\mu=0.98$  (03:38 h co-obs with IRIS)

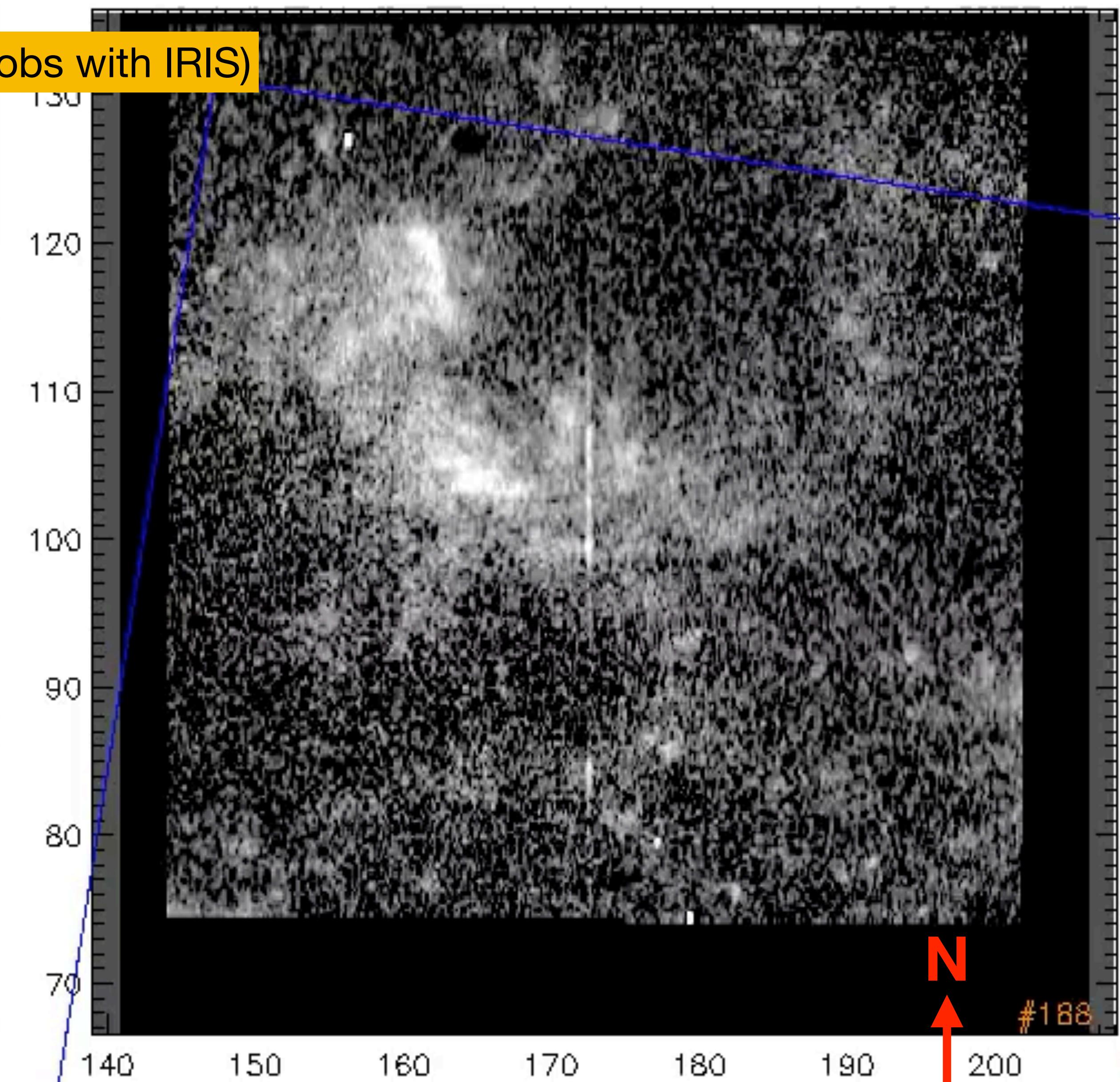
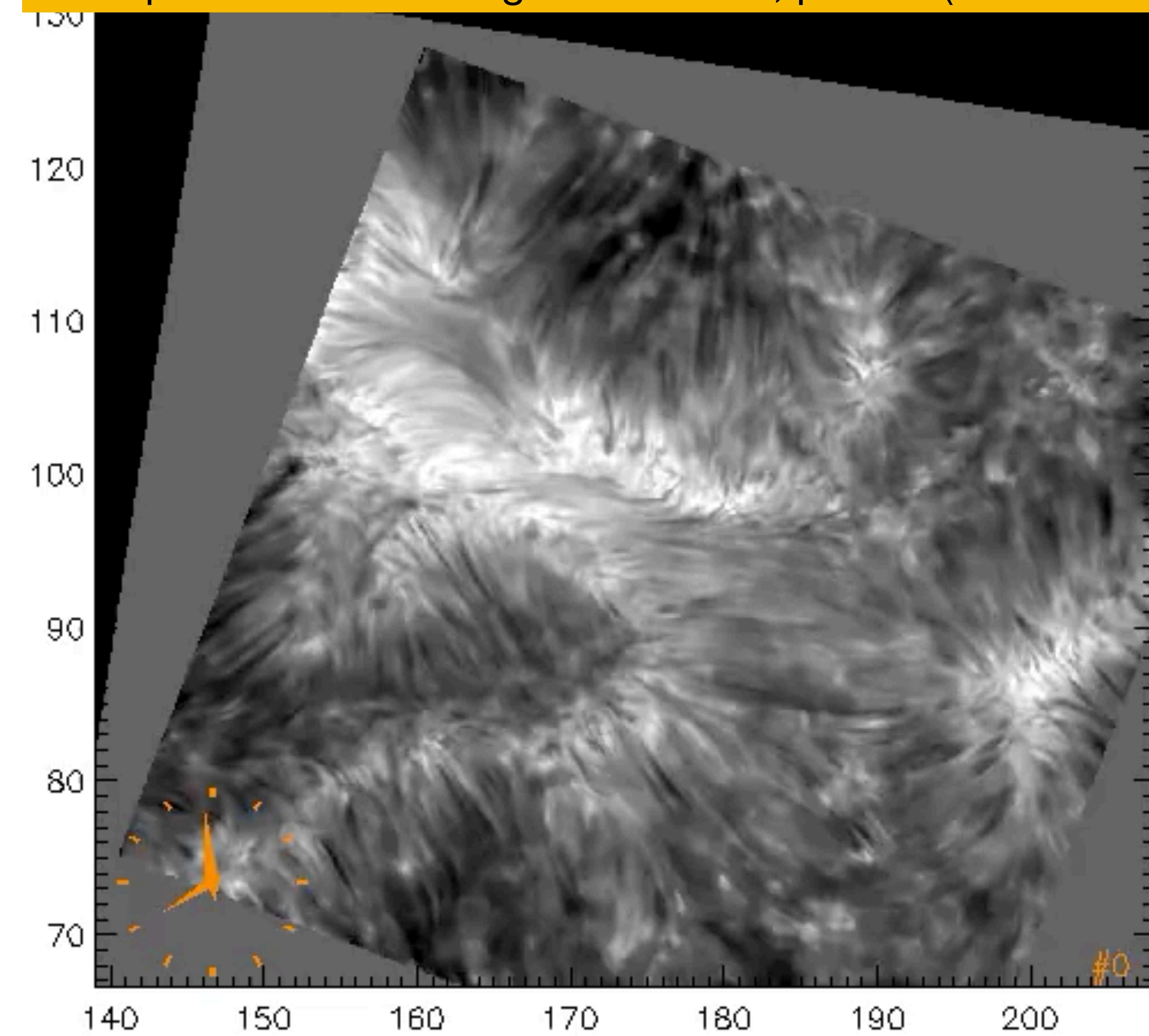


16-step dense raster, exposure time 1 s

SST/CRISP Ca II 8542Å +3 km/s

IRIS SJI 1400 (Si IV)

04-Sep-2019 : Active Region AR12748,  $\mu=0.98$  (03:38 h co-obs with IRIS)



16-step dense raster, exposure time 1 s

H-alpha line core

Fe I 6173  $|B_{\text{LOS}}| < 750 \text{ G}$  (Milne-Eddington inversion)

04-Sep-2019 : Active Region AR12748,  $\mu=0.98$  (03:38 h co-obs with IRIS)

y [arcsec]

20

0

-20

-30 -20 -10 0 10 20 30

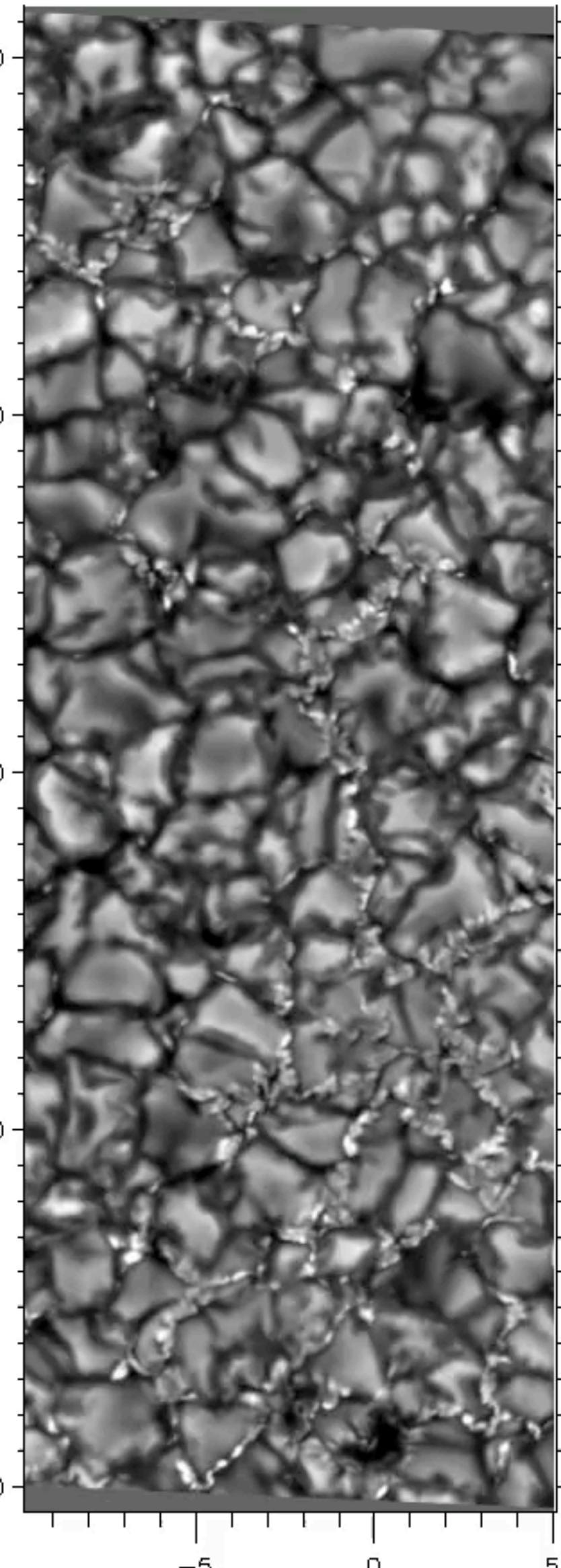
-30 -20 -10 0 10 20 30

SST/CRISP 2019.09.04 07:58:46, t= 0 07:59:19.989

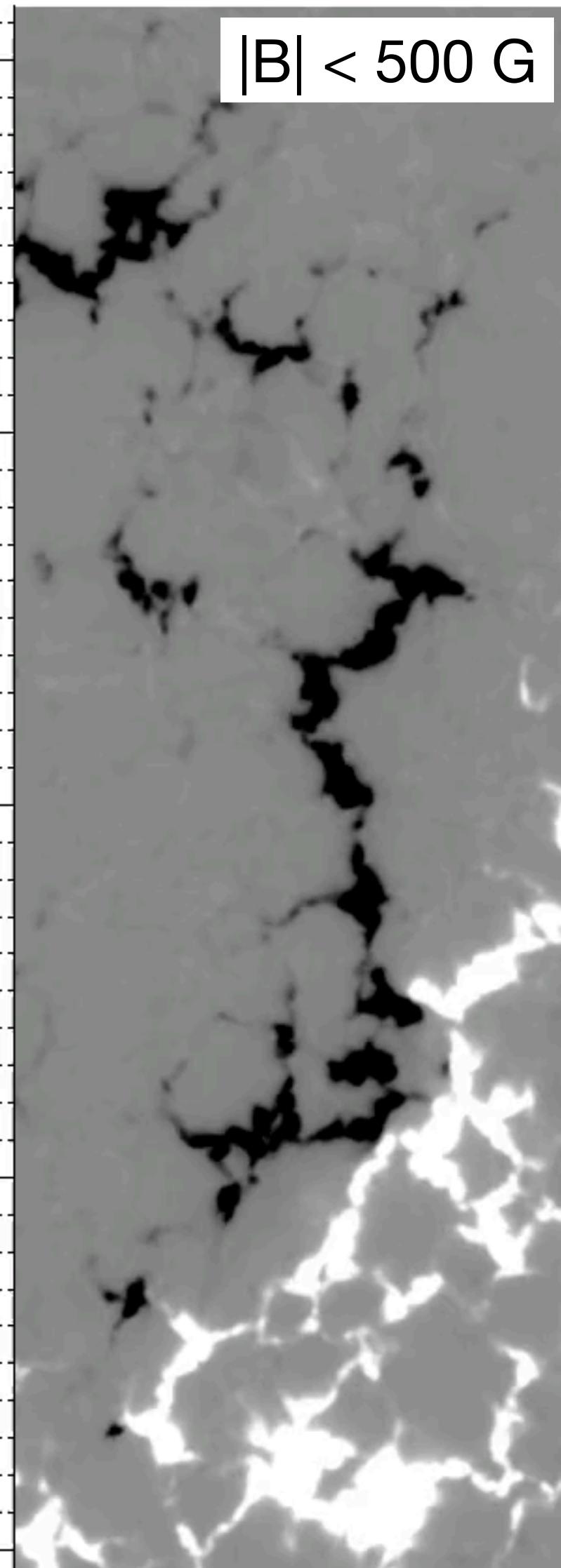
CRISP: Fe I 6173 pol + Ca II 8542 pol + H-alpha, 36 s cadence

N

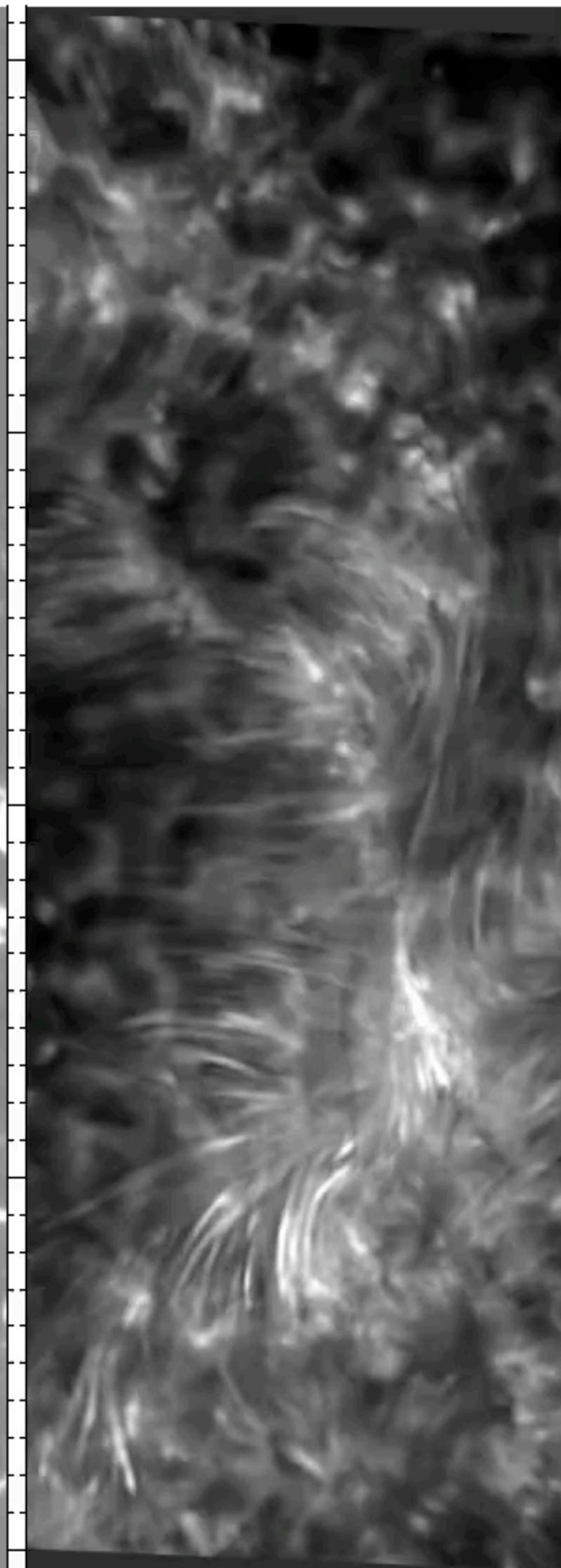
CHROMIS 11 s  
WB 3950



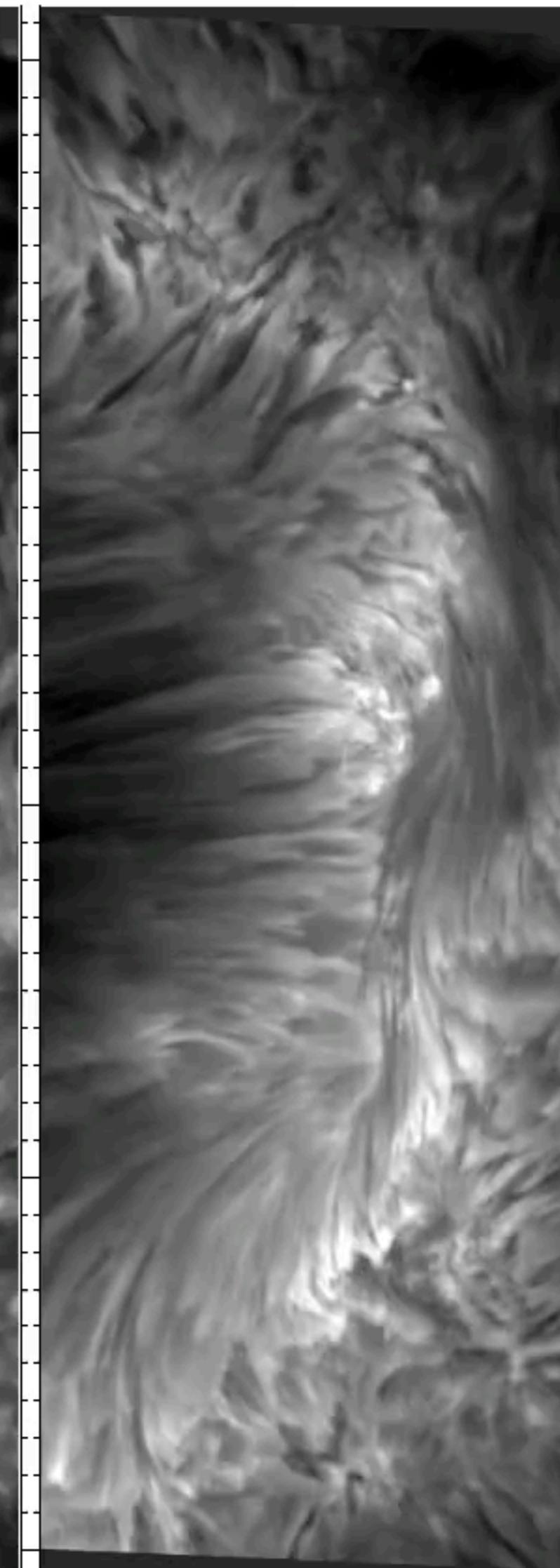
CRISP 36 s  
Fe 6173 B\_LOS



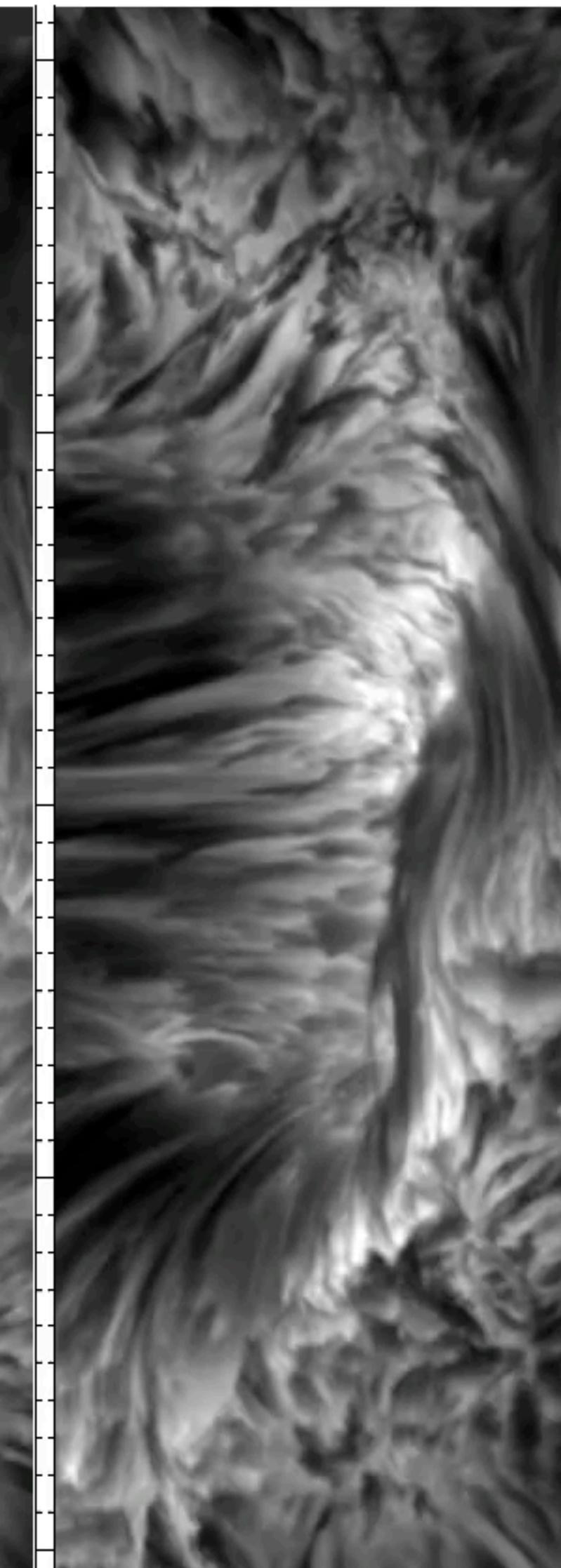
CHROMIS 11 s  
Ca II K -25 km/s



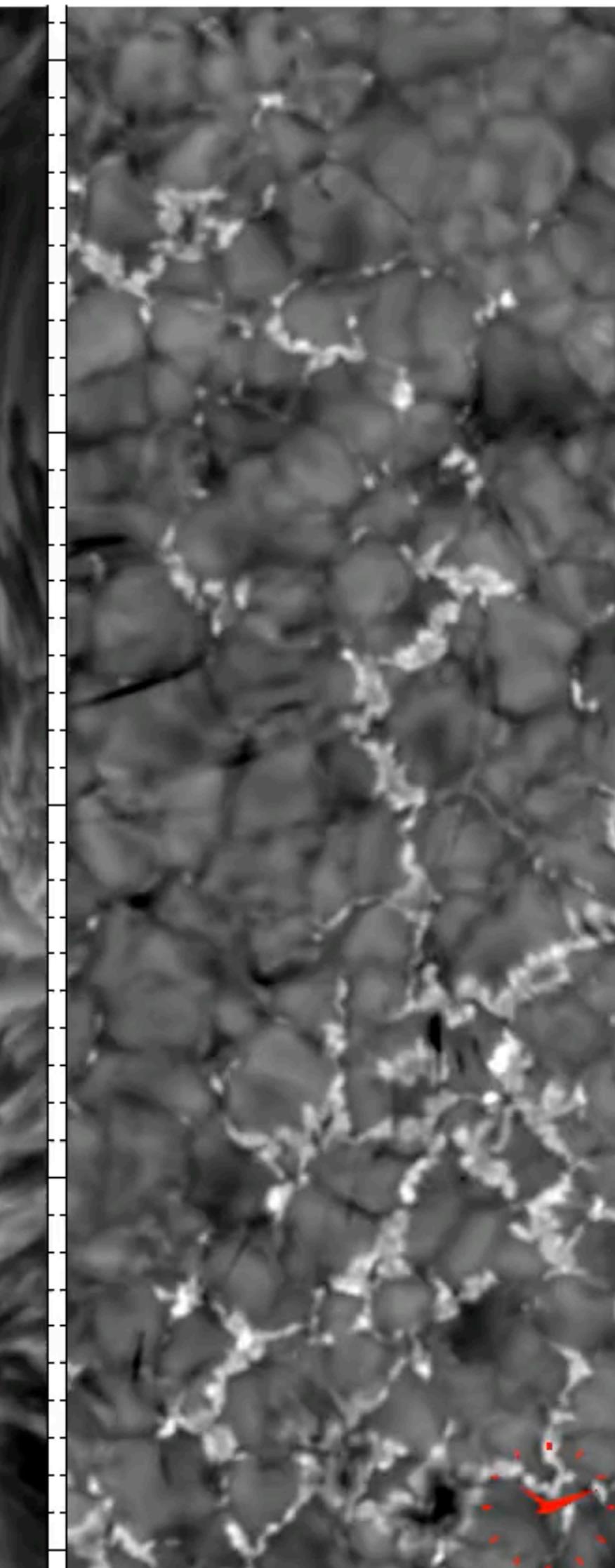
CHROMIS 11 s  
Ca II K core



CRISP 36 s  
H-alpha core



CRISP 36 s  
H-alpha -55 km/s

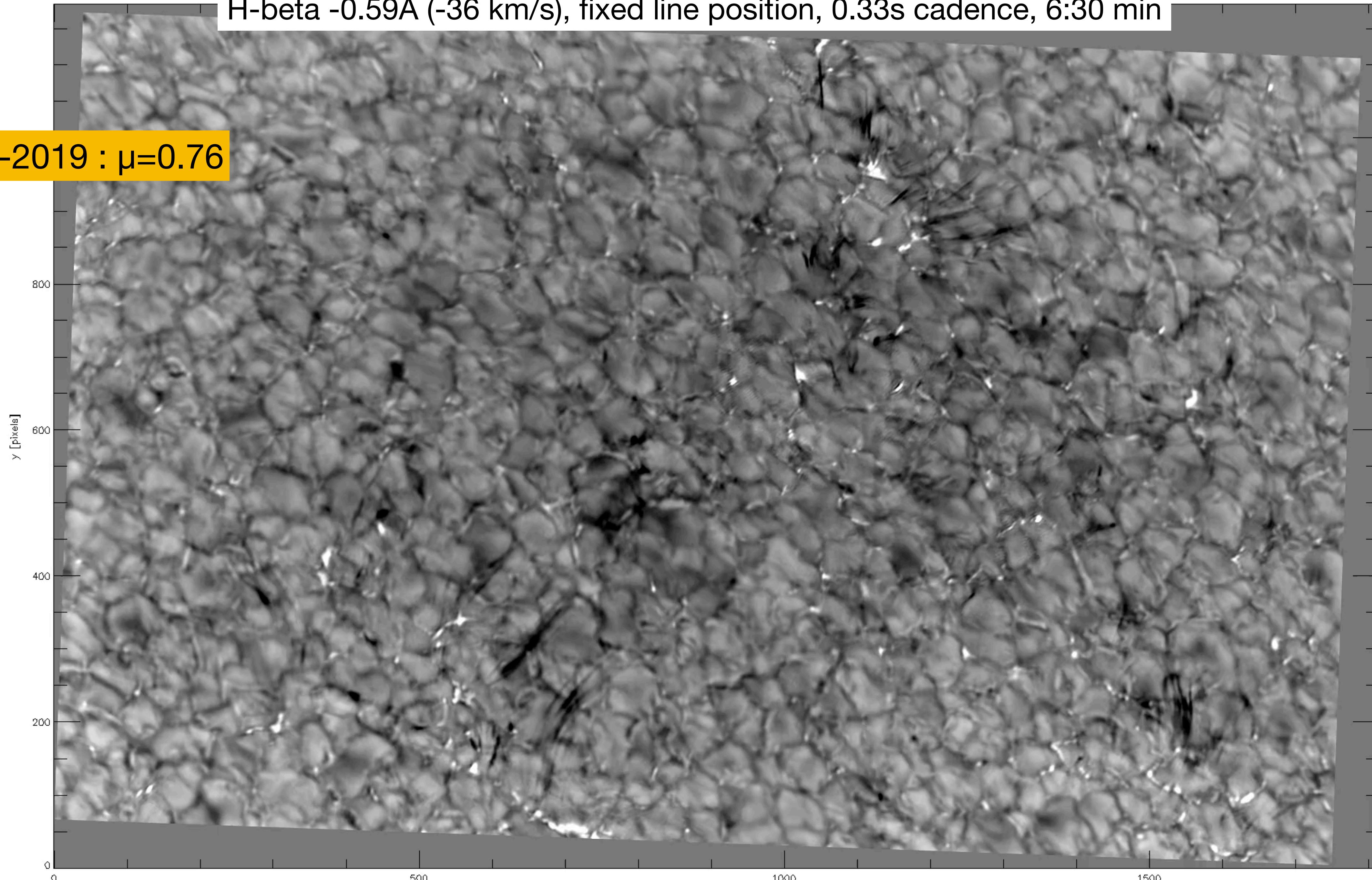


2019-09-04 10:11:31, t= 0 10:11:37.313

N

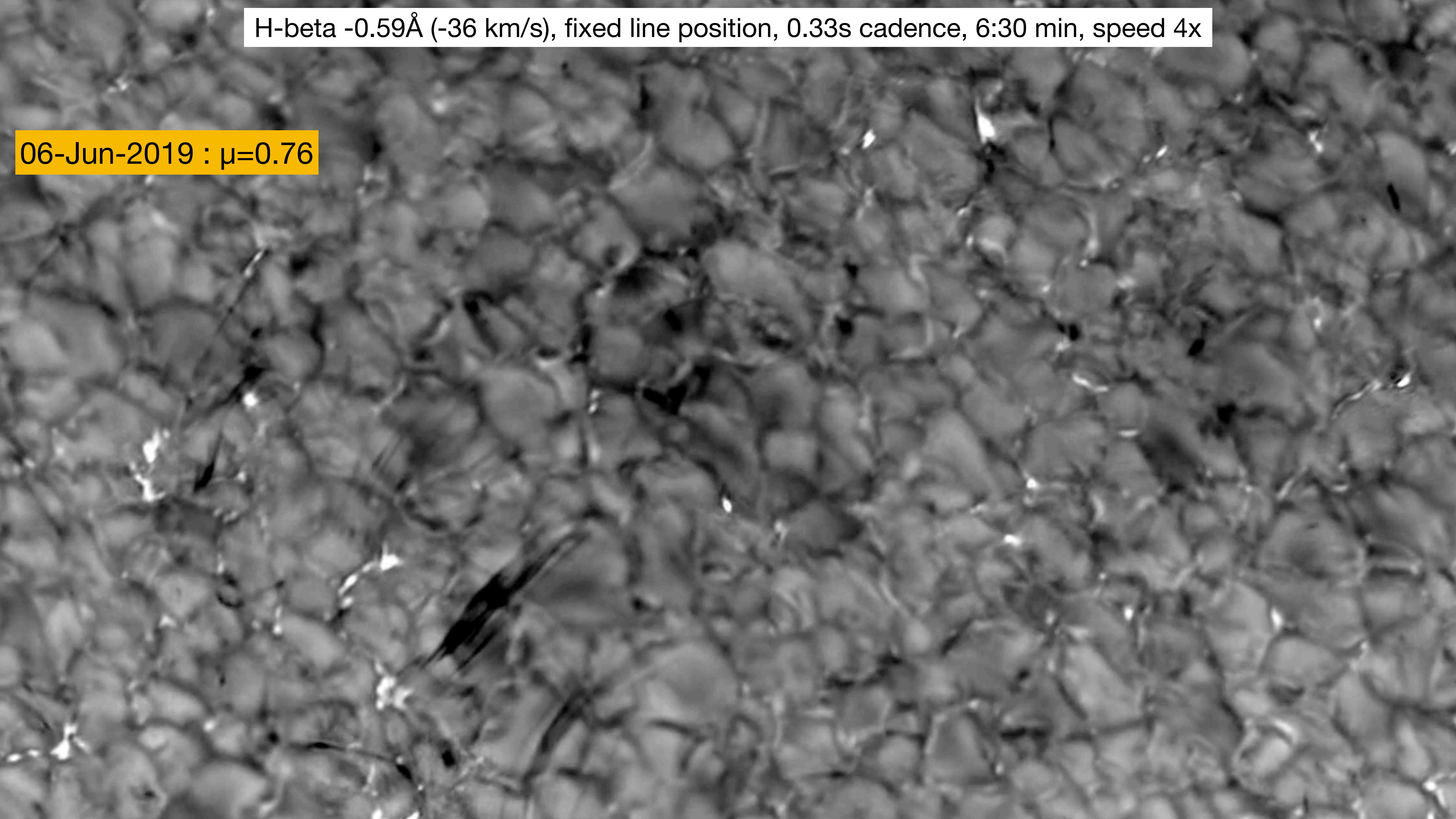
H-beta -0.59Å (-36 km/s), fixed line position, 0.33s cadence, 6:30 min

06-Jun-2019 :  $\mu=0.76$

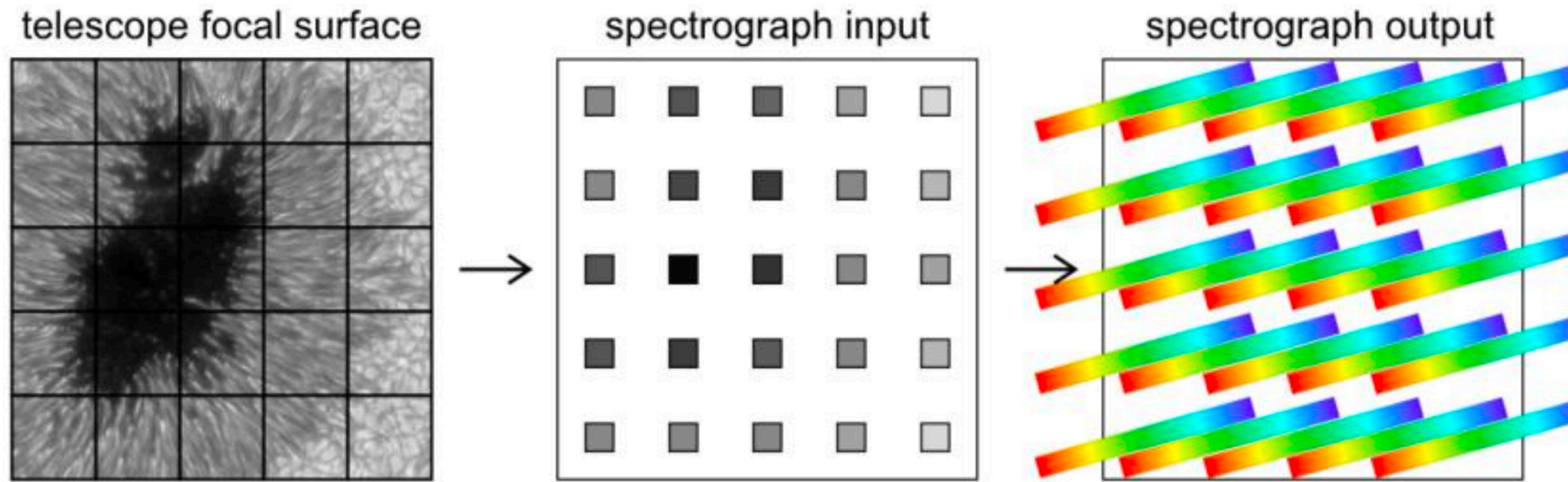


H-beta -0.59Å (-36 km/s), fixed line position, 0.33s cadence, 6:30 min, speed 4x

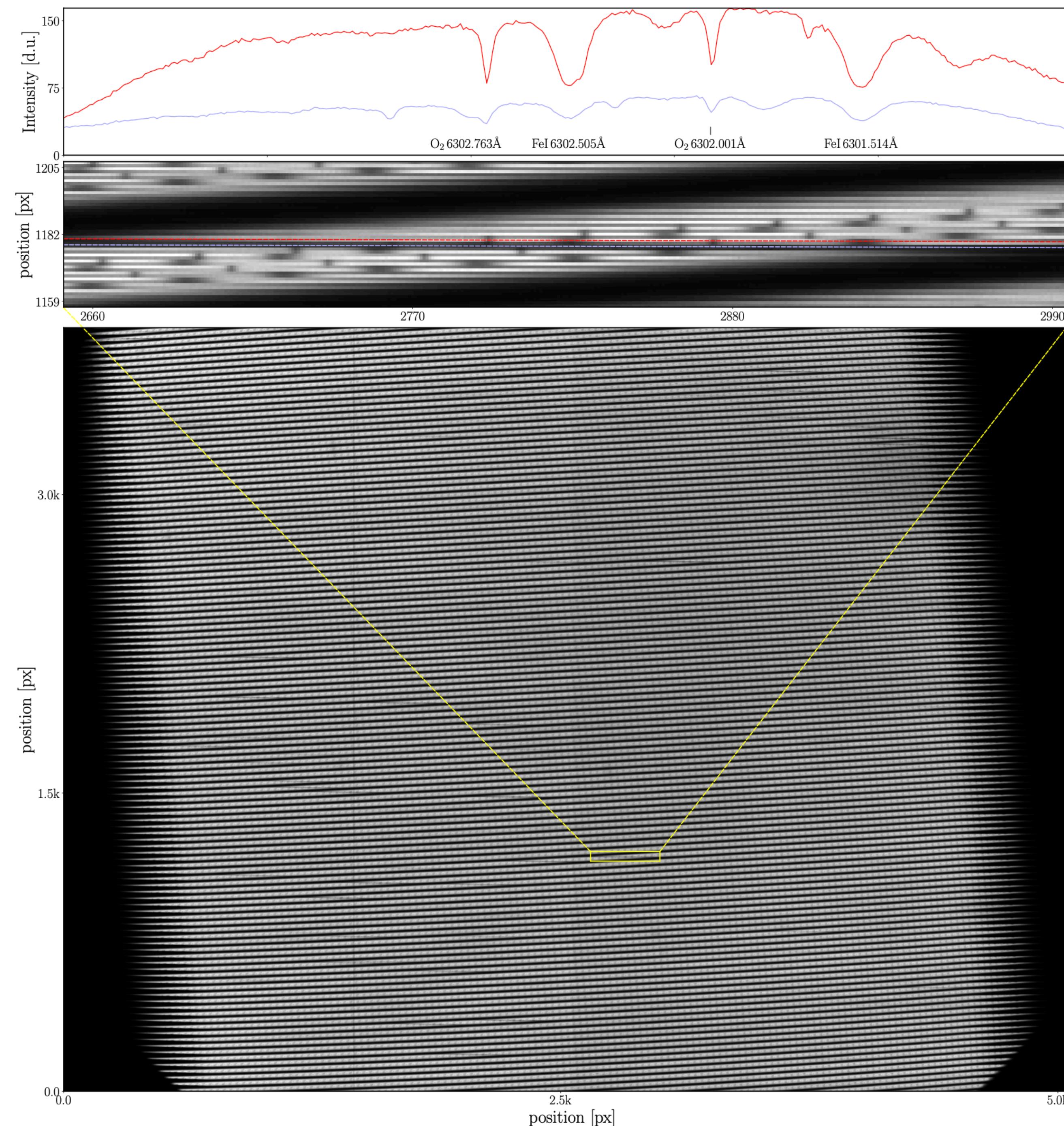
06-Jun-2019 :  $\mu=0.76$



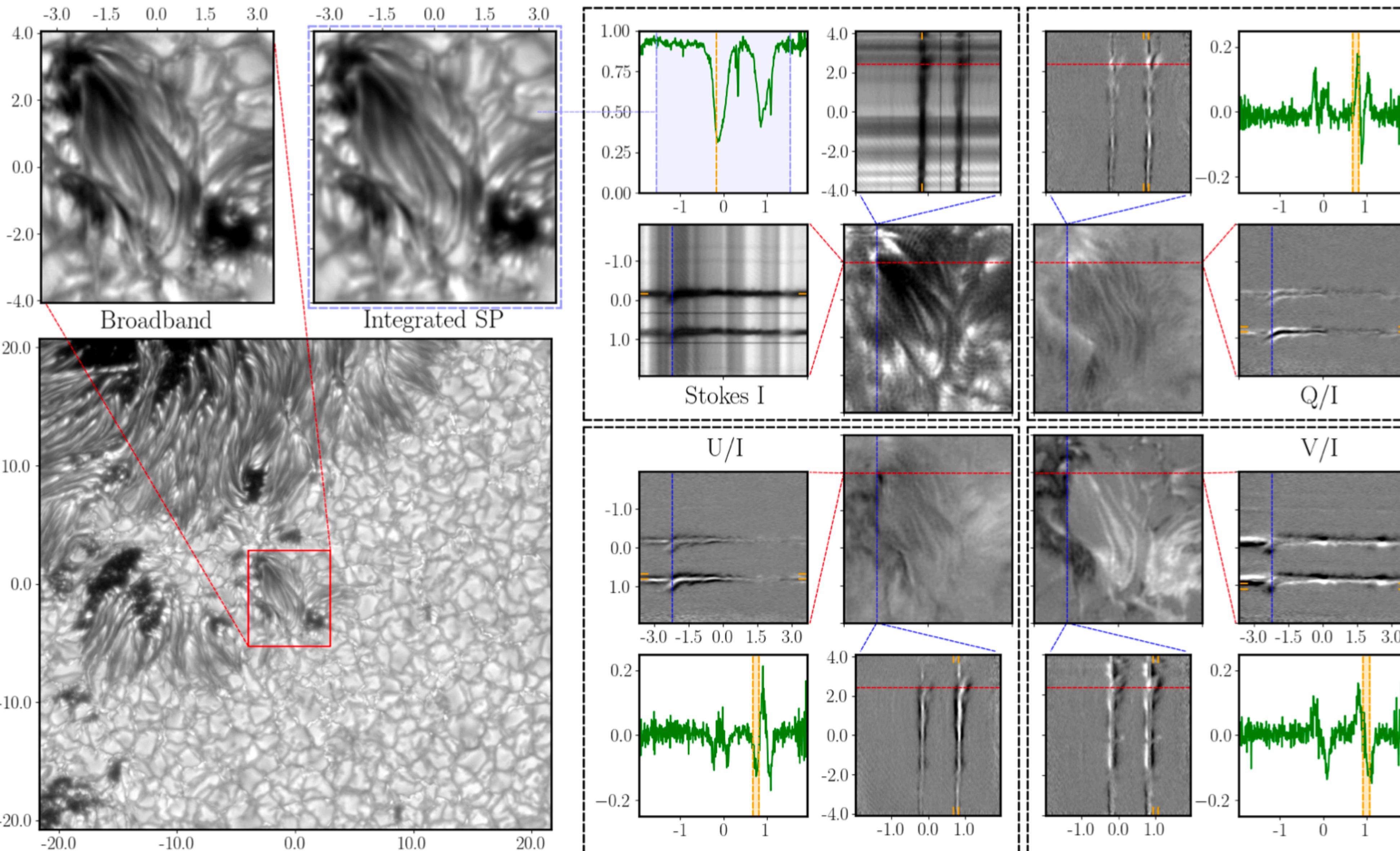
# Integral Field Spectrograph Micro-lensed Hyperspectral Imager (MiHI)



# Fe I 6301 & 6302 Å

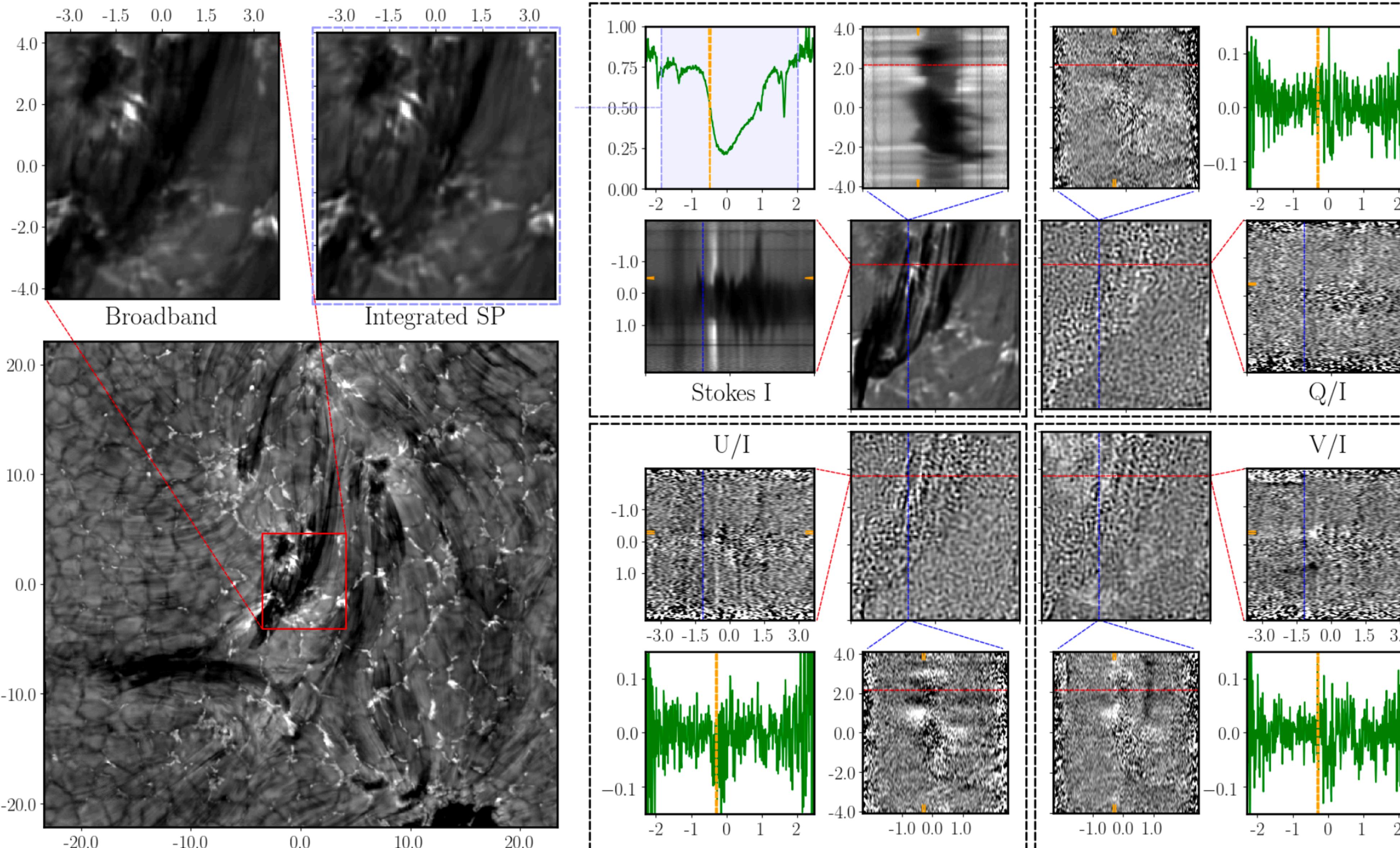


# Micro-lensed Hyperspectral Imager (MiHI)



**Fe I 6301 & 6302 Å**  
128 x 115 image elements  
7.9" x 7.1"  
0.062" per pixel  
4.5Å over 450 pixels  
 $R \approx 315,000$   
Polarimetry V/I 0.01  
10 s cadence  
MFBD wavefront sensing

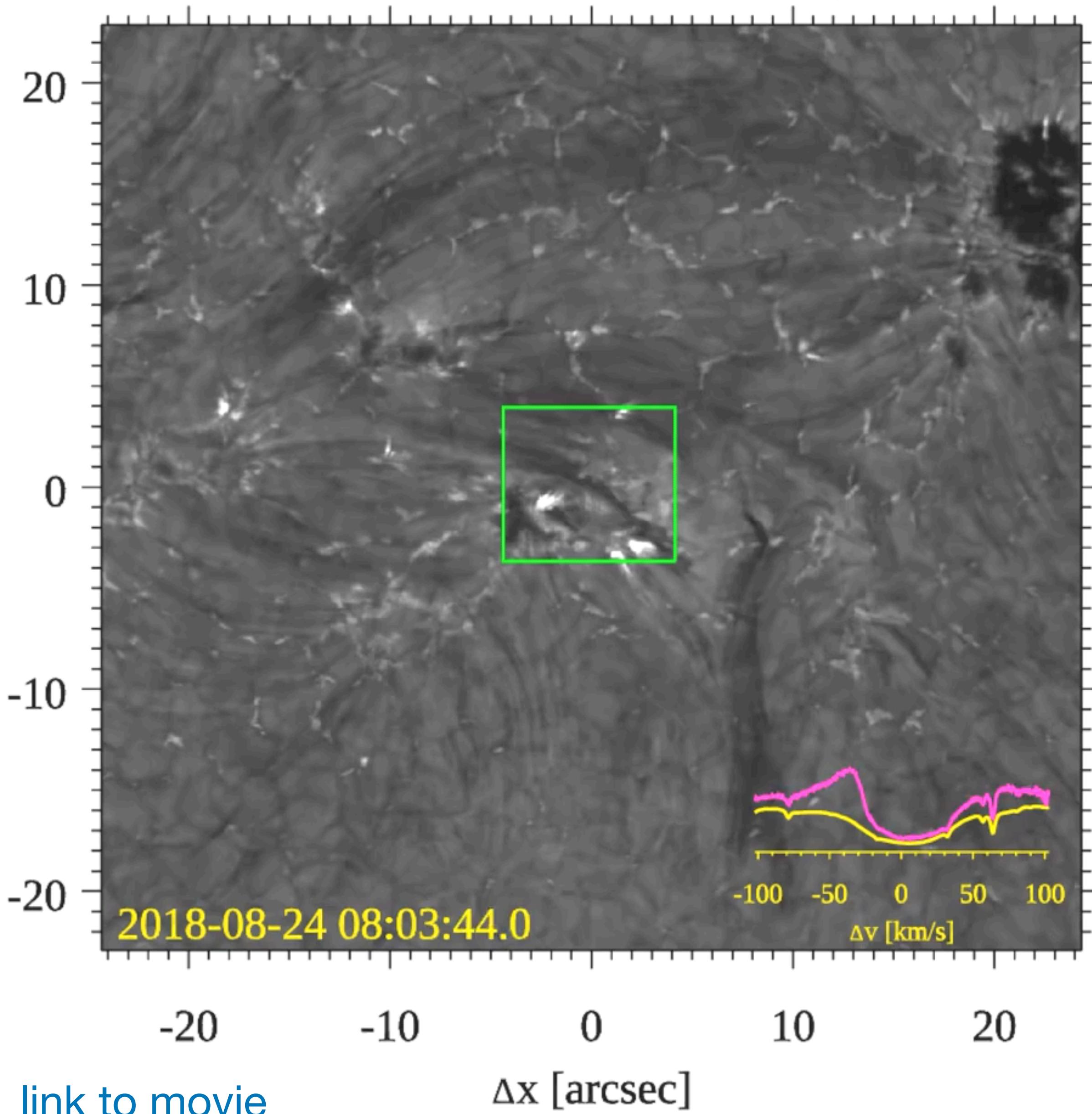
# Micro-lensed Hyperspectral Imager (MiHI)



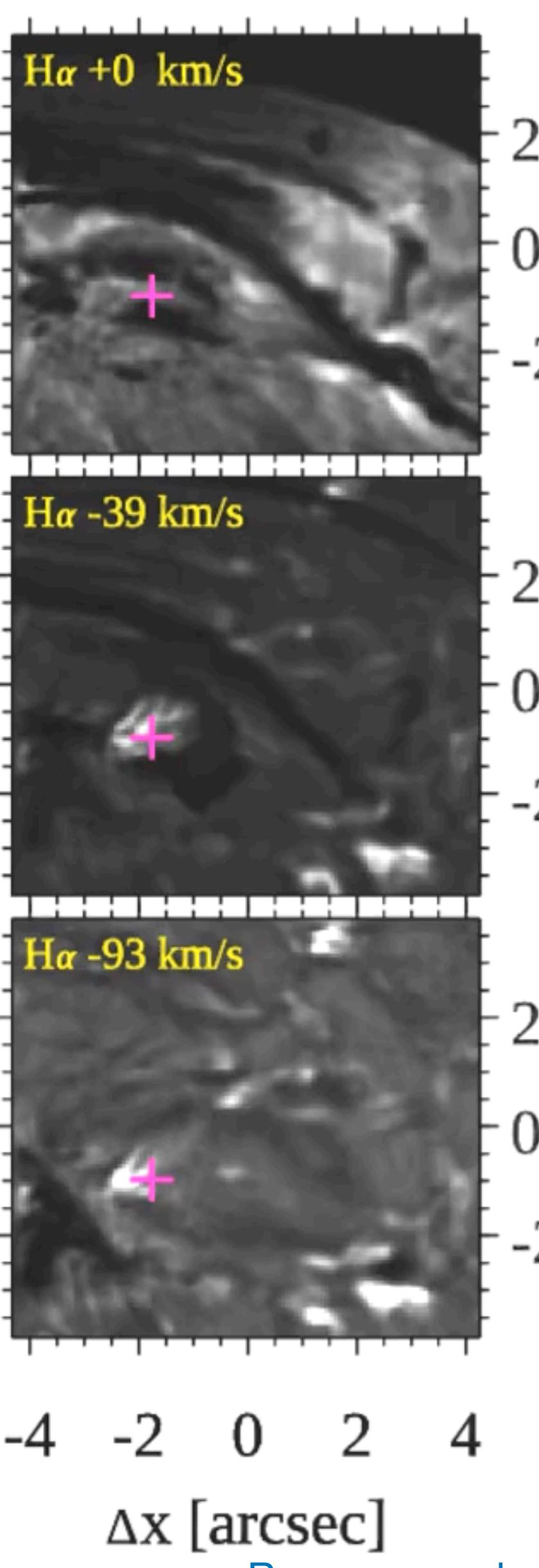
H-alpha 6563 Å  
24-Aug-2018

# Micro-lensed Hyperspectral Imager (MiHI)

SST / Context H $\alpha$  wideband



SST / MiHI



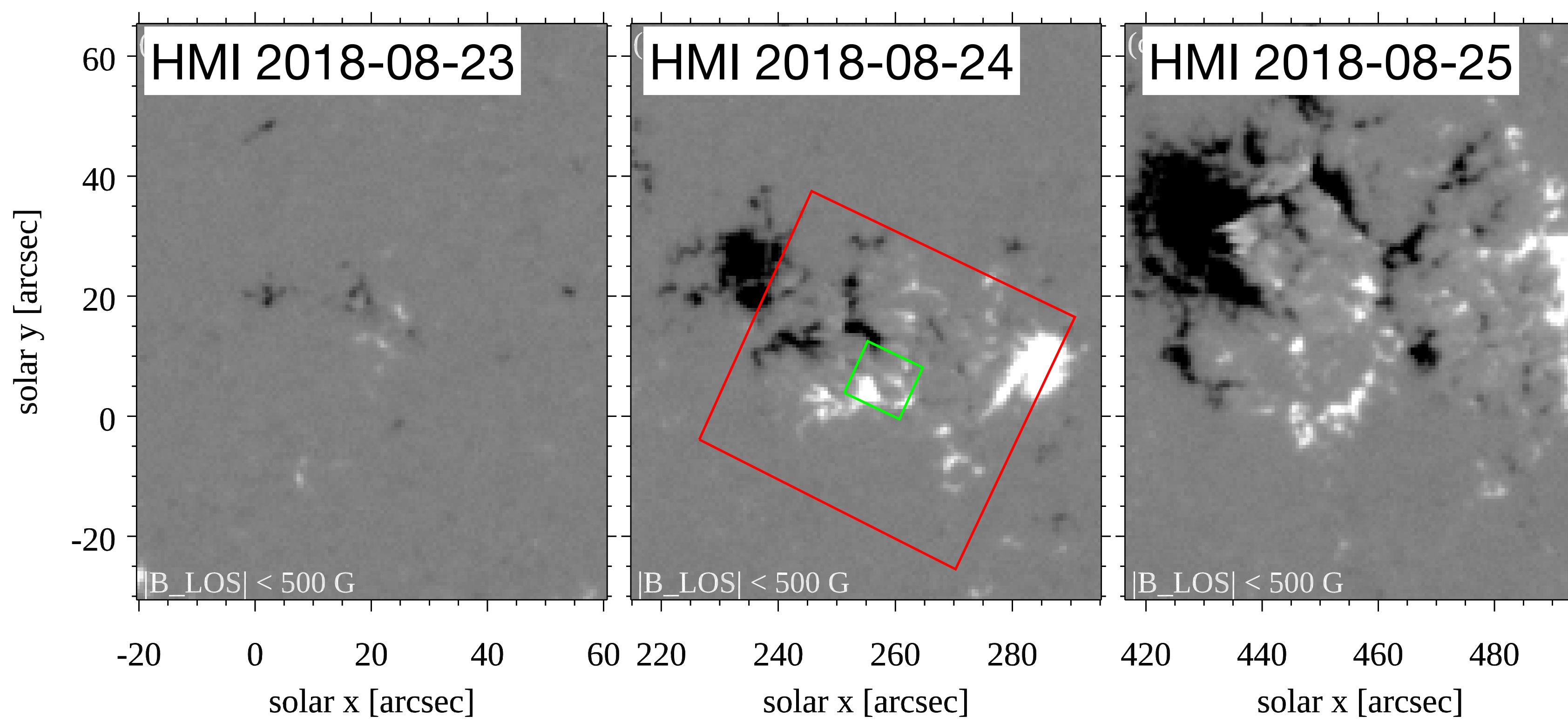
## H-alpha 6563 Å

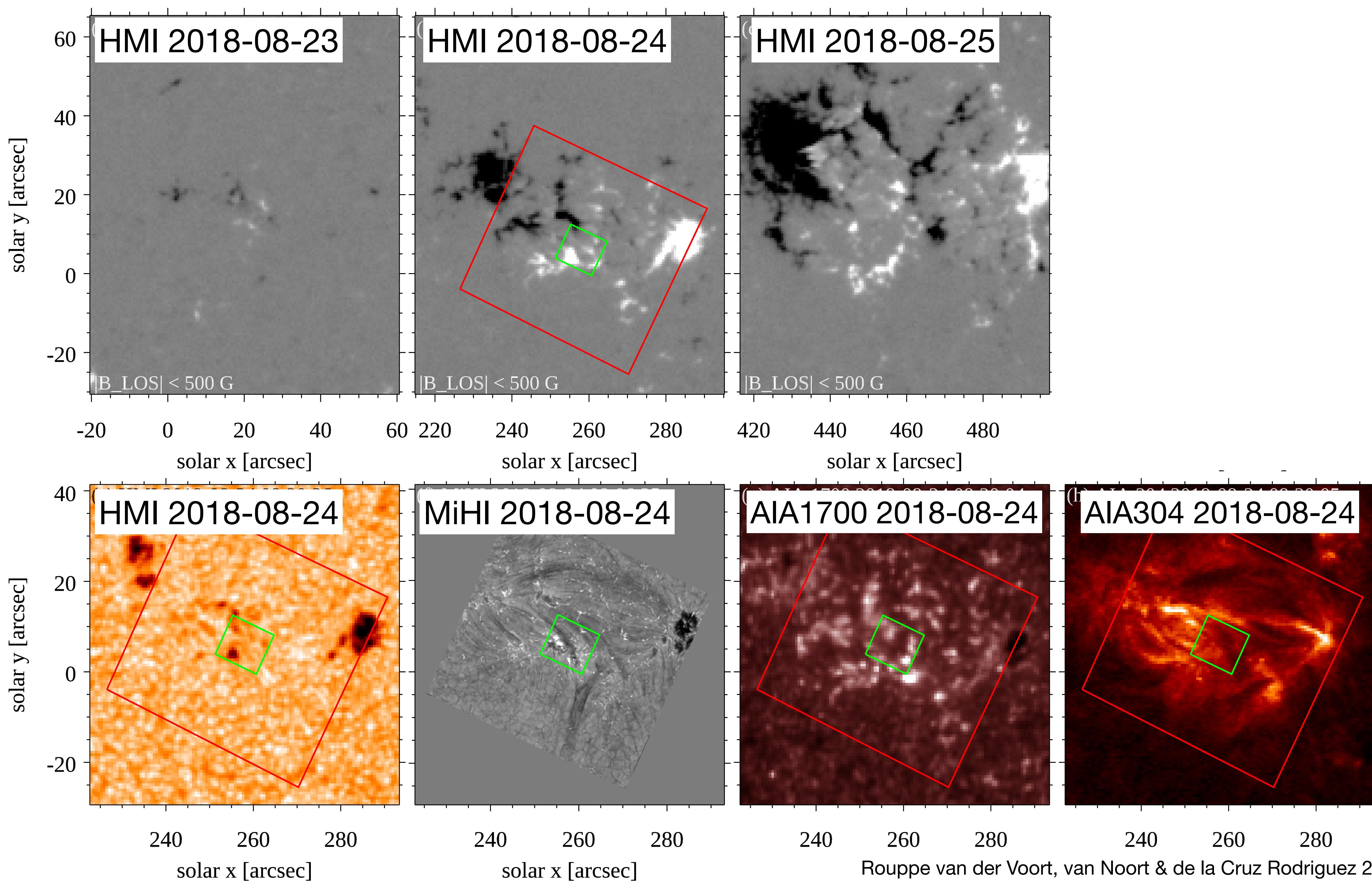
132 x 118 spatial pixels  
8.6" x 7.7"  
0.065"/pixel  
4.5 Å or  $\pm 102$  km/s  
0.45 km/s /pixel, 456 pixels  
1.33 s cadence  
40 exposures of 30 ms  
10 min duration  
132 x 118 x 456 x 455 hyper cube

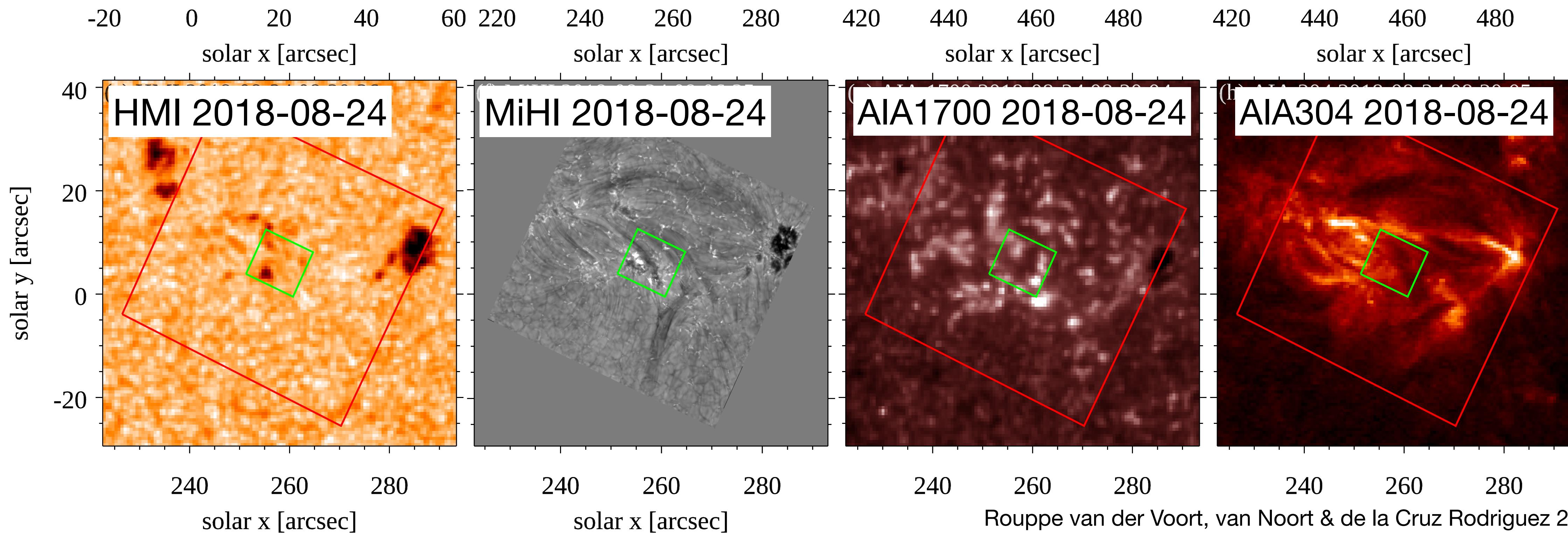
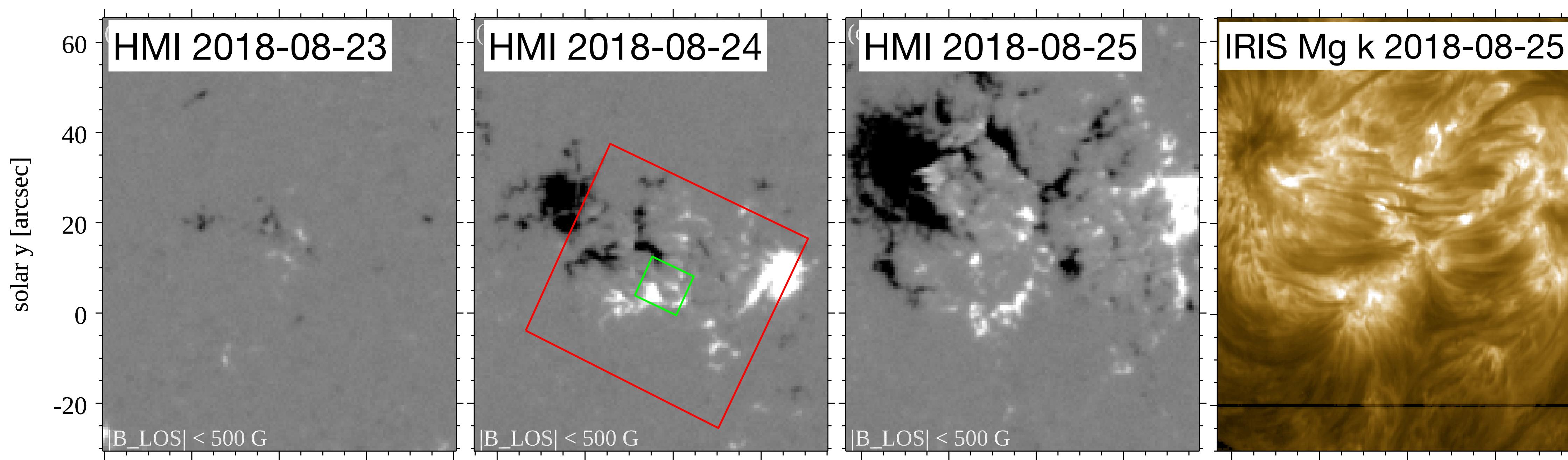
## Context imager:

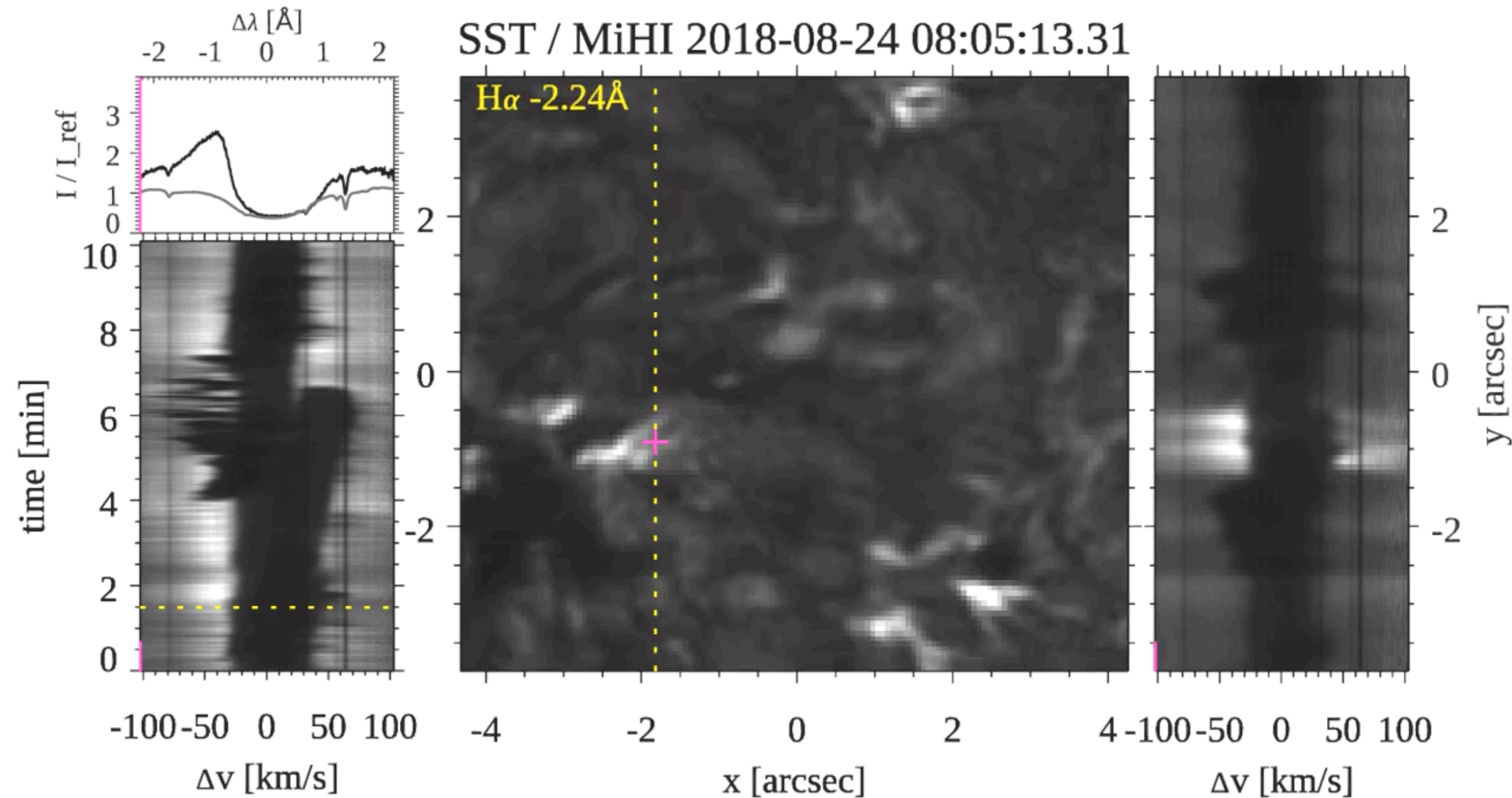
50" x 47"  
0.054" /pixel  
Filter  $\lambda=6563\text{\AA}$  FWHM=4Å  
1.5 ms exposure, 600 Hz  
20 exposures per MiHI exp

[link to movie](#)





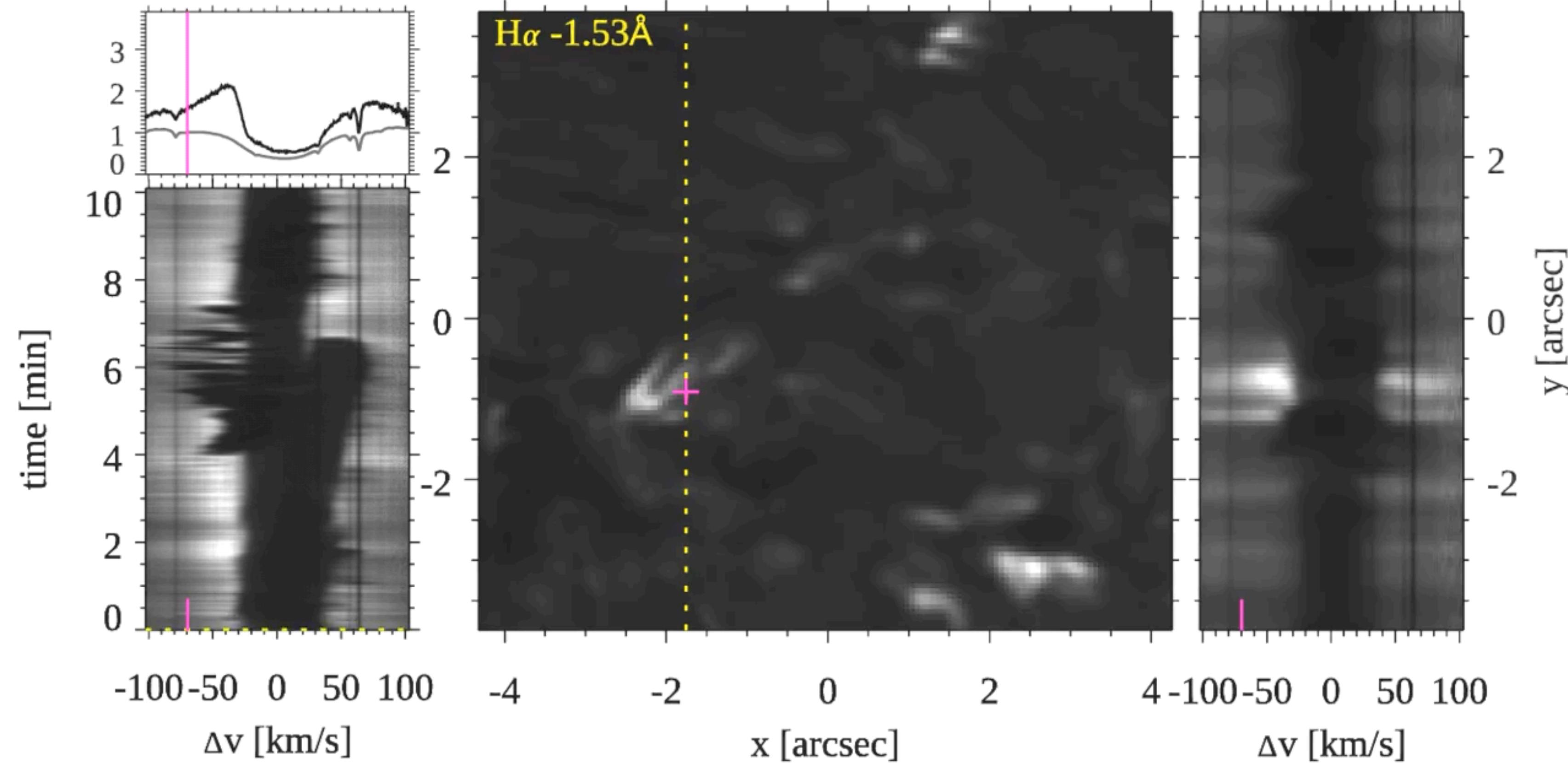




**H-alpha 6563 Å**  
8.6" x 7.7"  
4.5 Å or  $\pm 102 \text{ km/s}$   
1.33 s cadence  
10 min duration

[link to movie](#)

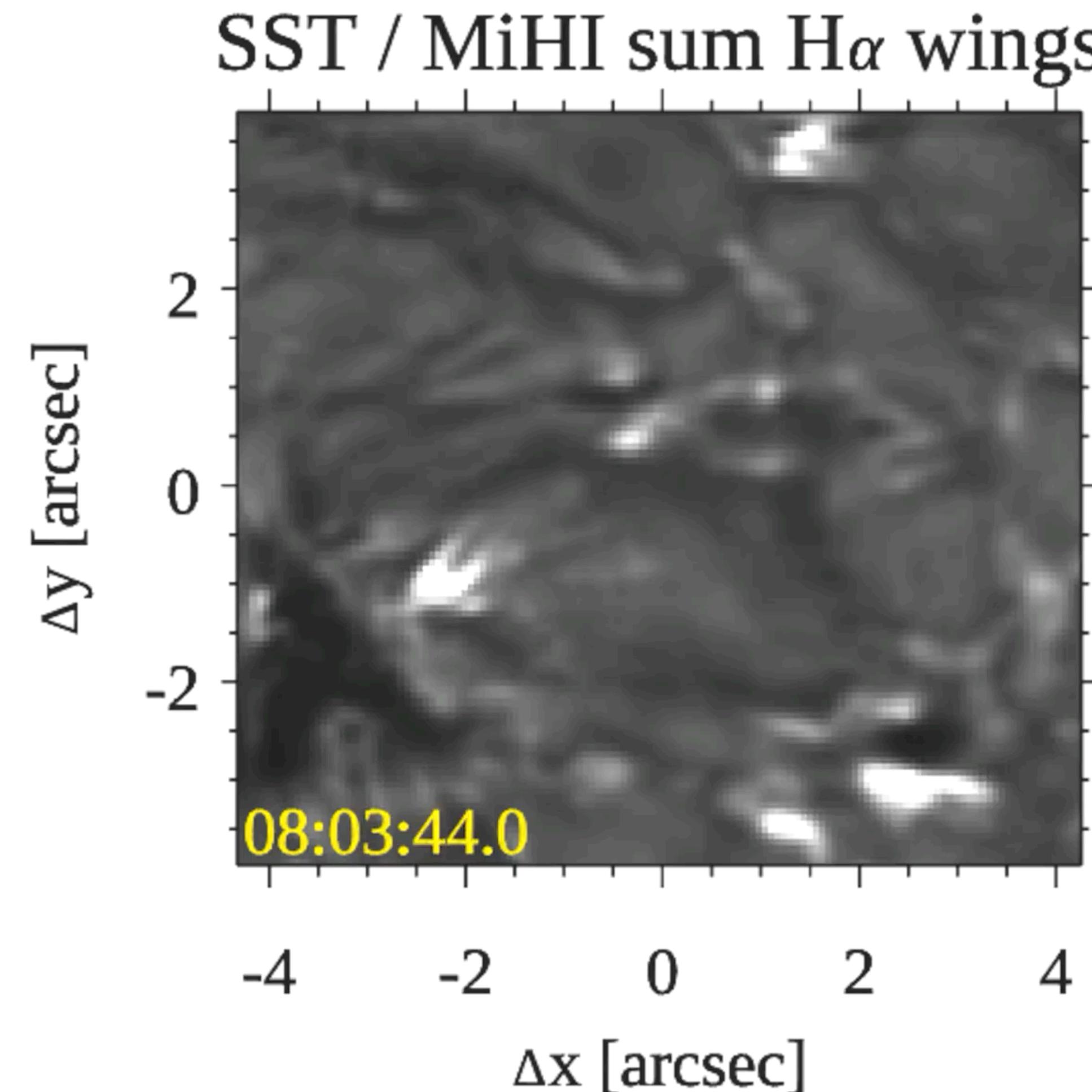
SST / MiHI 2018-08-24 08:03:44.00



**H-alpha 6563 Å**  
8.6" x 7.7"  
4.5 Å or  $\pm 102$  km/s  
1.33 s cadence  
10 min duration

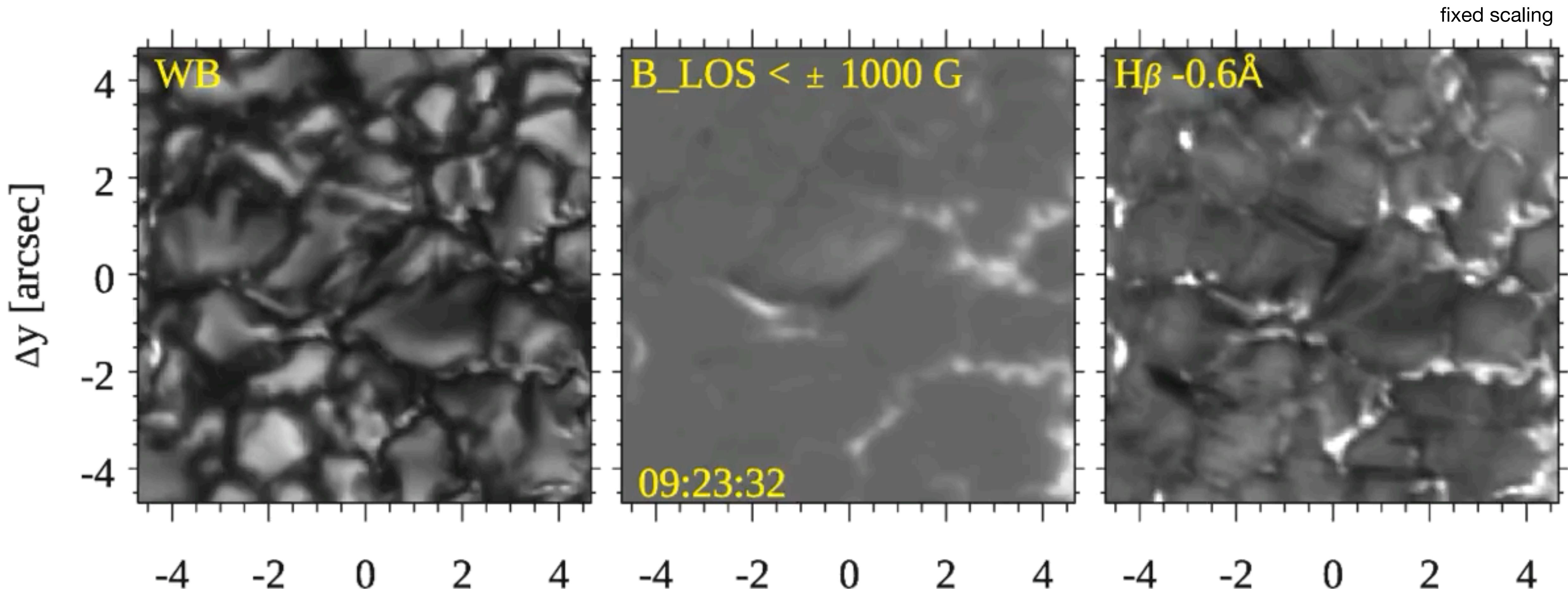
[link to movie](#)

# Flux emergence: elongated granules and Ellerman bombs



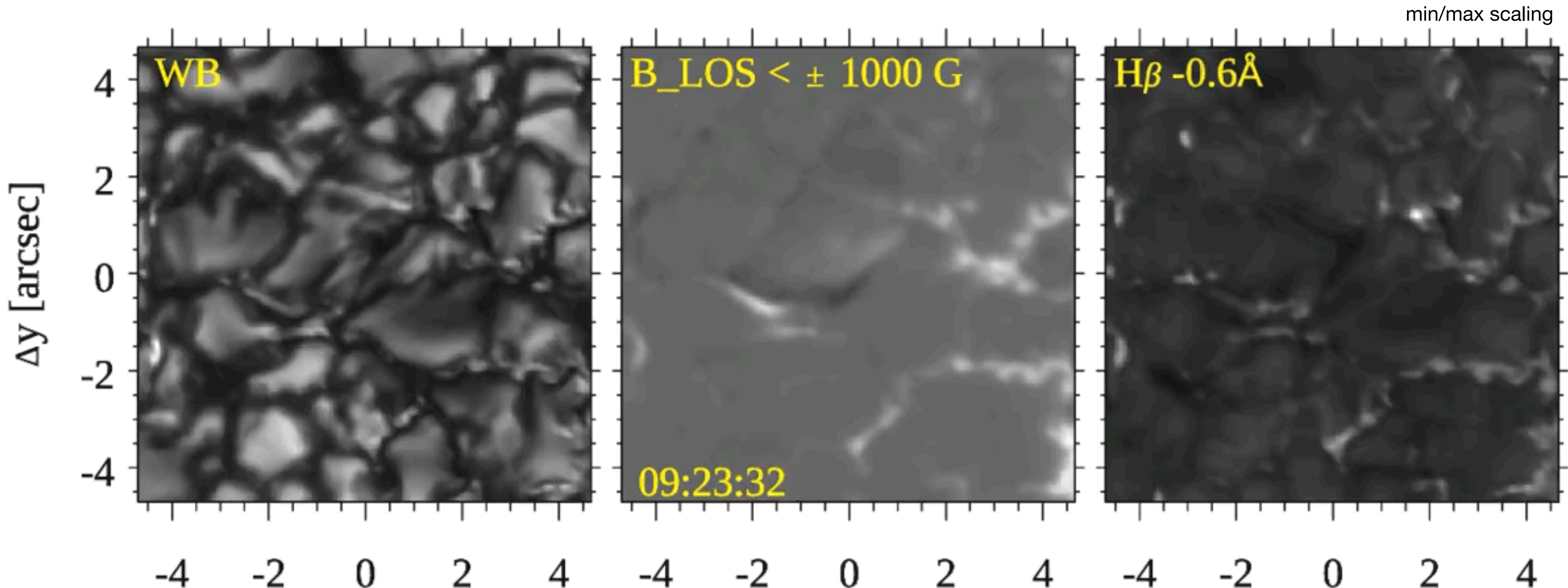
[link to movie](#)

# Flux emergence: elongated granules and Ellerman bombs



SST/CHROMIS/CRISP 11-Aug-2020 AR12770 17 sec cadence

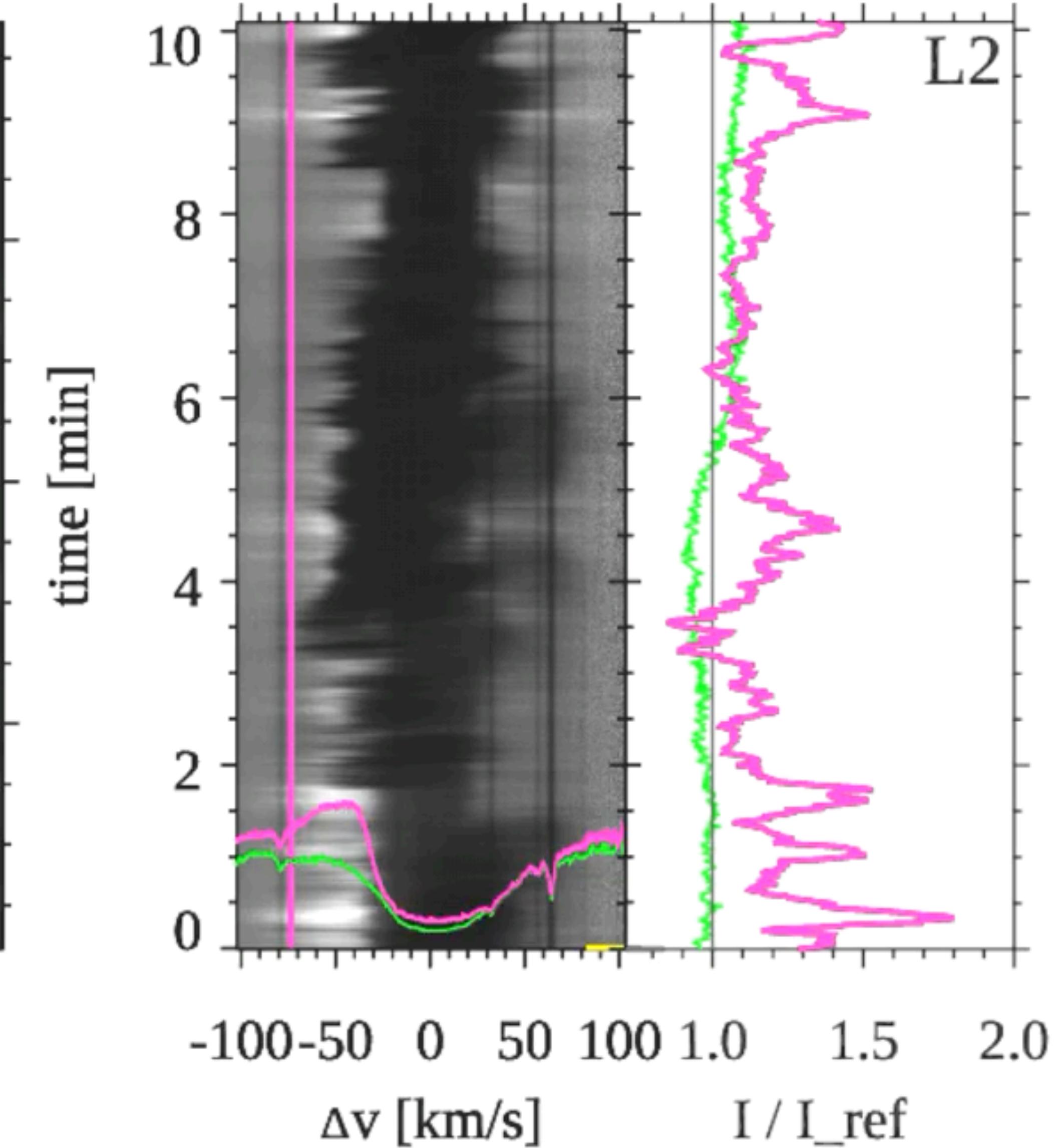
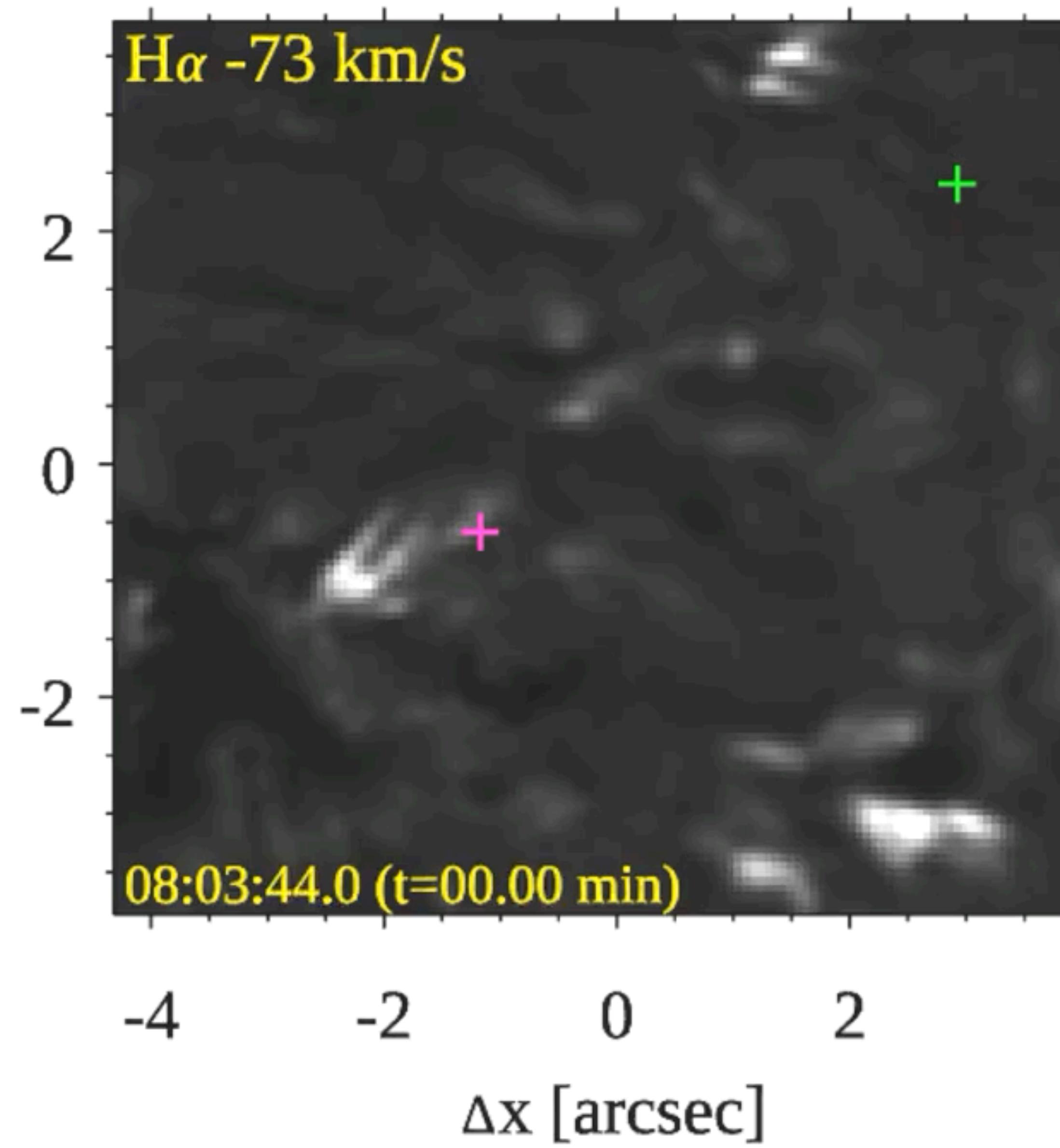
# Flux emergence: elongated granules and Ellerman bombs



SST/CHROMIS/CRISP 11-Aug-2020 AR12770 17 sec cadence

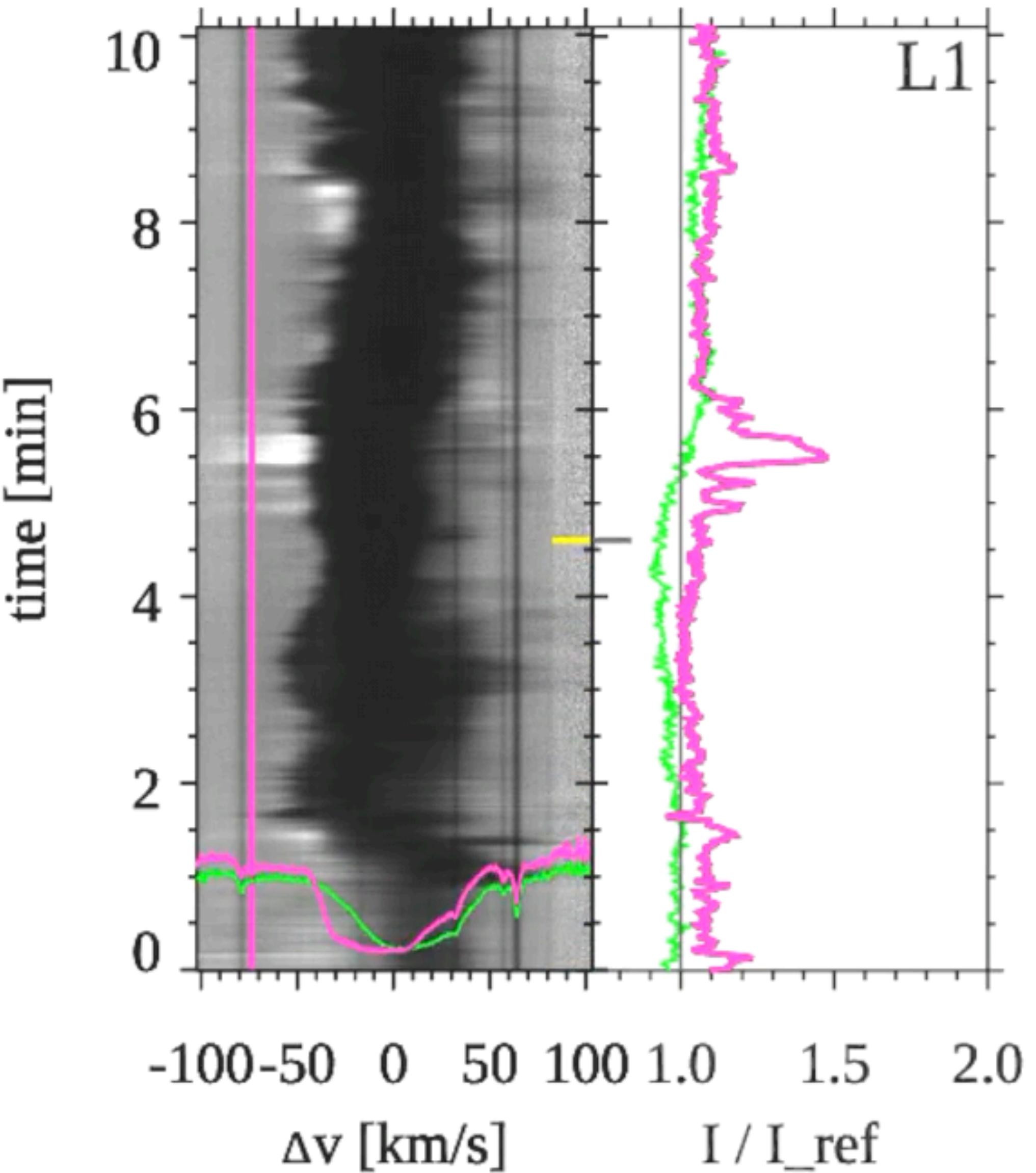
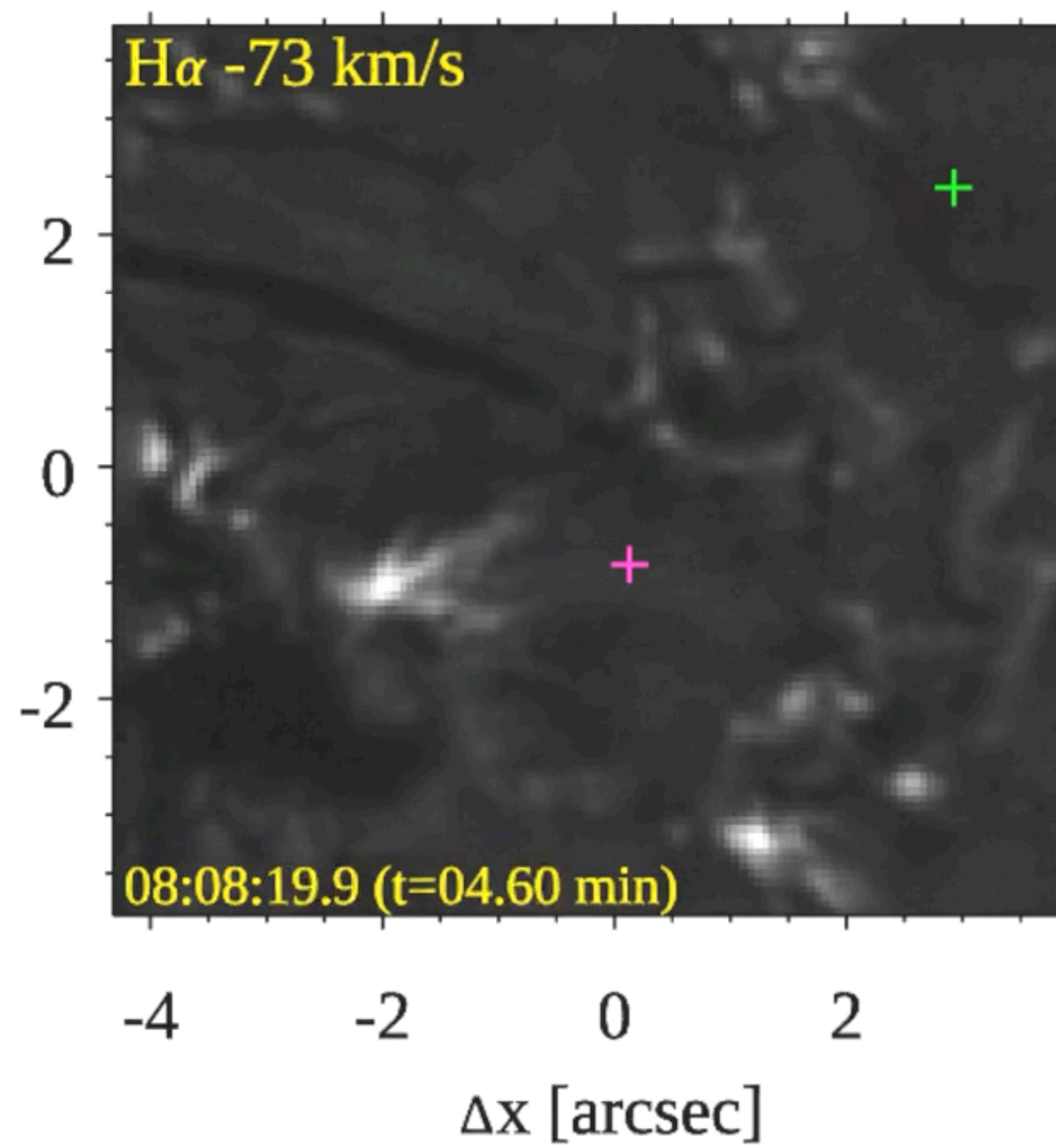
[link to movie](#)

# Plasmoid-like blobs : FWHM sizes 0.1 - 0.4"



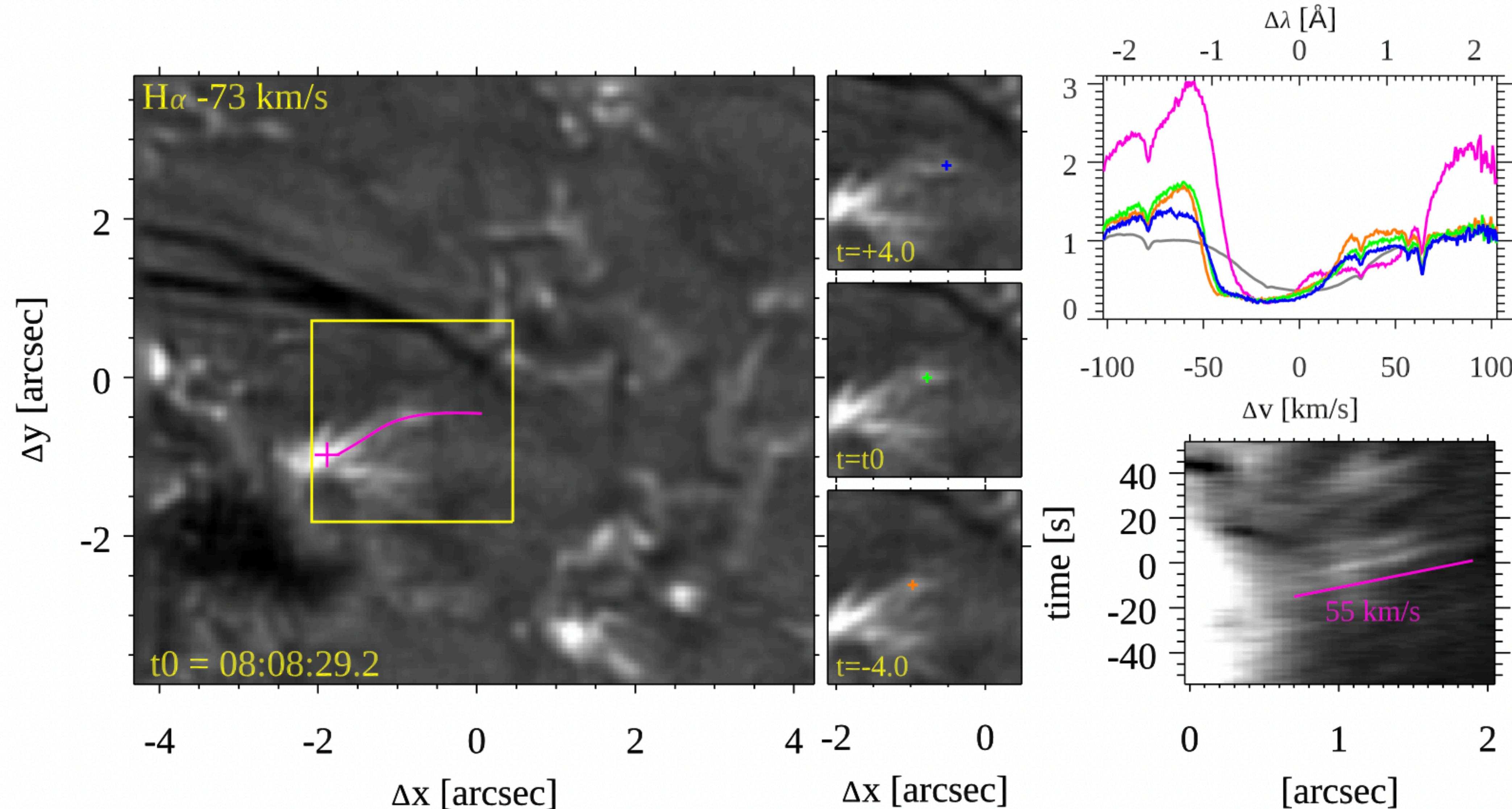
[link to movie](#)

# Plasmoid-like blobs : FWHM sizes 0.1 - 0.4"



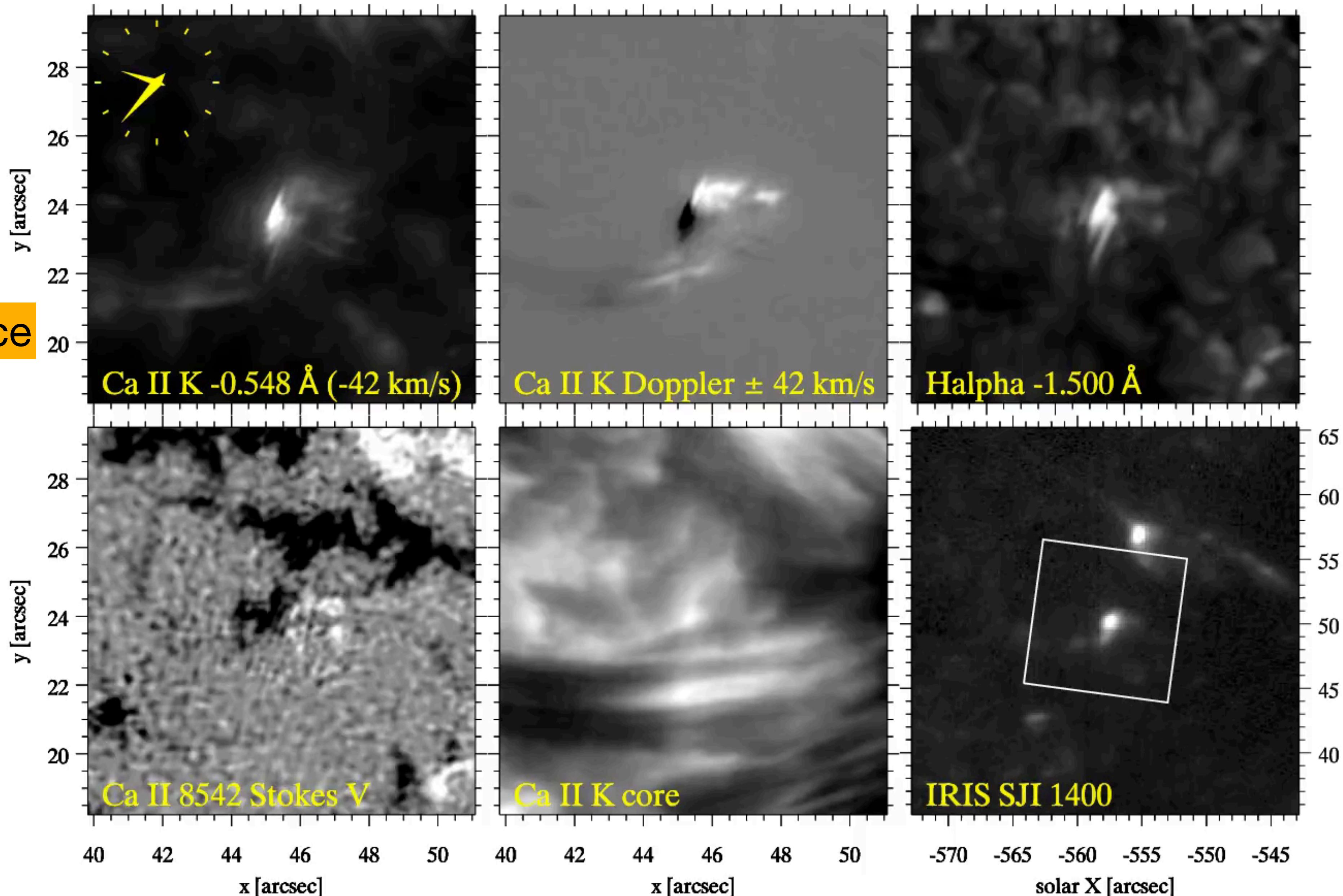
[link to movie](#)

# Plasmoid-like blobs : apparent speed 14 - 77 km/s



# IRIS+SST observations of UV bursts and Ellerman Bombs: plasmoid-like blobs

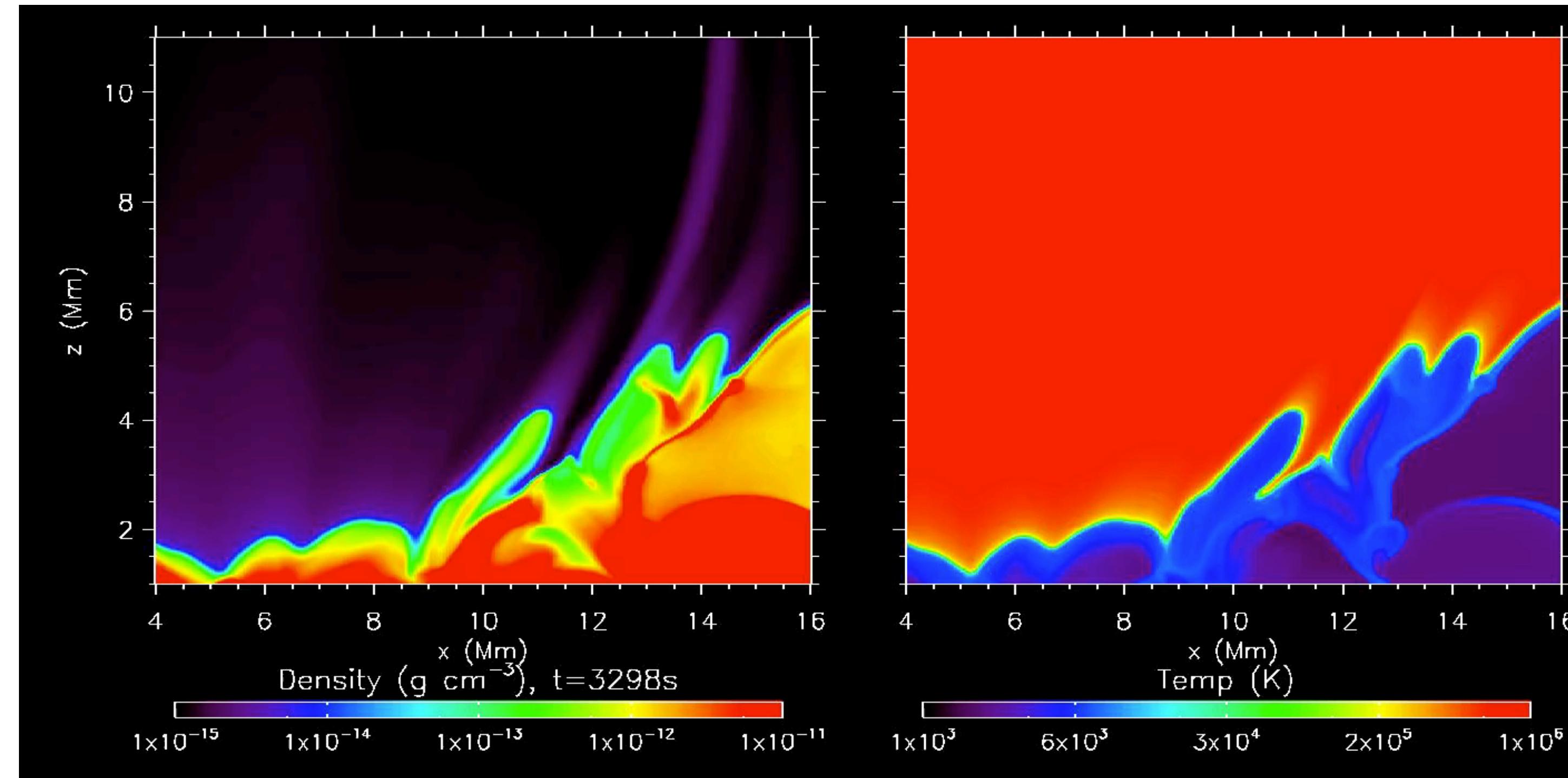
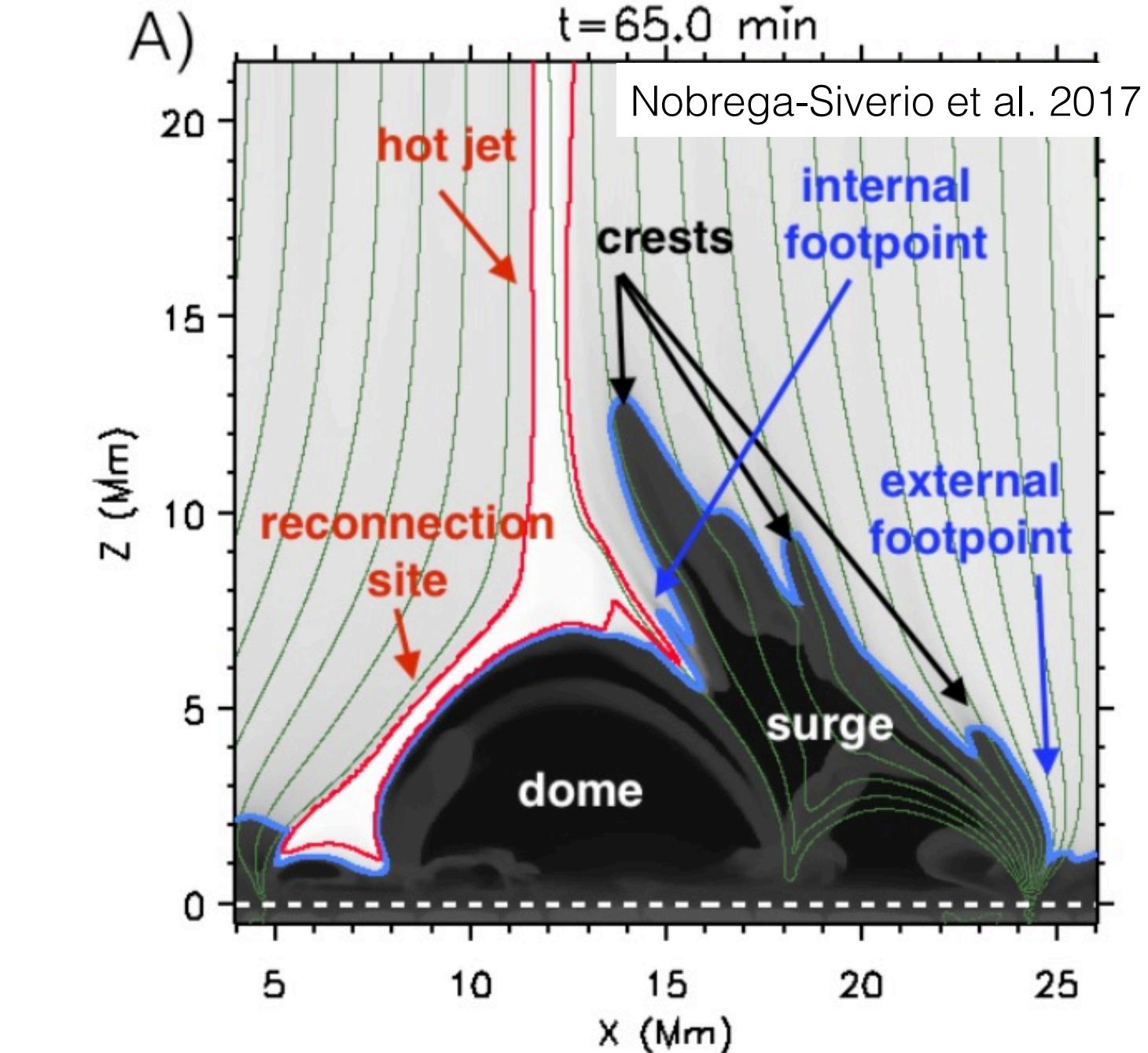
13 s cadence



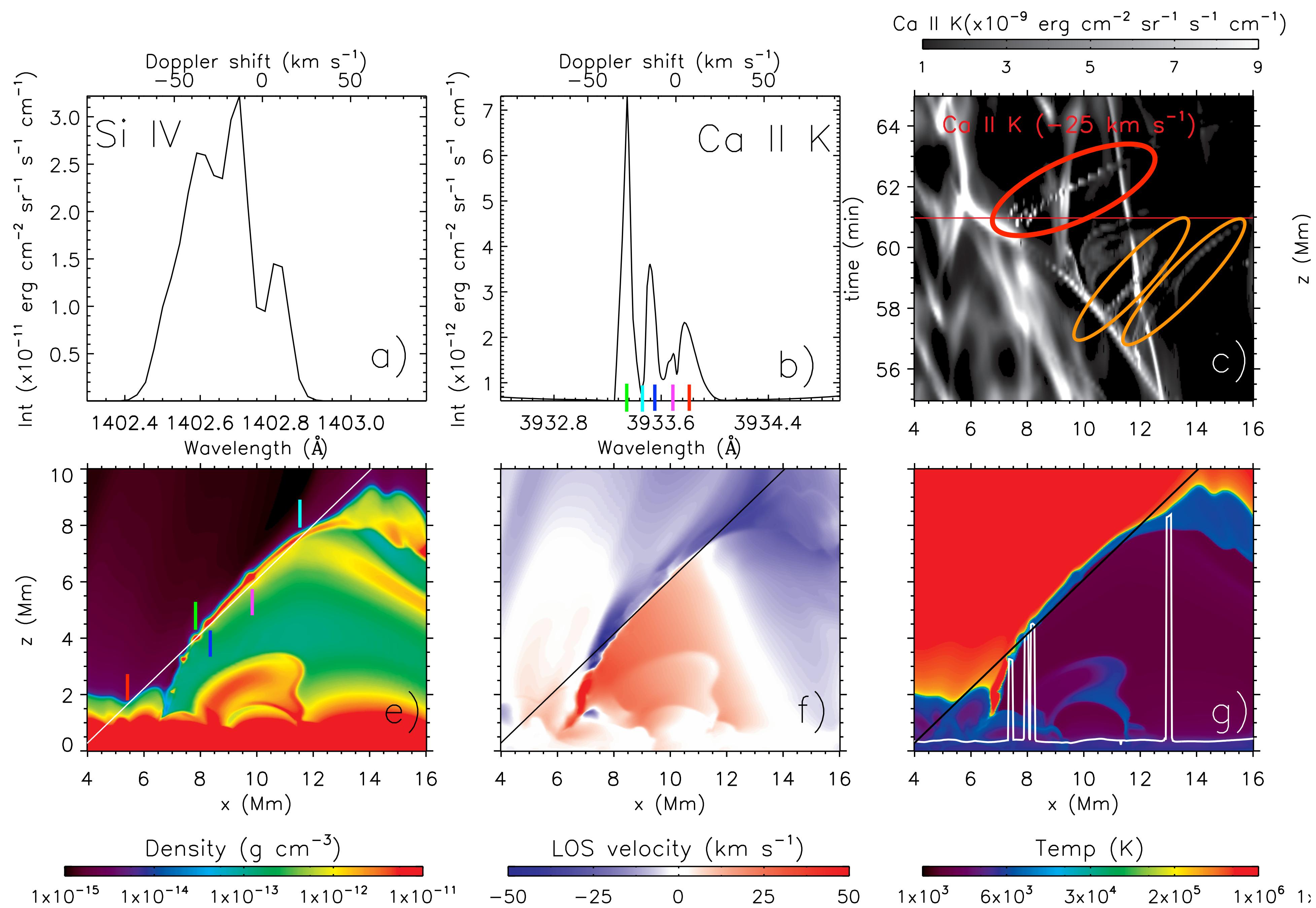
2016-09-03 : 000 09:36:56

Roupe van der Voort et al. 2017 ApJL 851 L6

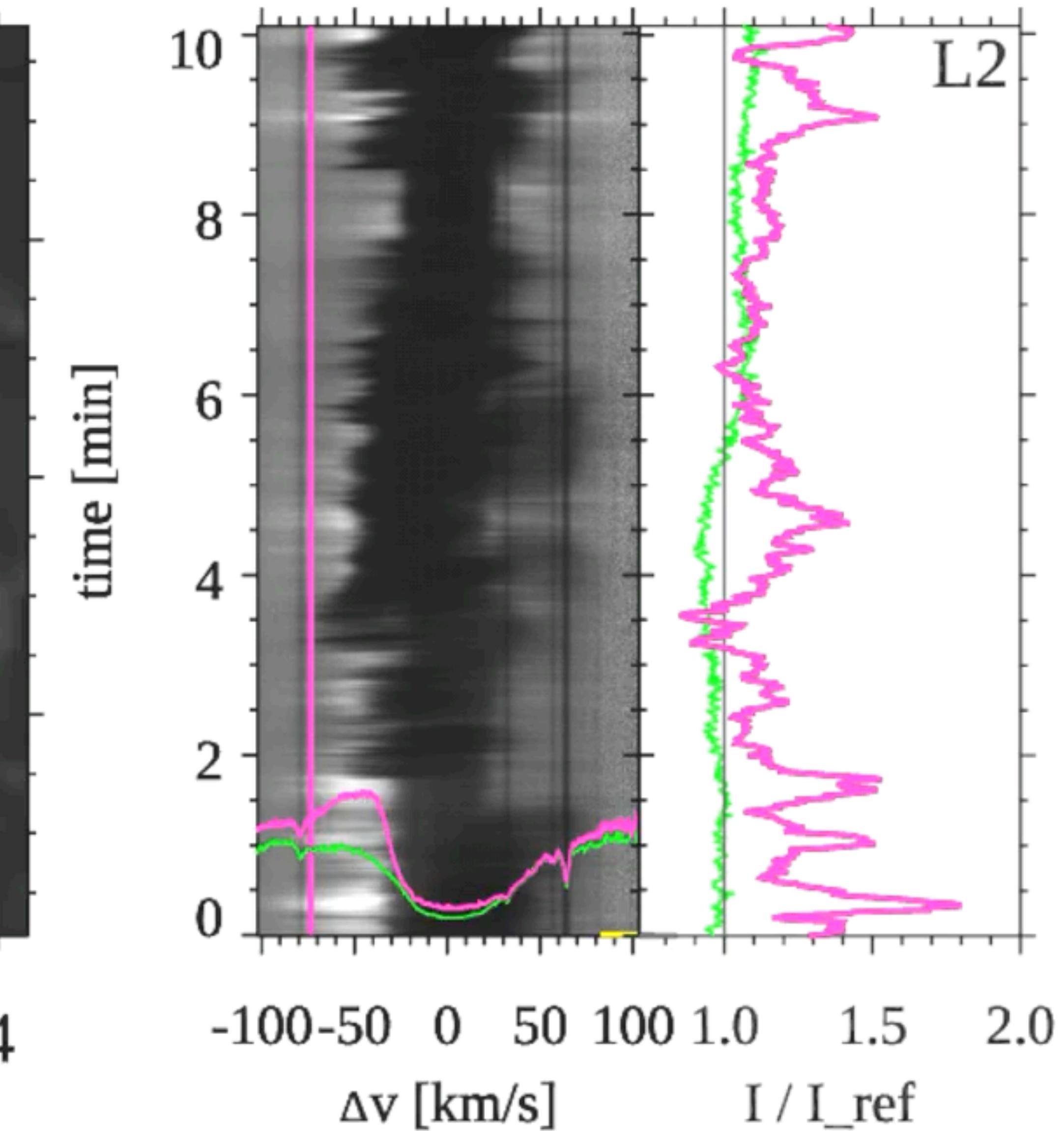
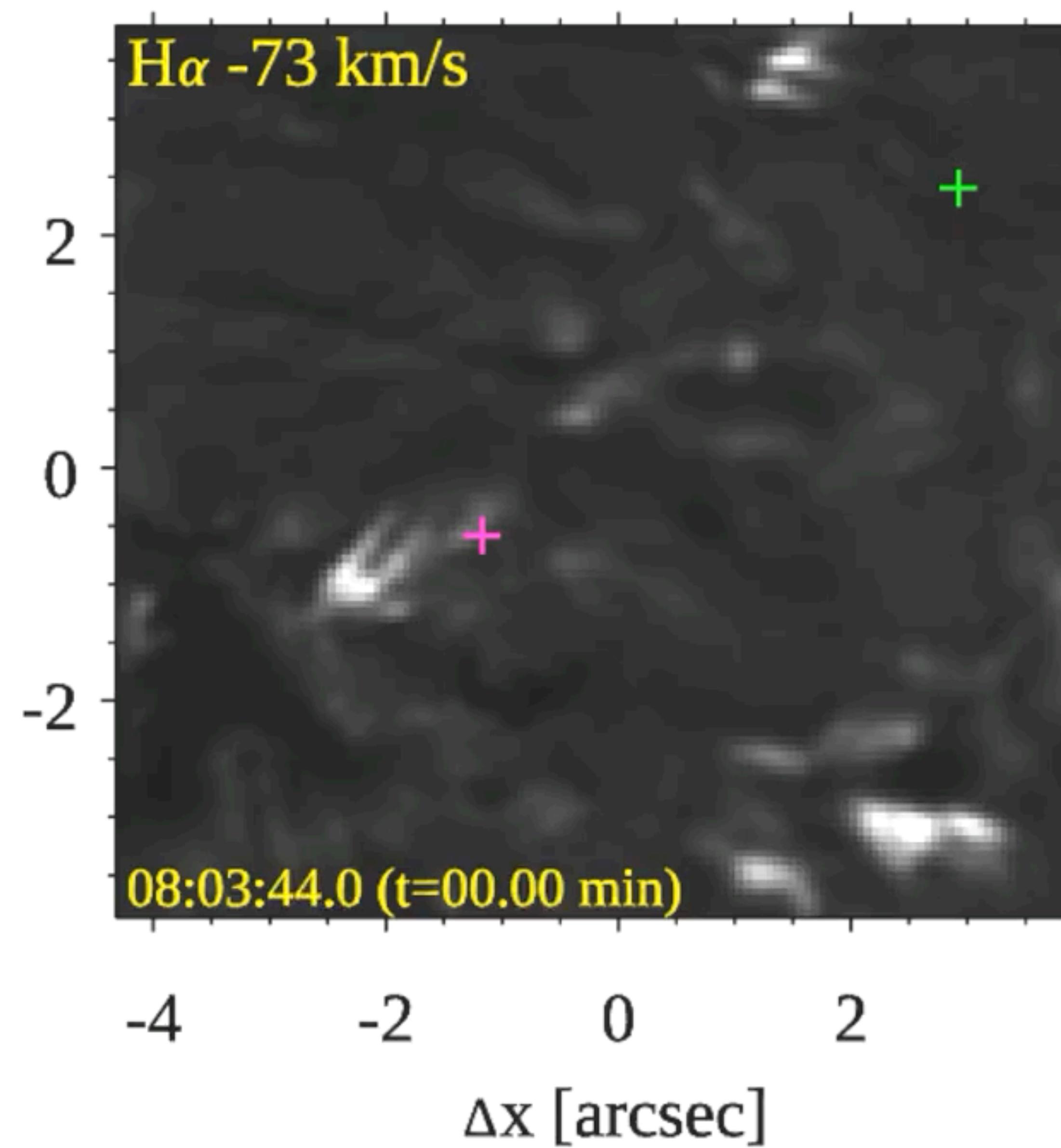
2.5D Bifrost simulation of emergence  
of twisted magnetic flux tube  
→ reconnection with ambient field  
→ plasmoids

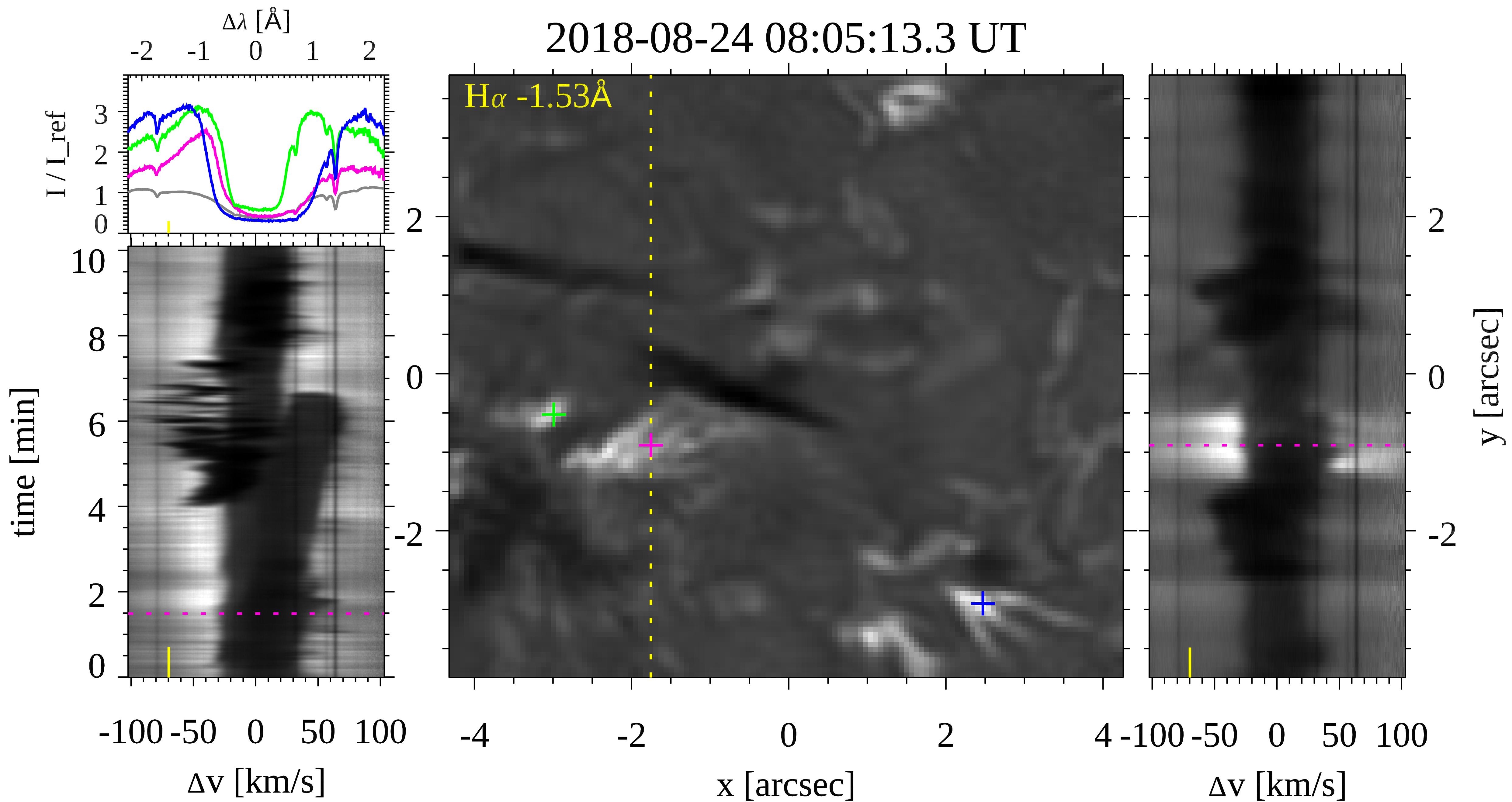


Rouppé van der Voort et al. 2017

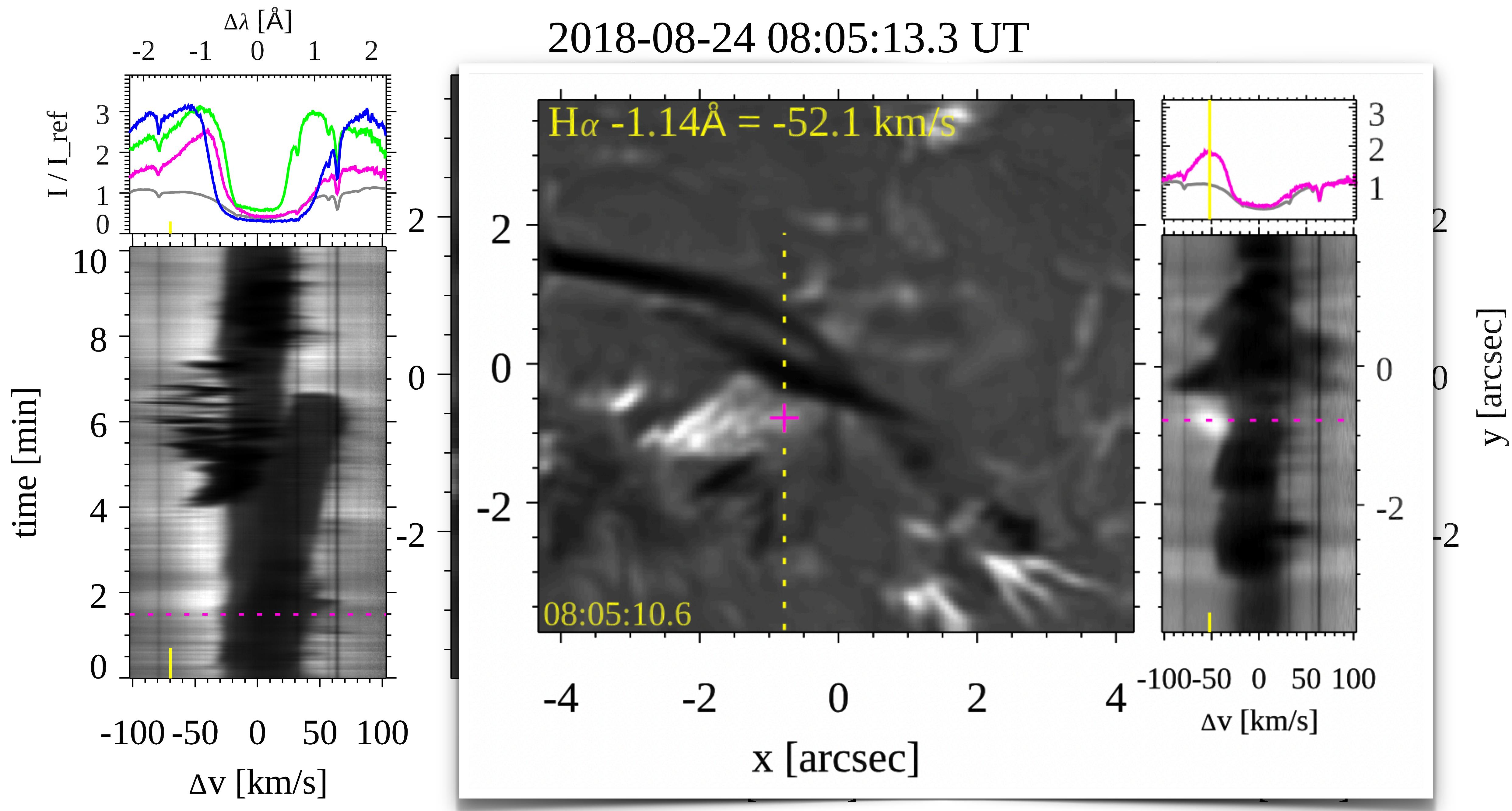


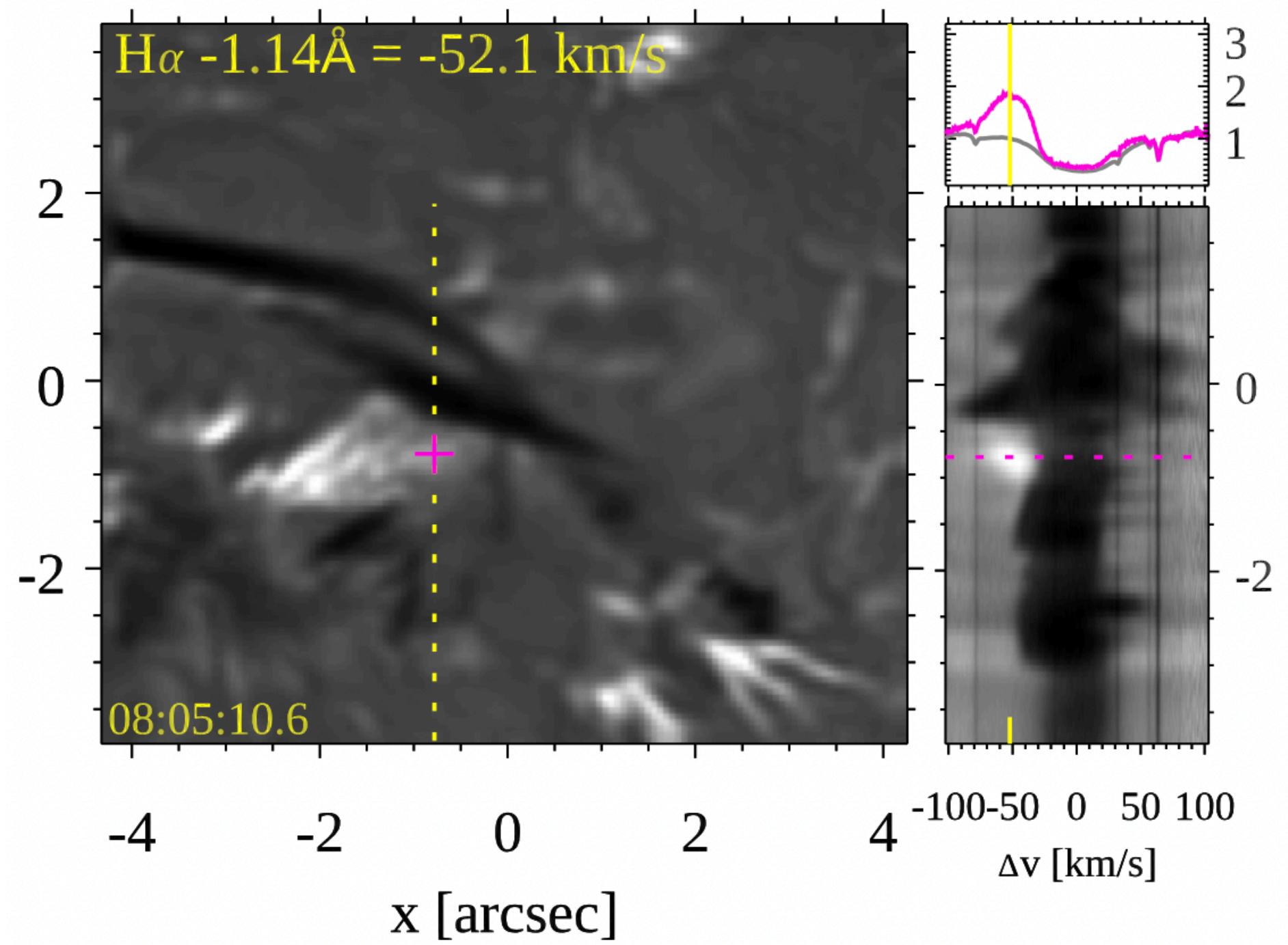
# Plasmoid-like blobs : FWHM sizes 0.1 - 0.4"

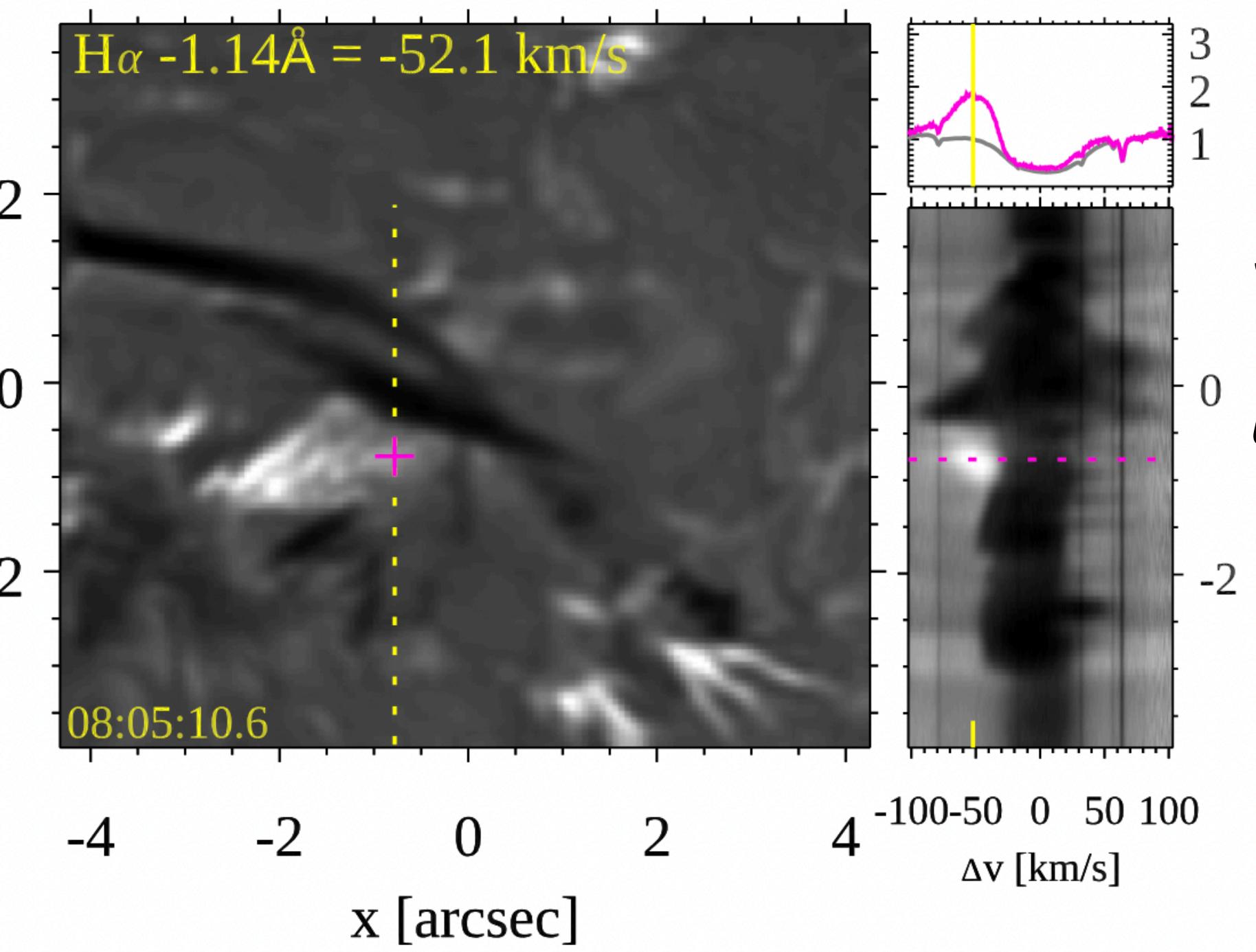
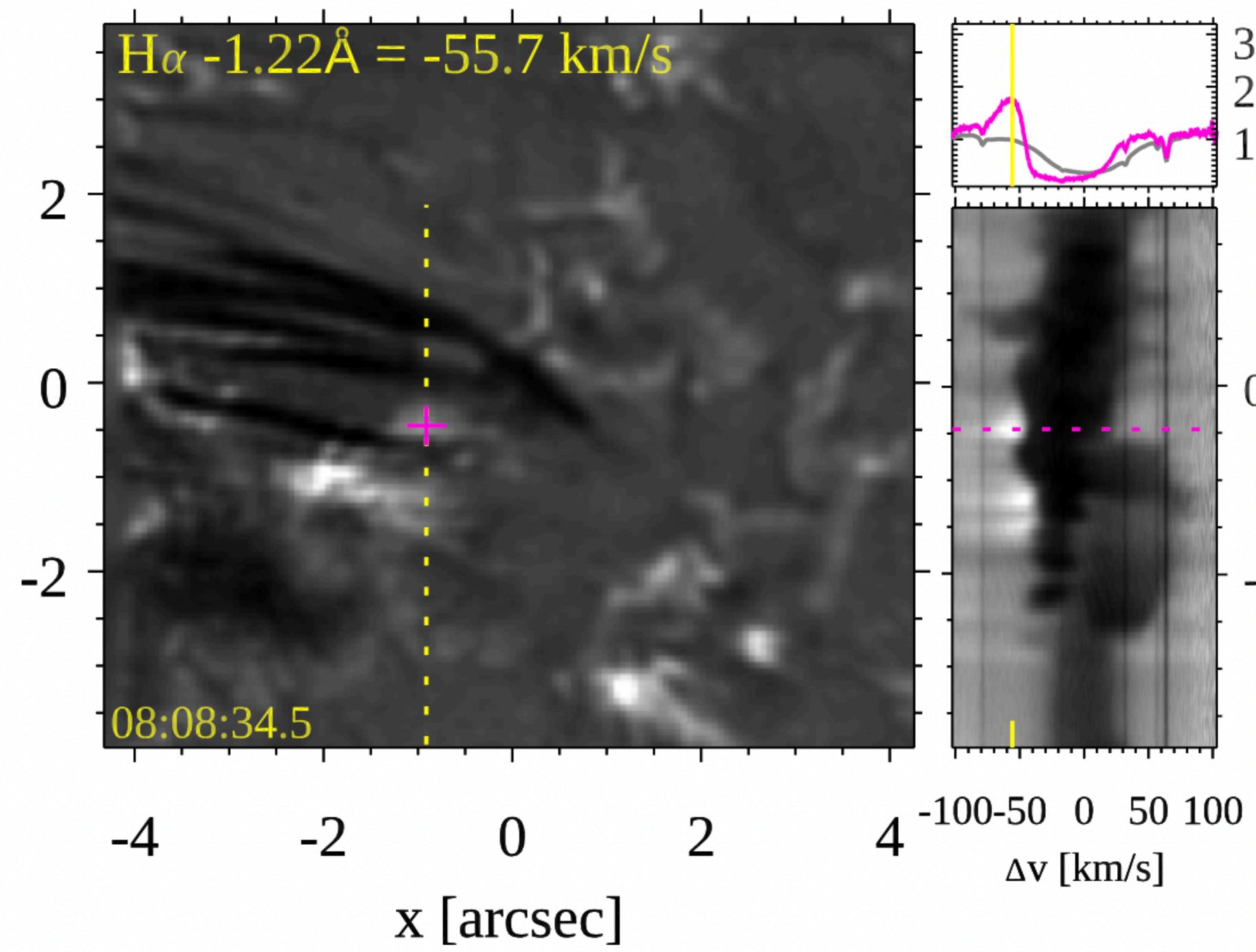




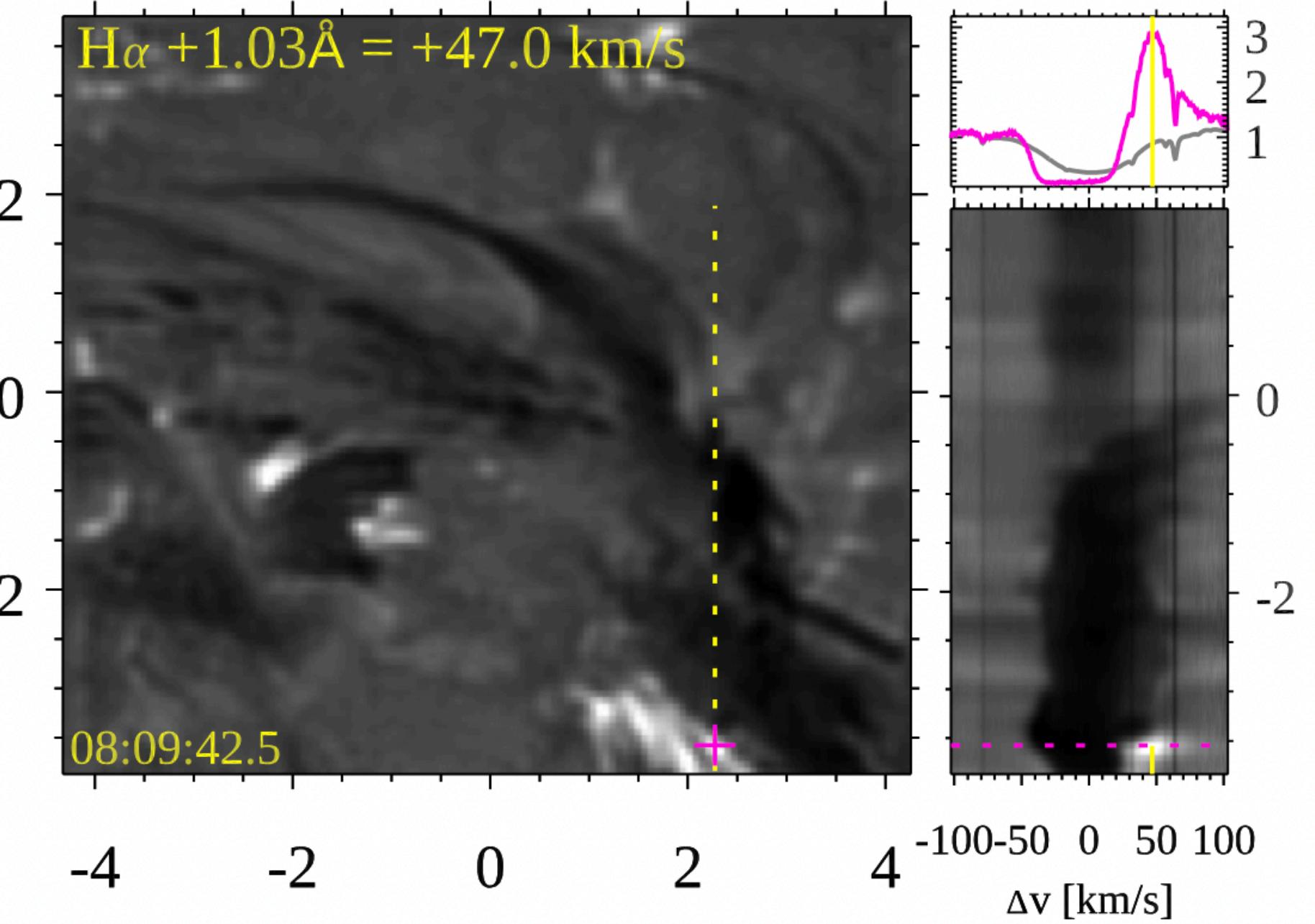
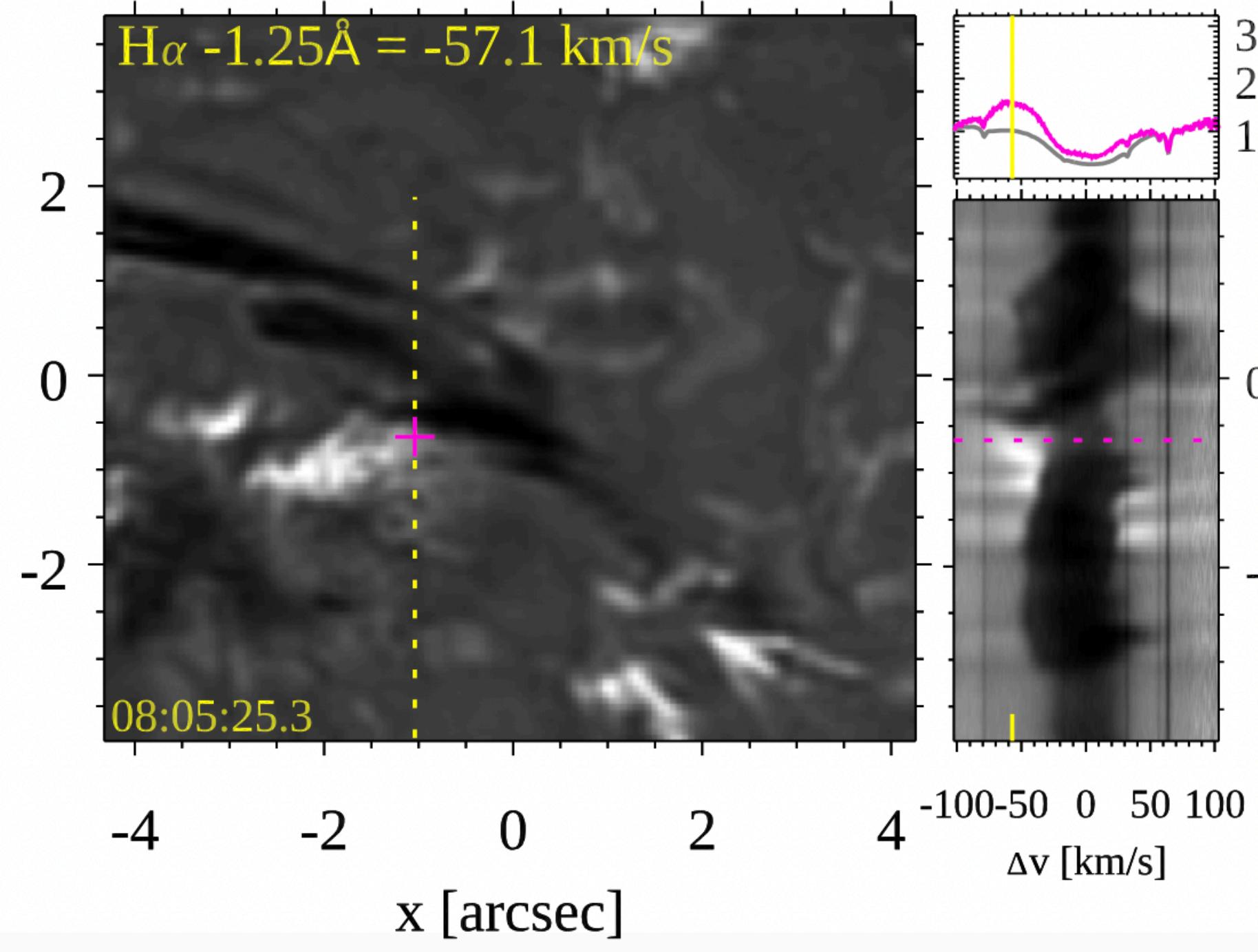
2018-08-24 08:05:13.3 UT







Single peak profiles:  
Doppler offset 47 - 57 km/s  
*upper limit LOS velocity*



# Conclusions

- MiHI H-alpha observations of Ellerman bombs:
  - plasmoid-like blobs
  - sizes 0.1" - 0.4"
  - apparent speed 14 - 77 km/s
  - Doppler velocity  $\leq 50$  km/s
- MiHI observations underline short dynamic time scale of chromosphere  
*probably we do not need to go <1 s*
- All instruments have to compromise somehow in **xyλt**
  - MiHI:
    - small FOV  $\approx 8'' \times 8''$
    - one spectral line