

Past and present observations of
coronal rain in chromospheric lines

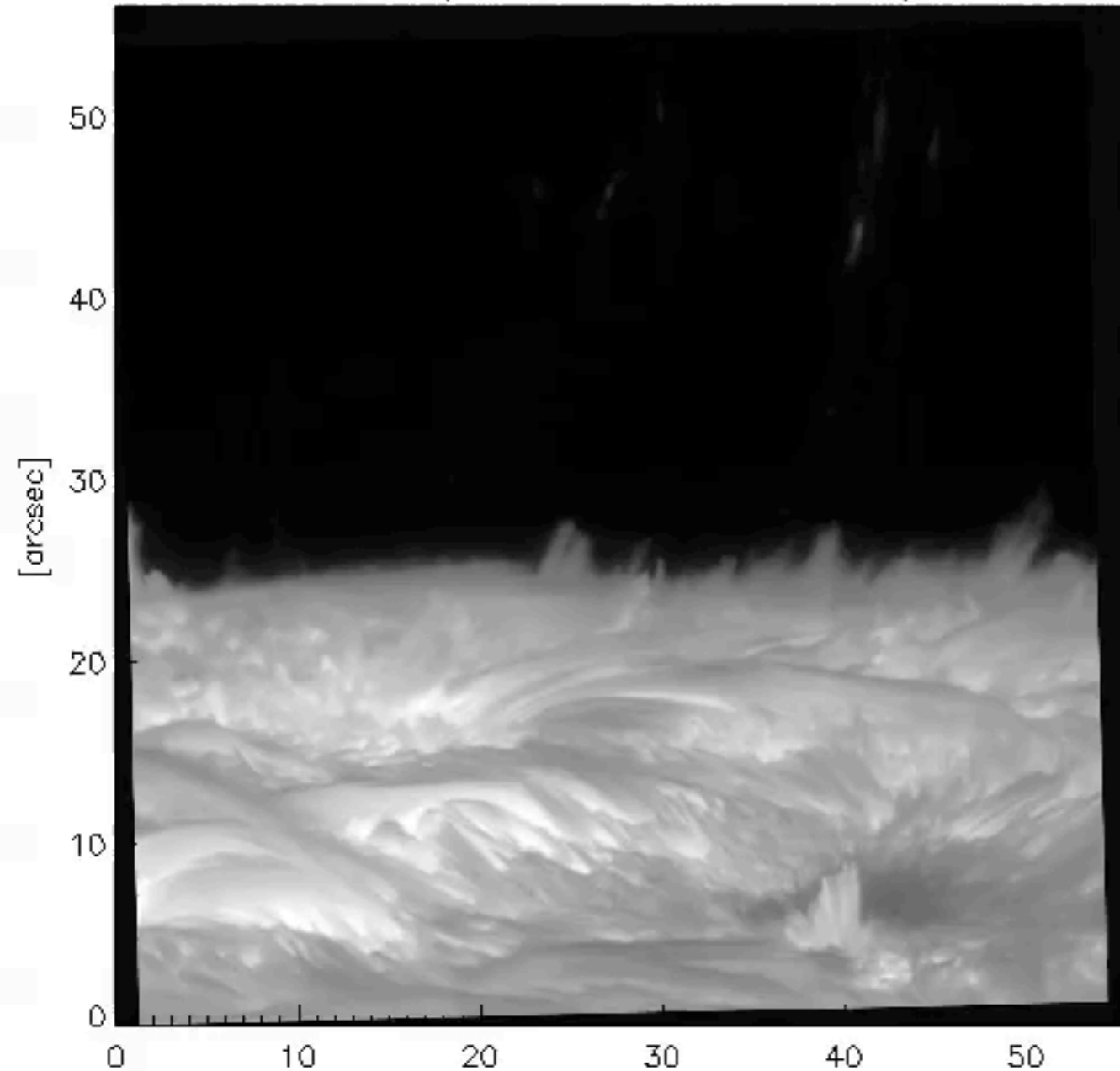
+ results from SST-IRIS campaigns

Luc Rouppe van der Voort

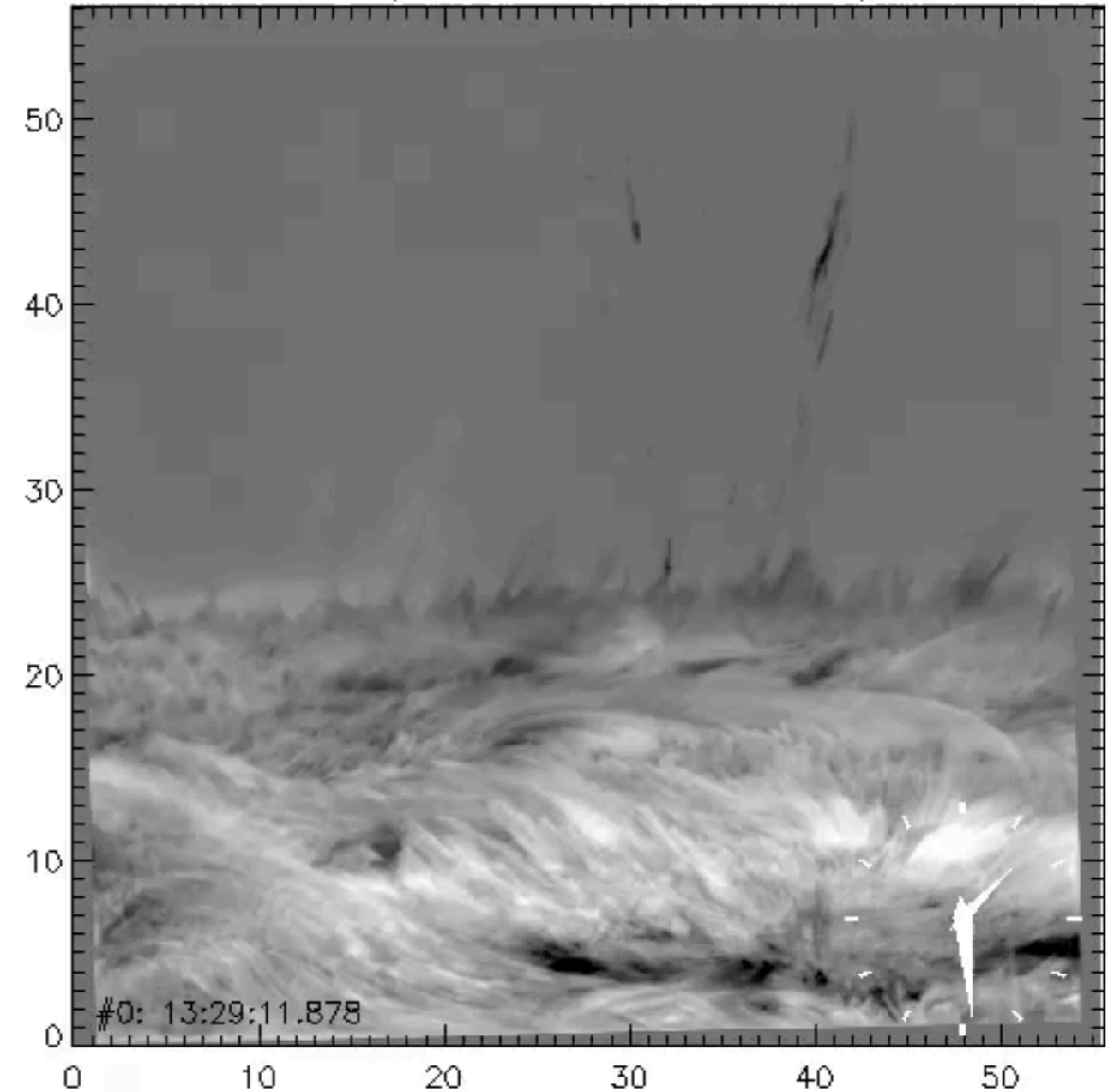
University of Oslo

CRISP at SST: tunable filter, ~ 4 line positions/sec
spatial resolution: $\lambda/D = 0.14''$ or 100 km at 6563 Å
500 - 860 nm: H-alpha and Ca II 8542

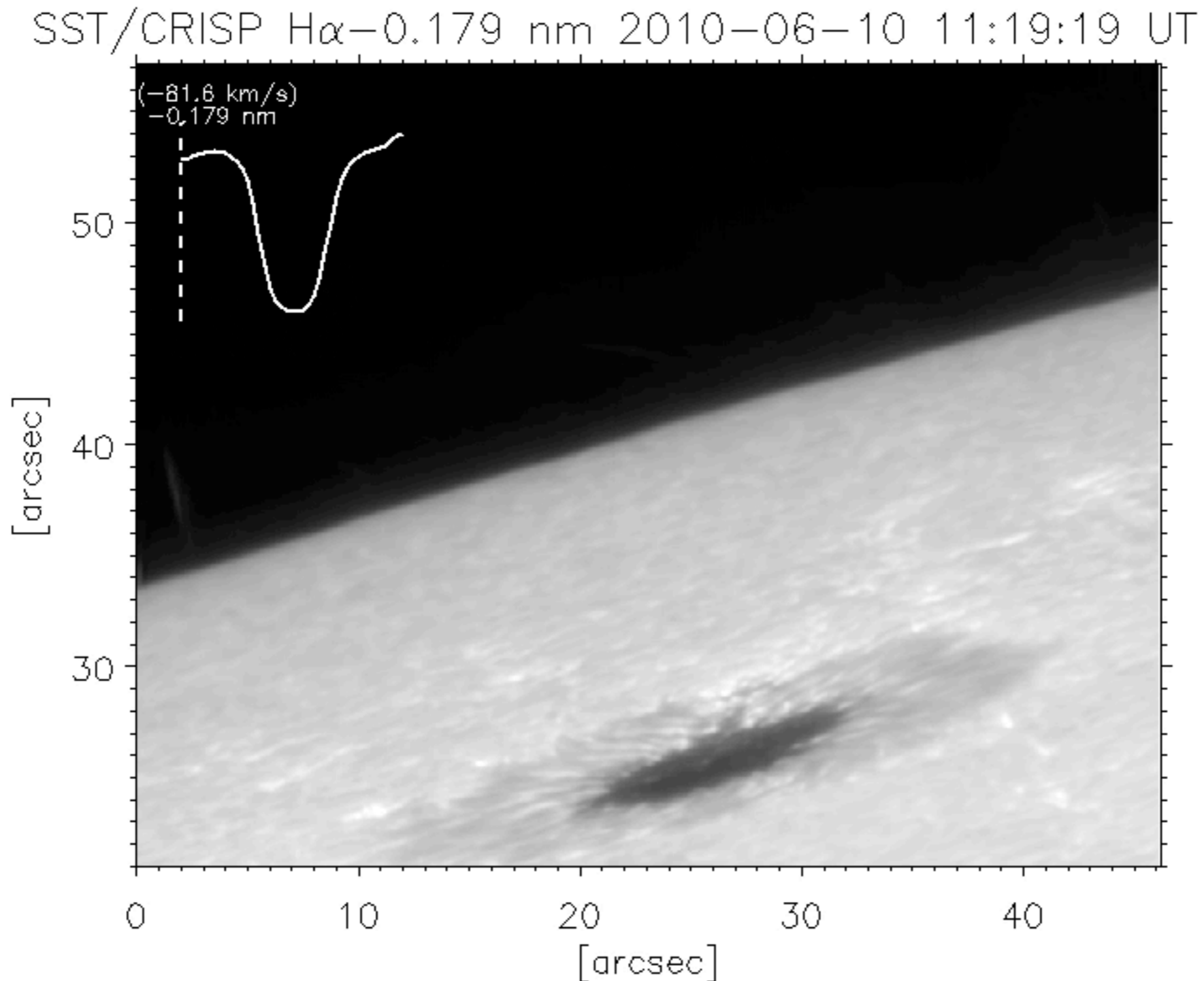
2014.08.23 : SST/CRISP 13:29:05 : H-alpha +0.000



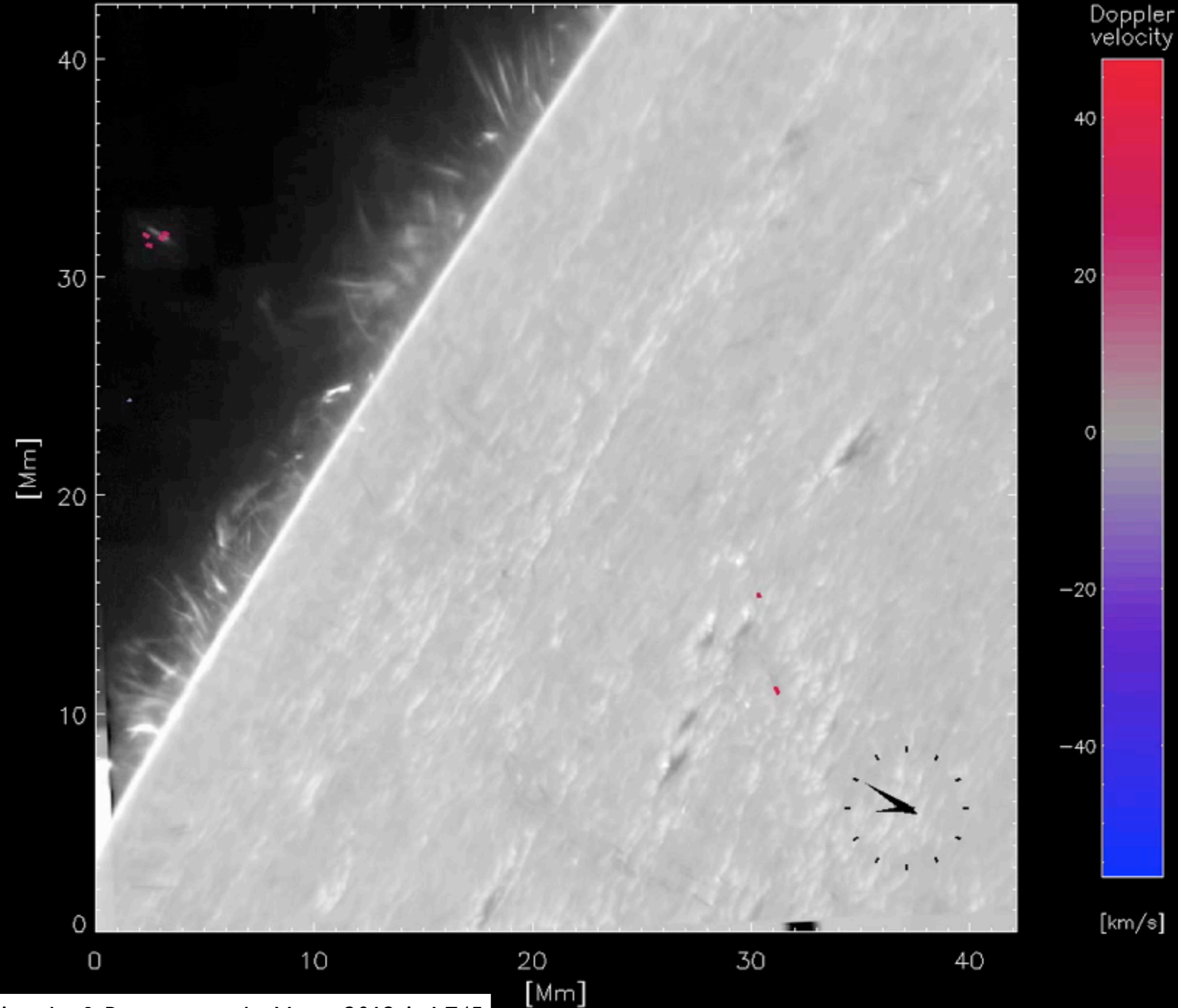
2014.08.23 : SST/CRISP 13:29:05 : H-alpha +-0.560



CRISP at SST: tunable filter, ~ 4 line positions/sec
spatial resolution: $\lambda/D = 0.14''$ or 100 km at 6563 Å



SST/CRISP $H\alpha+1.1\text{\AA}$ \rightarrow center 2009-05-10



Antolin & Rouppe van der Voort 2012 ApJ 745

coronal rain in H-alpha: sizes

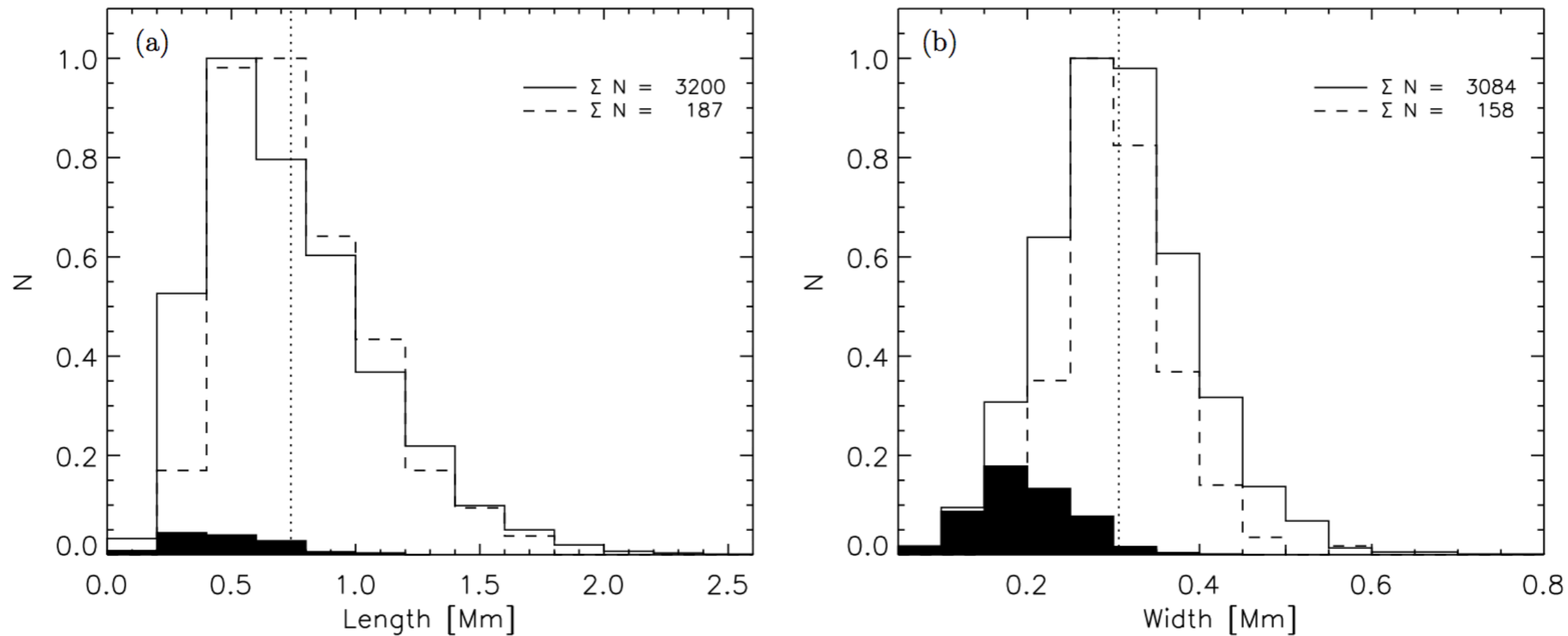


Figure 10. Normalized histograms for the lengths (a) and widths (b) of the condensations. The solid and dashed lines correspond to off-limb and on-disk blobs, respectively. The total number of measurements is specified in each panel. The dotted line corresponds to the average value over all measurements. The black histograms denote the measurements for which the 1σ errors in the Gaussian fit are above 10% of the measured values (see Section 3.2 for details).

Antolin & Rouppe van der Voort 2012 ApJ 745

spatial resolution: $\lambda/D = 0.14''$ or 100 km at 6563 Å

coronal rain in H-alpha: shapes

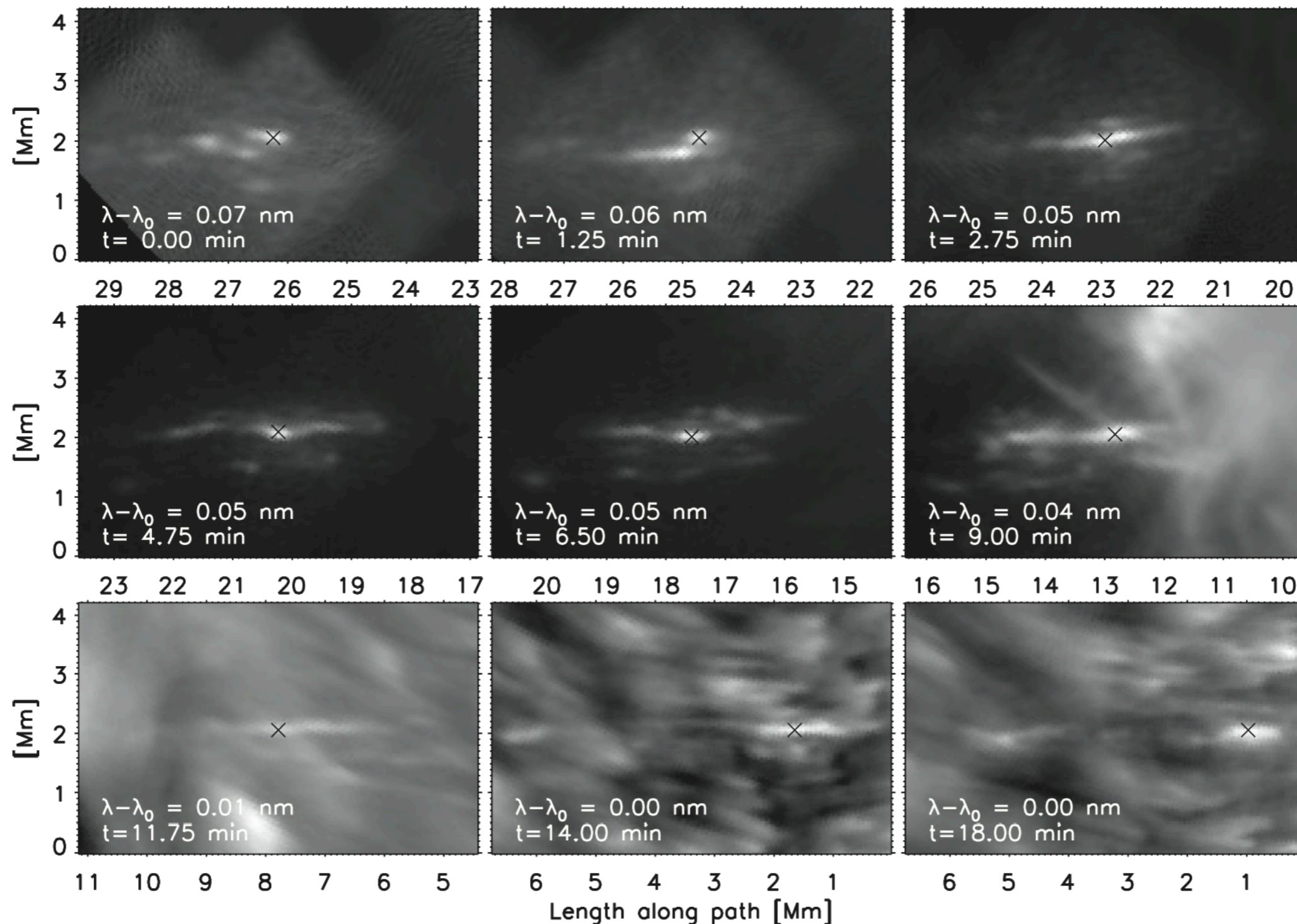
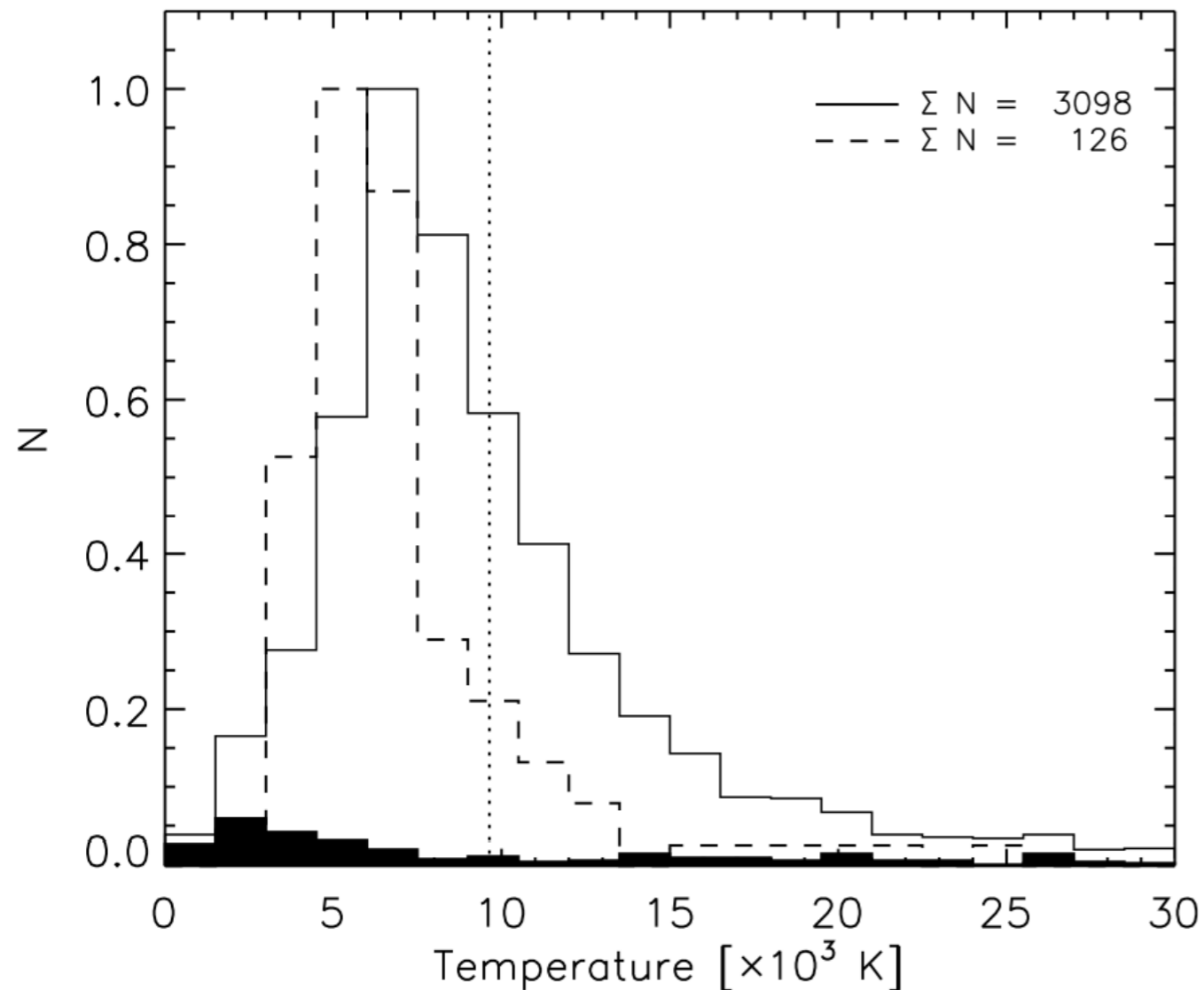
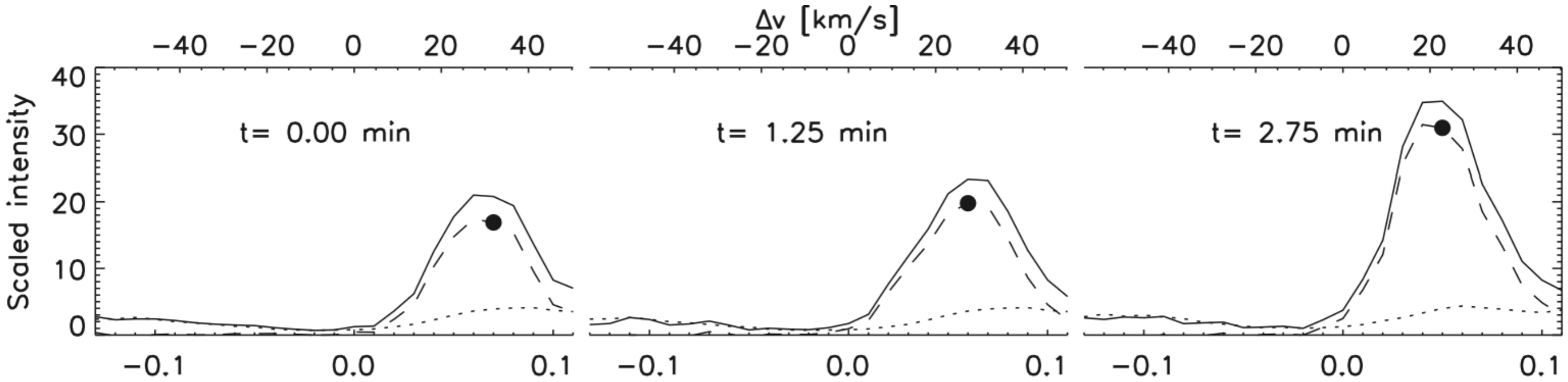


Figure 8. Nine consecutive snapshots of a group of condensations, followed as they fall across the SST field of view toward the chromosphere. Each image corresponds to the brightest line position at which the blobs are observed. The offset from the line center is specified in each panel, together with the time in minutes starting from the first image (top left). Note the apparent continuous change in shape of the condensations, especially the elongation and separation. The images are obtained after application of the radial filter, as discussed in Section 2.1.

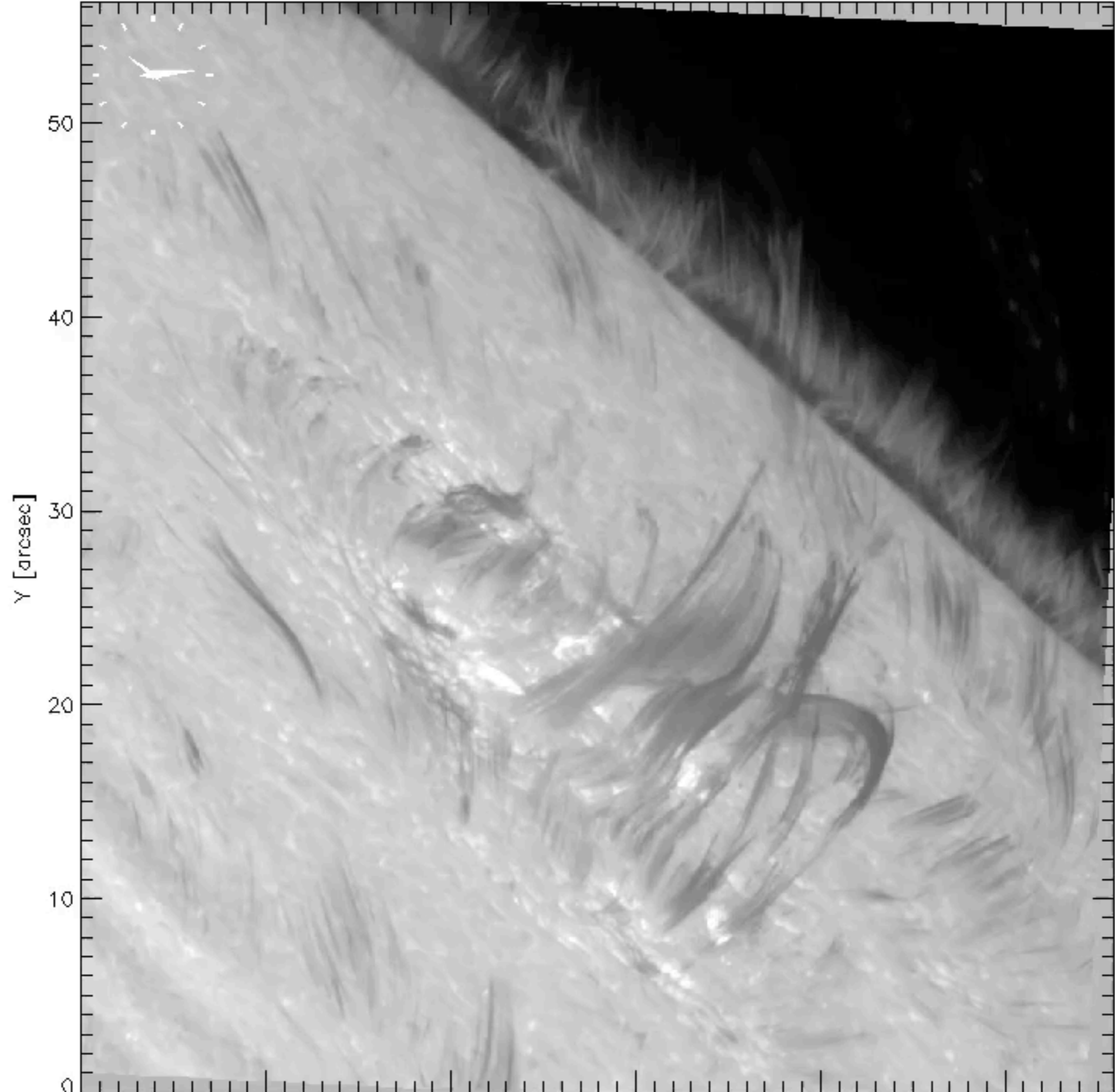
coronal rain in H-alpha: spectral profiles and temperatures



$$\text{FWHM} = 2\sqrt{2 \ln 2} \frac{\lambda_0}{c} \sqrt{\frac{2k_B T}{m_H} + v_{\text{mic}}^2}$$

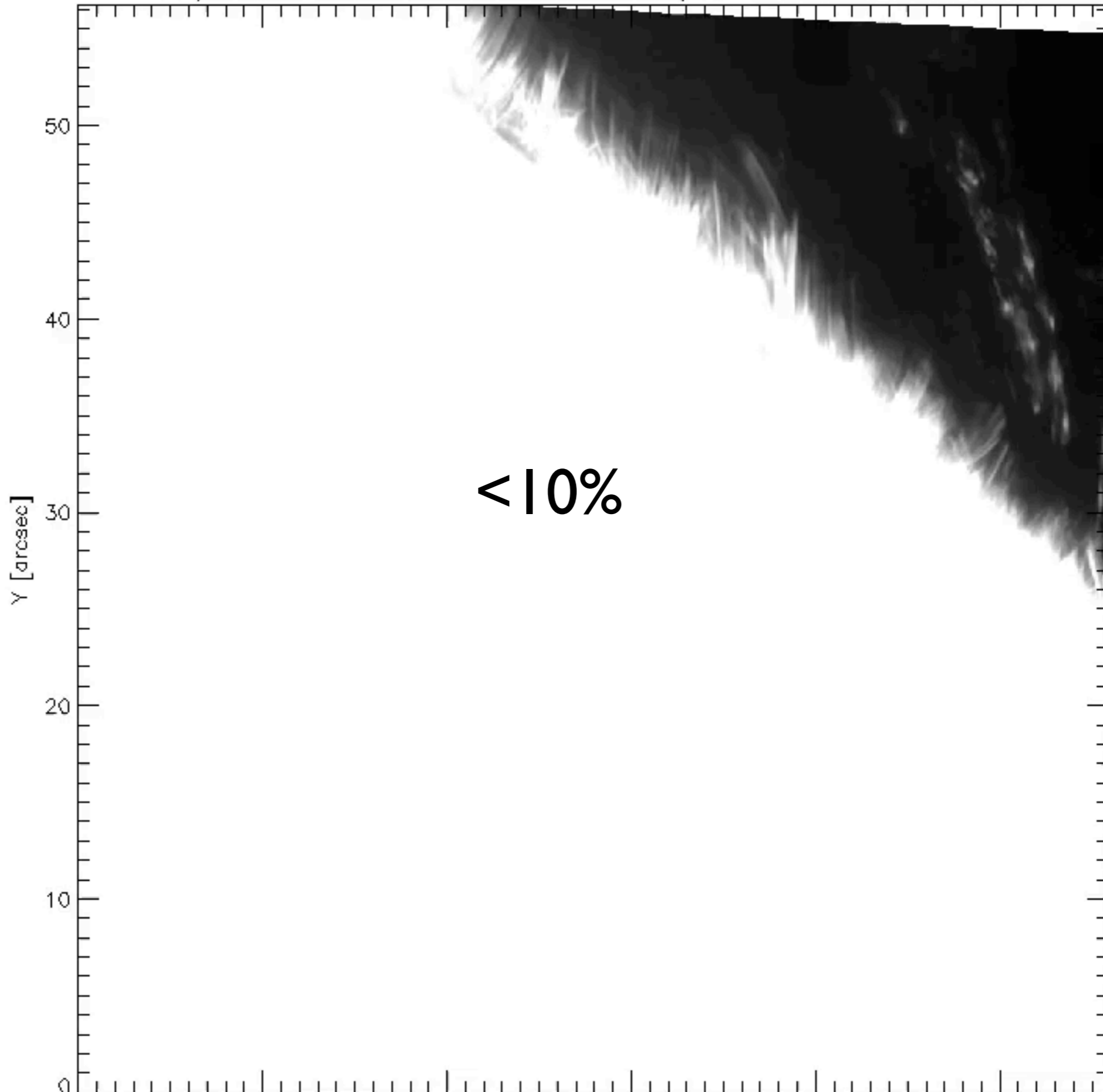
coronal rain in H-alpha: very common in active regions(?)

SST/CRISP 2013.07.04 10:13:55 H-alpha -0.860 10:14:00.005



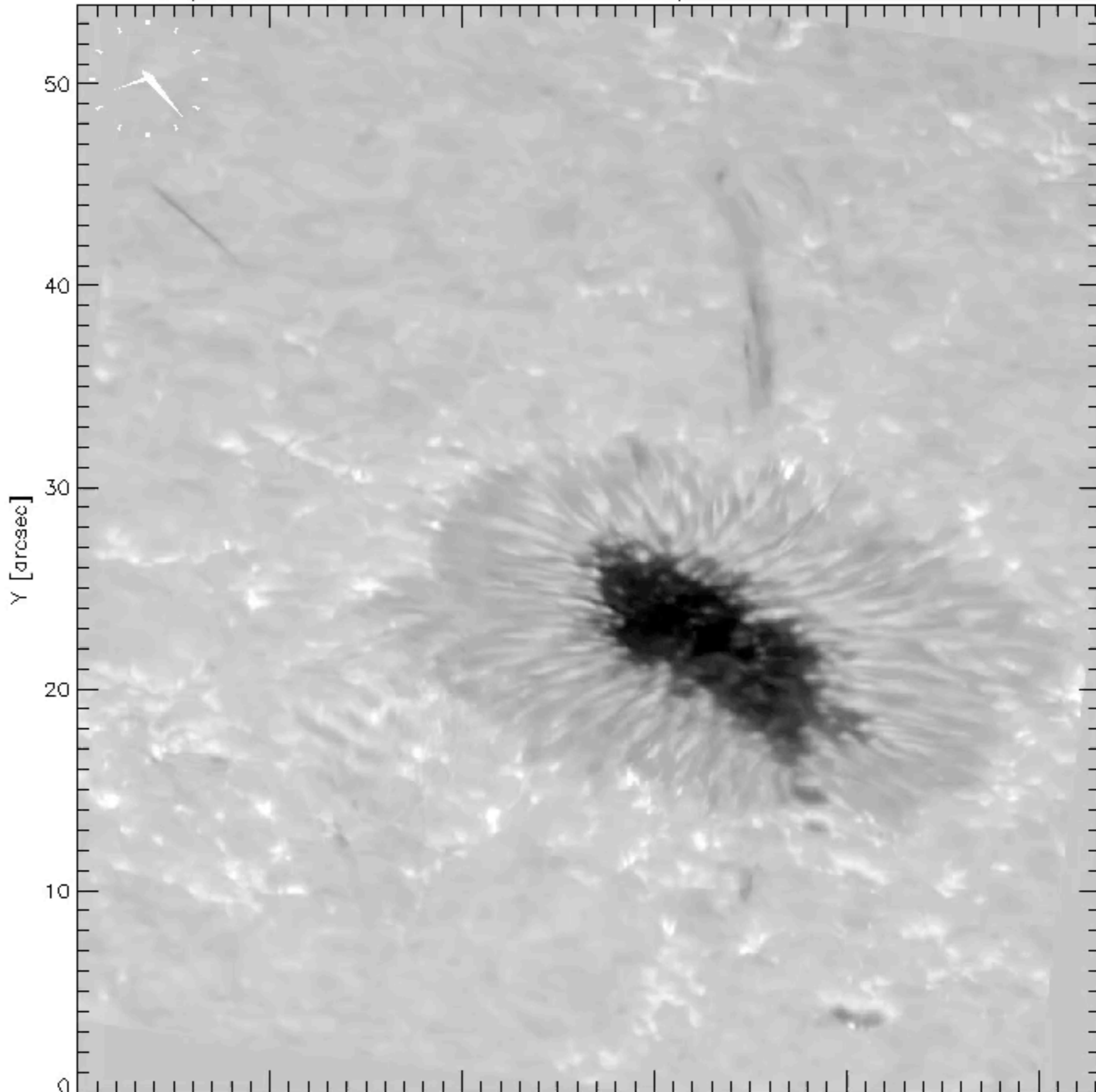
coronal rain in H-alpha: very common in active regions(?)

SST/CRISP 2013.07.04 10:13:55 H-alpha -0.860 10:14:00.005



coronal rain in H-alpha: very common in active regions(?)

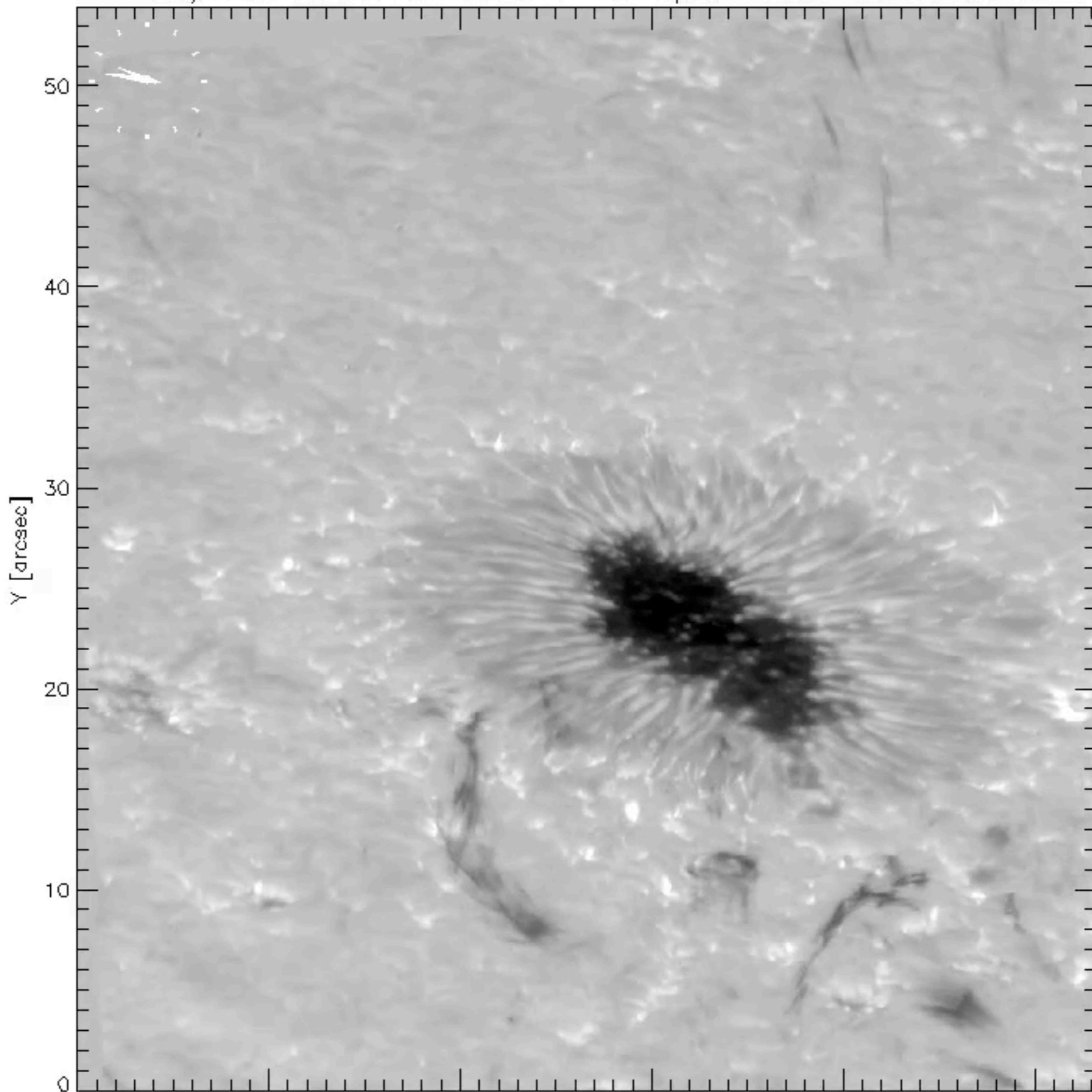
SST/CRISP 2014.09.06 08:23:07 H-alpha -1.200 08:23:09.575



$\mu=0.41$

coronal rain in H-alpha: very common in active regions(?)

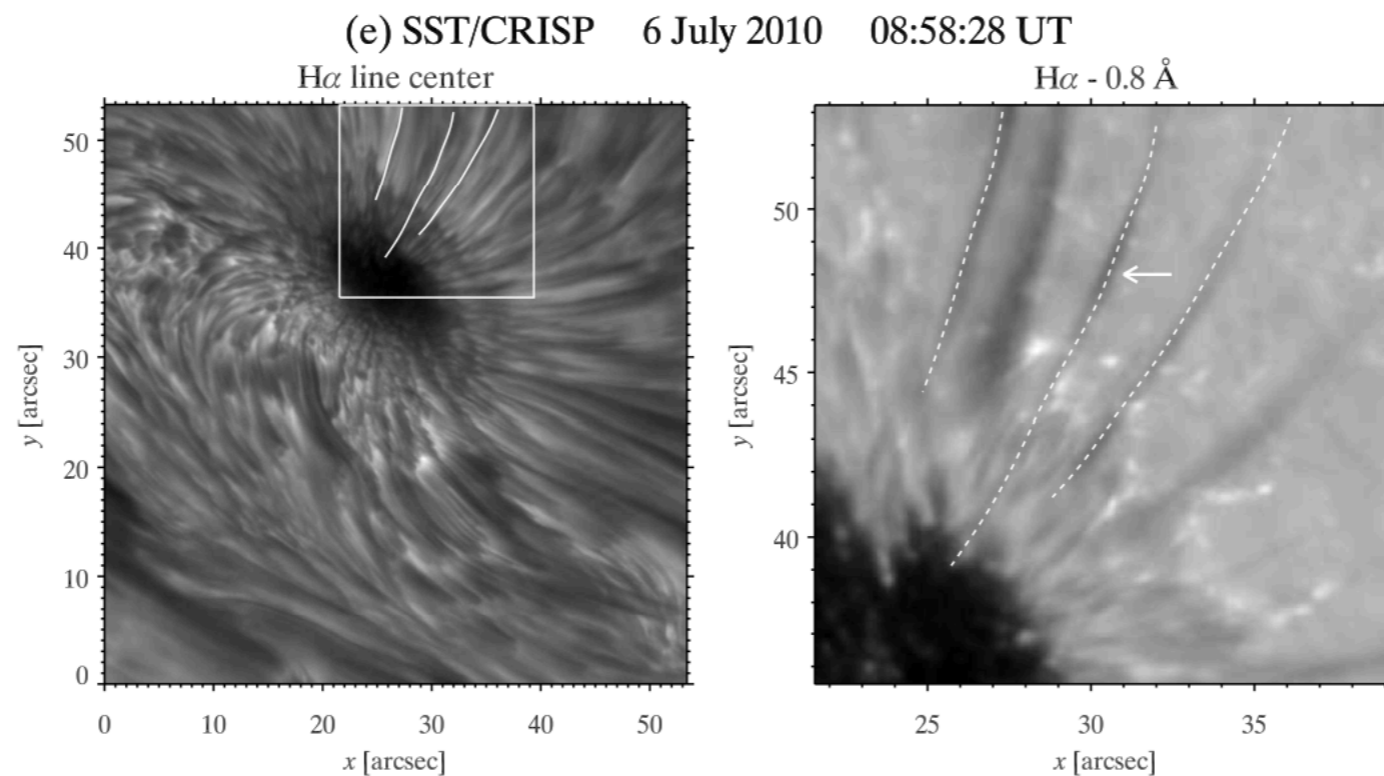
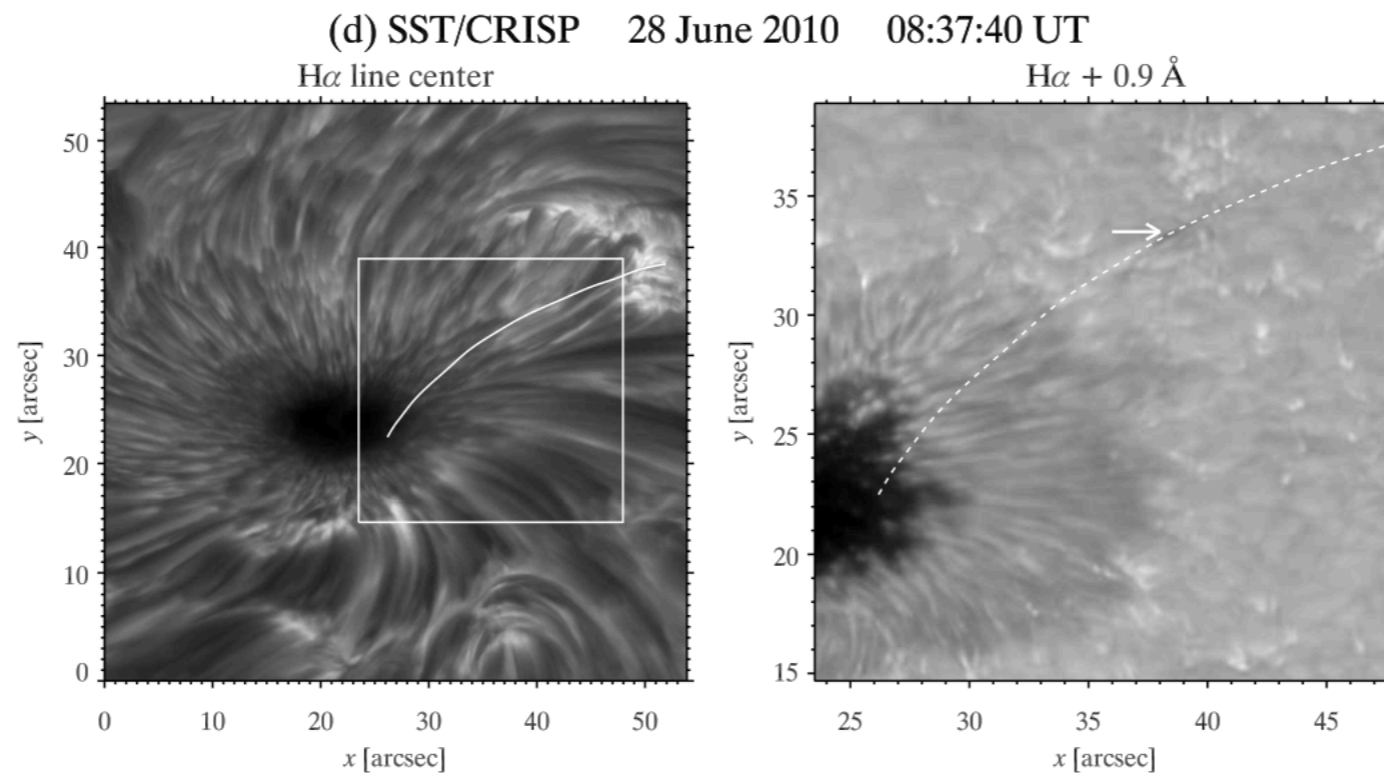
SST/CRISP 2014.09.06 08:23:07 H-alpha +1.200 09:46:17.936



$\mu=0.41$

coronal rain in H-alpha: very common in active regions(?)

on-disk coronal rain in 5 Active Regions



SST - IRIS - HINODE CO-OBSERVING CAMPAIGN

August 20 - 29, 2014

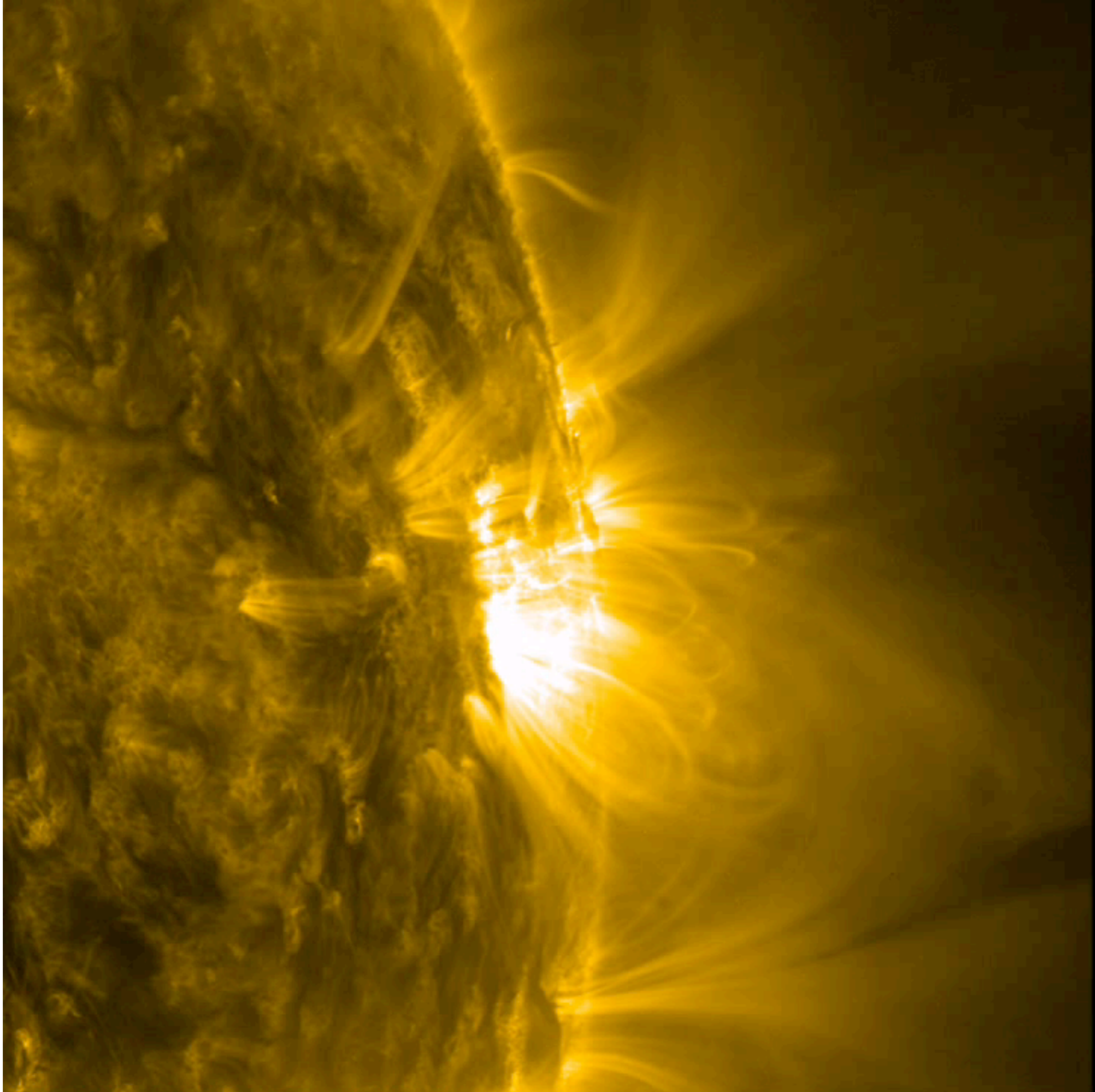
P. Antolin, G. Vissers, L. Rouppe van der Voort, Y. Katsukawa,
T. Van Doorselaere, E. Verwichte

Observers: Gregal Vissers, Patrick Antolin, Petra Kohutova,
Ding Yuan

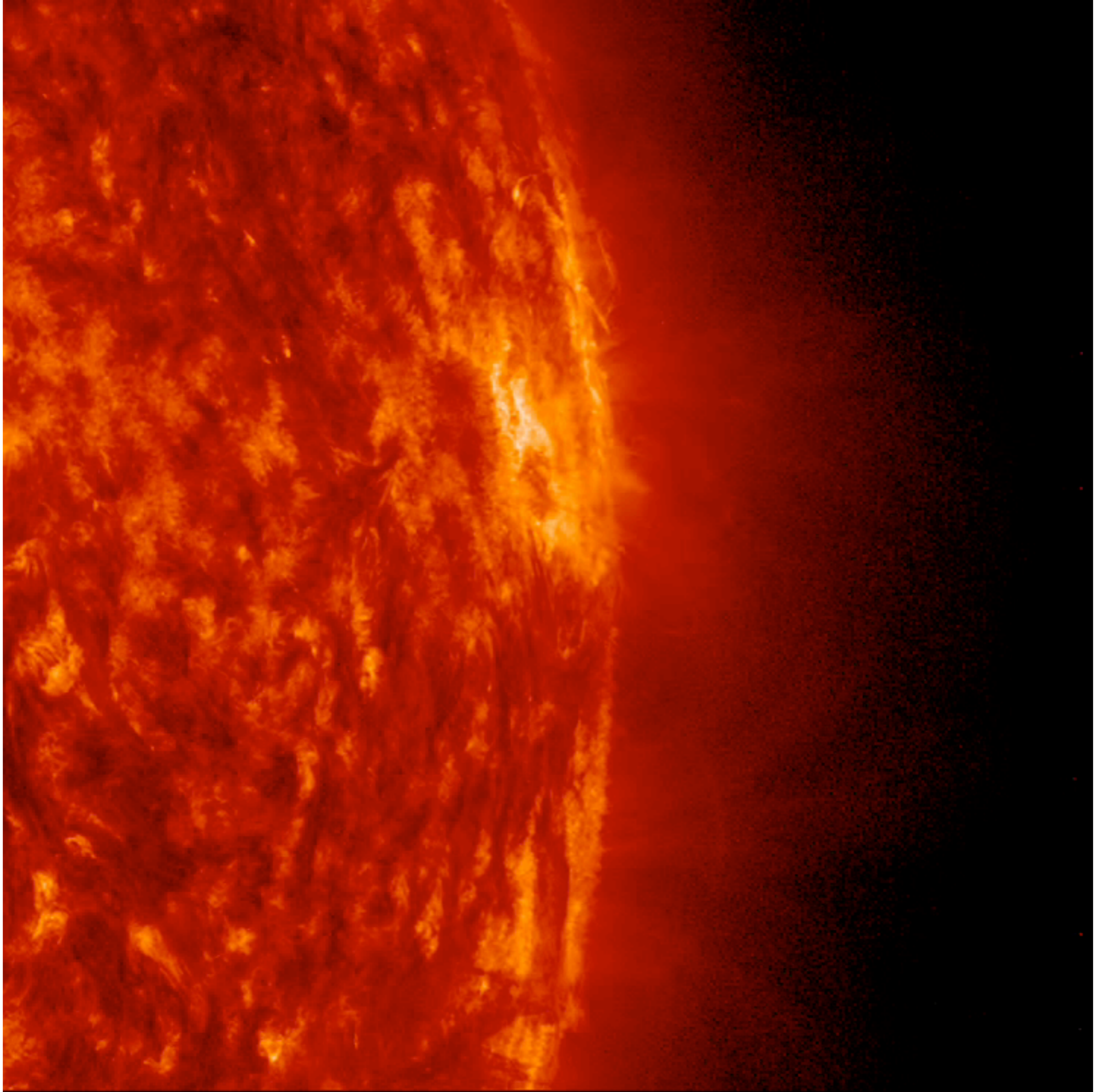
Selected data sets:

- 29-Aug-2014: filament eruption, SST + IRIS
- 23-Aug-2014: coronal rain, SST + IRIS
- 23-Aug-2014: coronal rain, SST only
- 24-Aug-2014: post-flare draining loops, SST only

29-Aug-2014: Filament eruption SST + IRIS



AIA 171 - 2014/08/29 - 15:30:11Z



AIA 304 - 2014/08/29 - 15:30:07Z

Filament eruption 29-Aug-2014

IRIS:

12:27:59 - 16:43:16, duration 04:15:17

OBS_DESC: Large coarse 8-step raster 14x120 8s C II Deep x 8 FUV spectrally

120" slit, 2" step

8s exposure

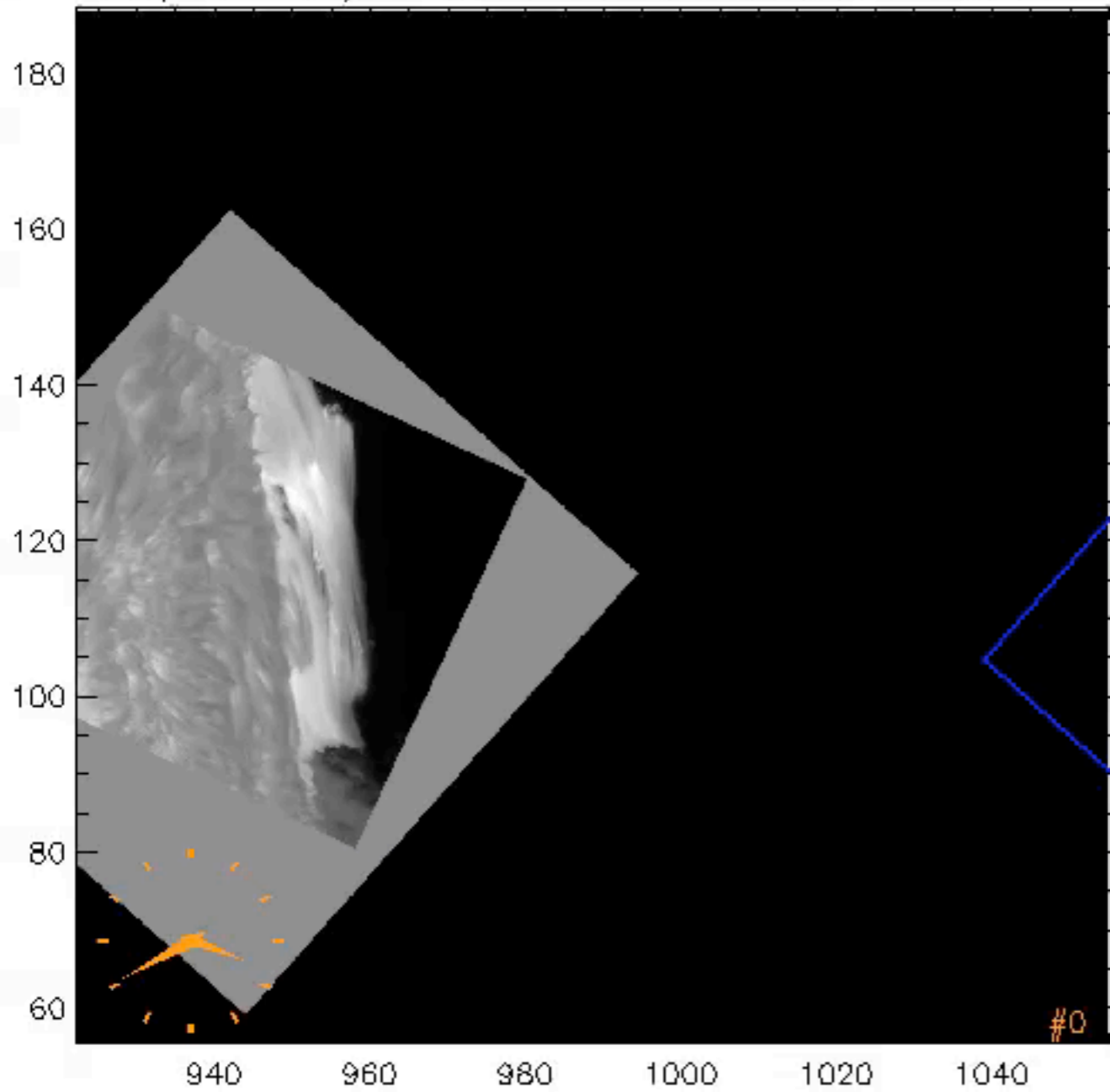
slitjaw SJI 1330 (C II)

SST:

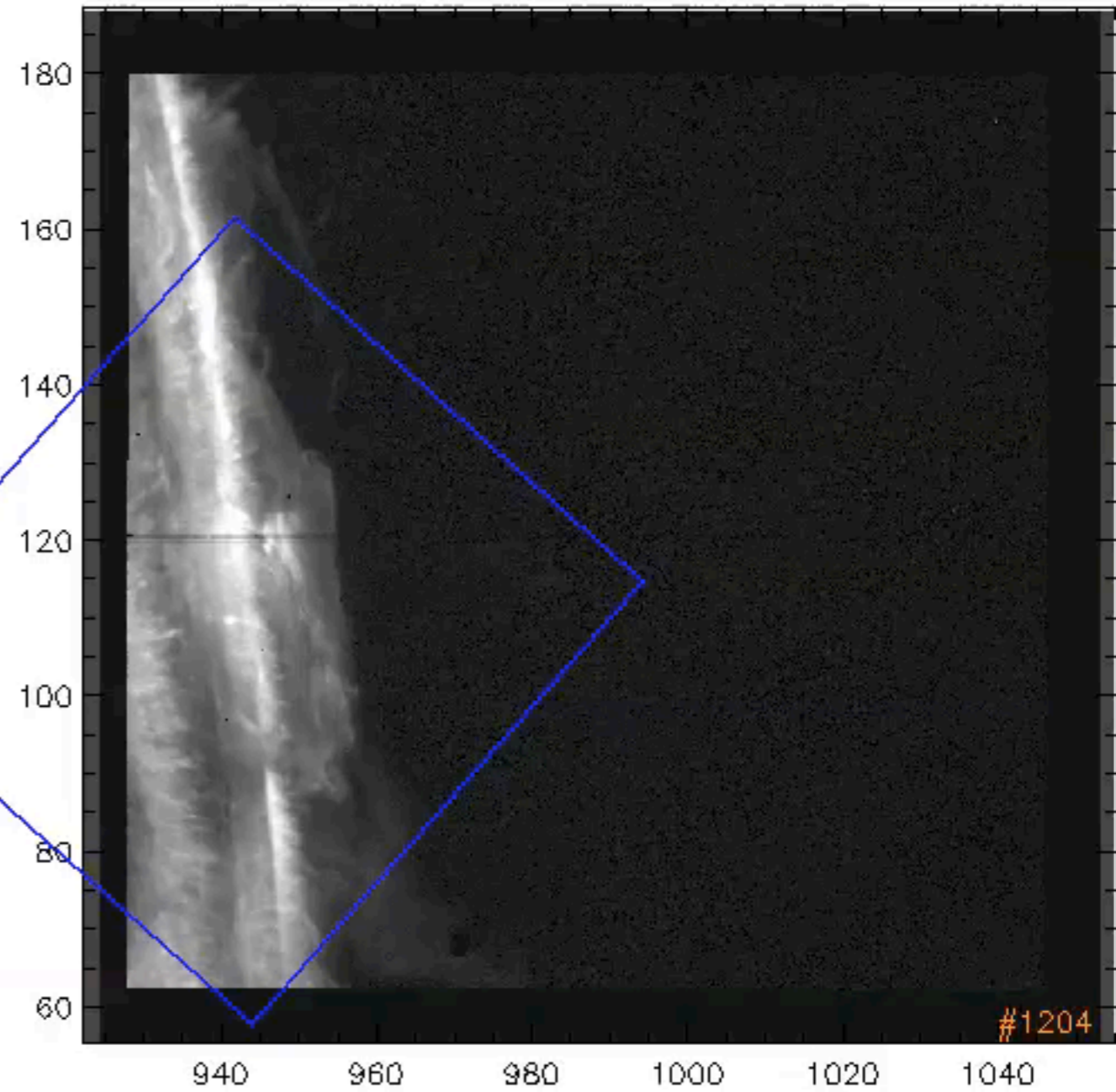
15:40 - 17:43, duration 02:03

H-alpha 39 line positions, 9s cadence

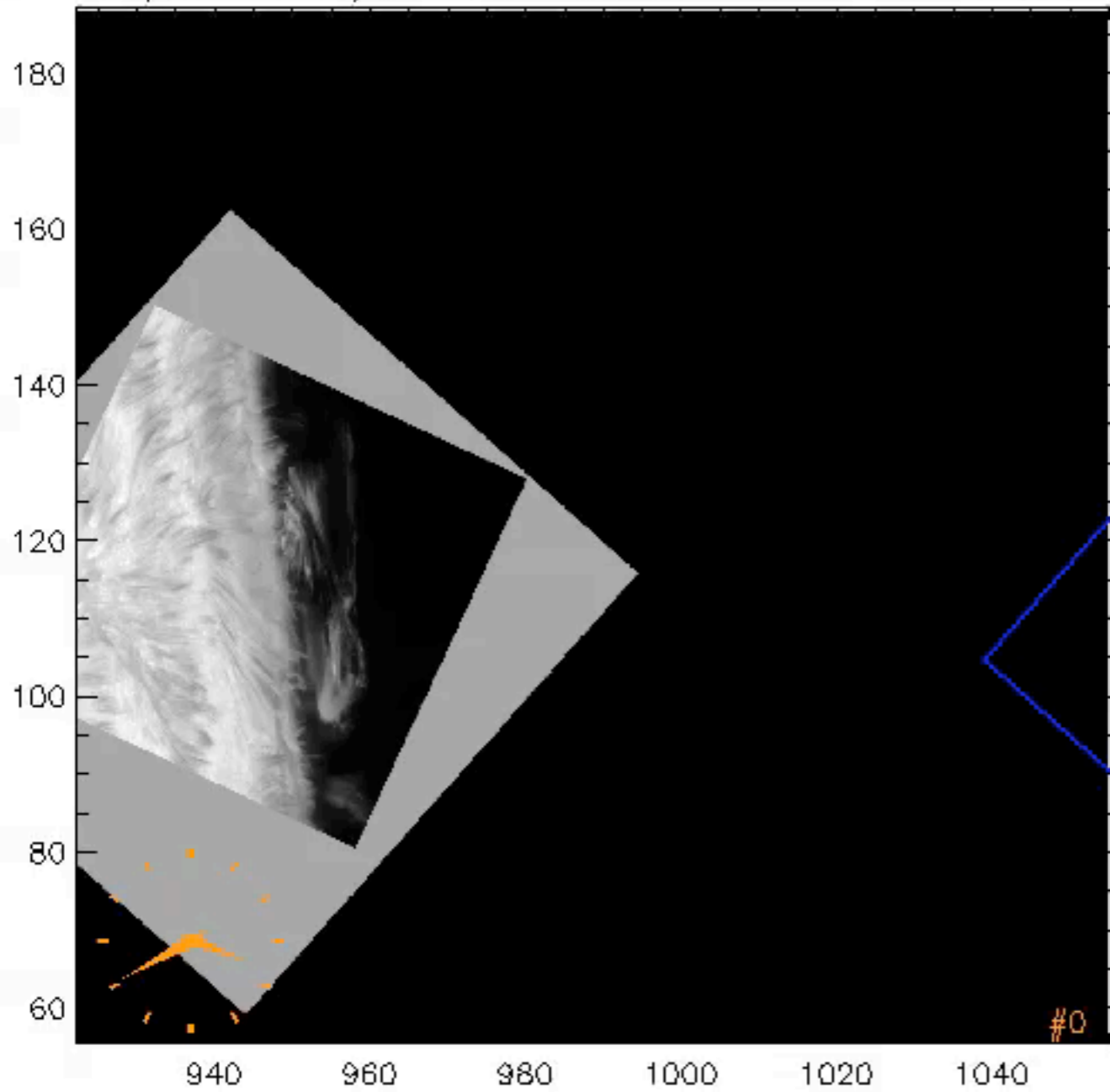
Halpha 0 km/s : 2014-08-29:15:40:09 : 15:40:13



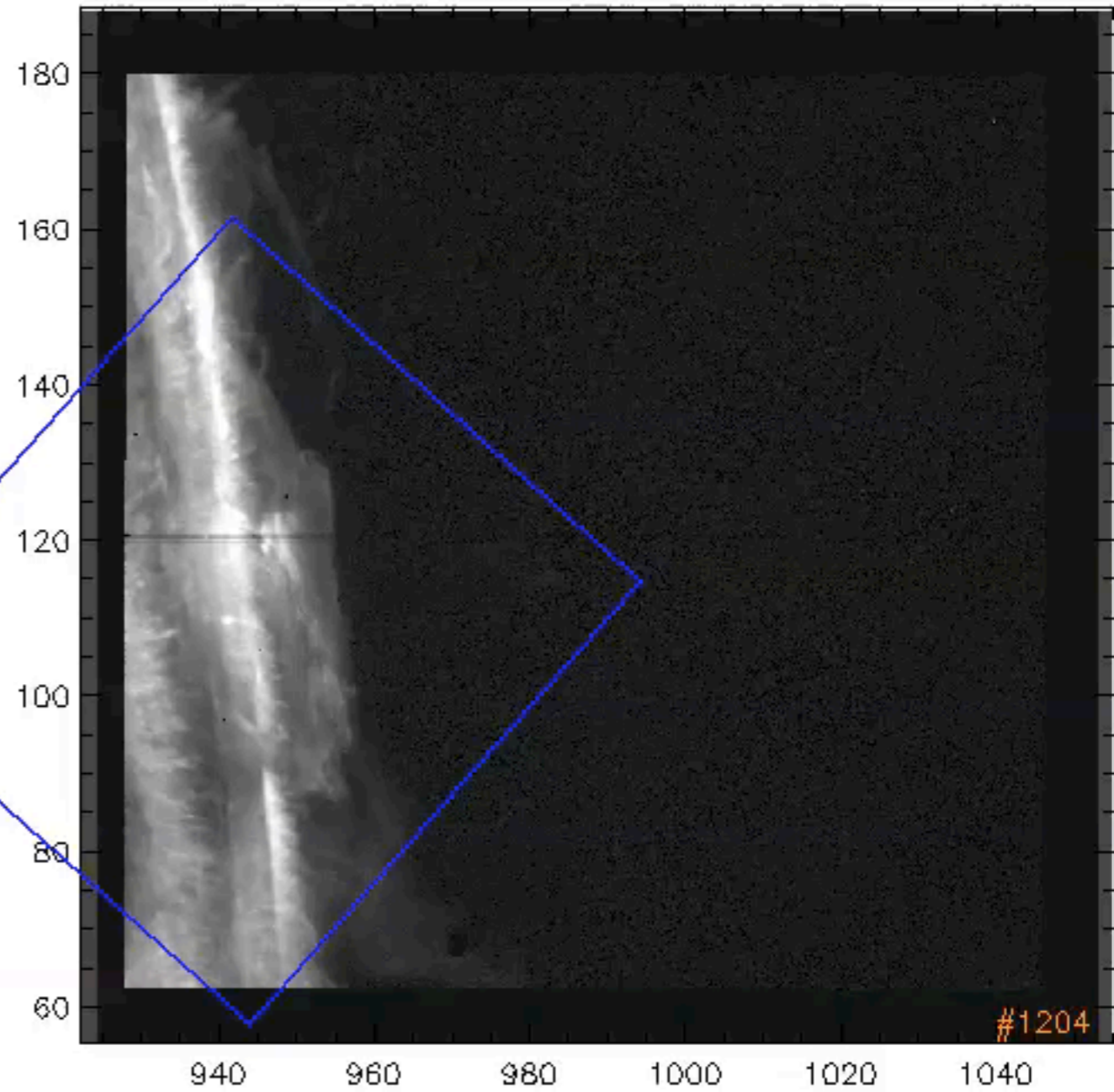
SJI 1330 20140829_122759_3820259580 : 15:40:11



Halpha 36 km/s : 2014-08-29 15:40:09 : 15:40:13

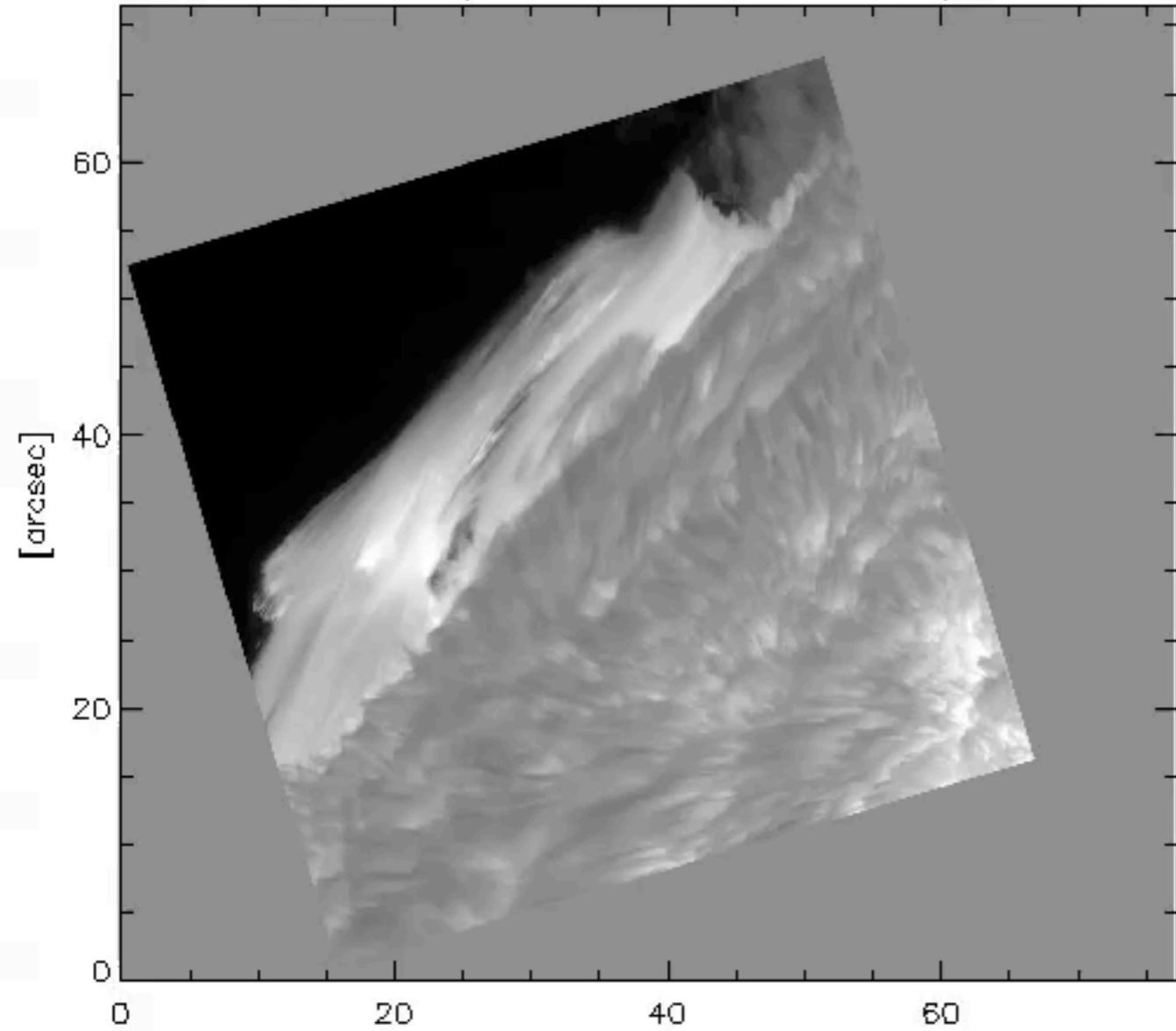


SJI 1330 20140829_122759_3820259580 : 15:40:11

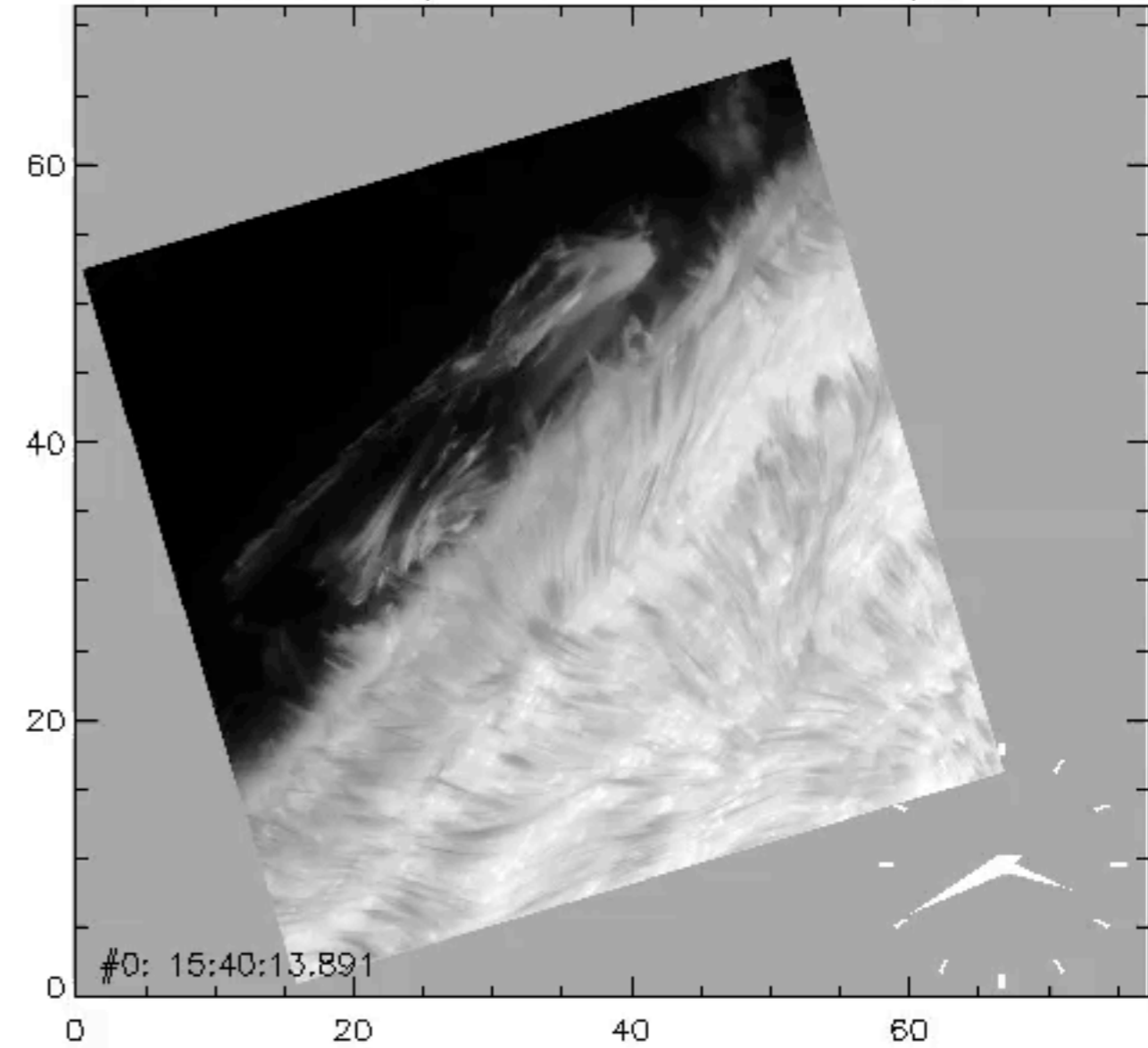


15:40 - 17:30, duration 01:50 h
39 line positions, 9 s cadence

2014.08.29 : SST/CRISP 15:40:09 : H-alpha +0.000

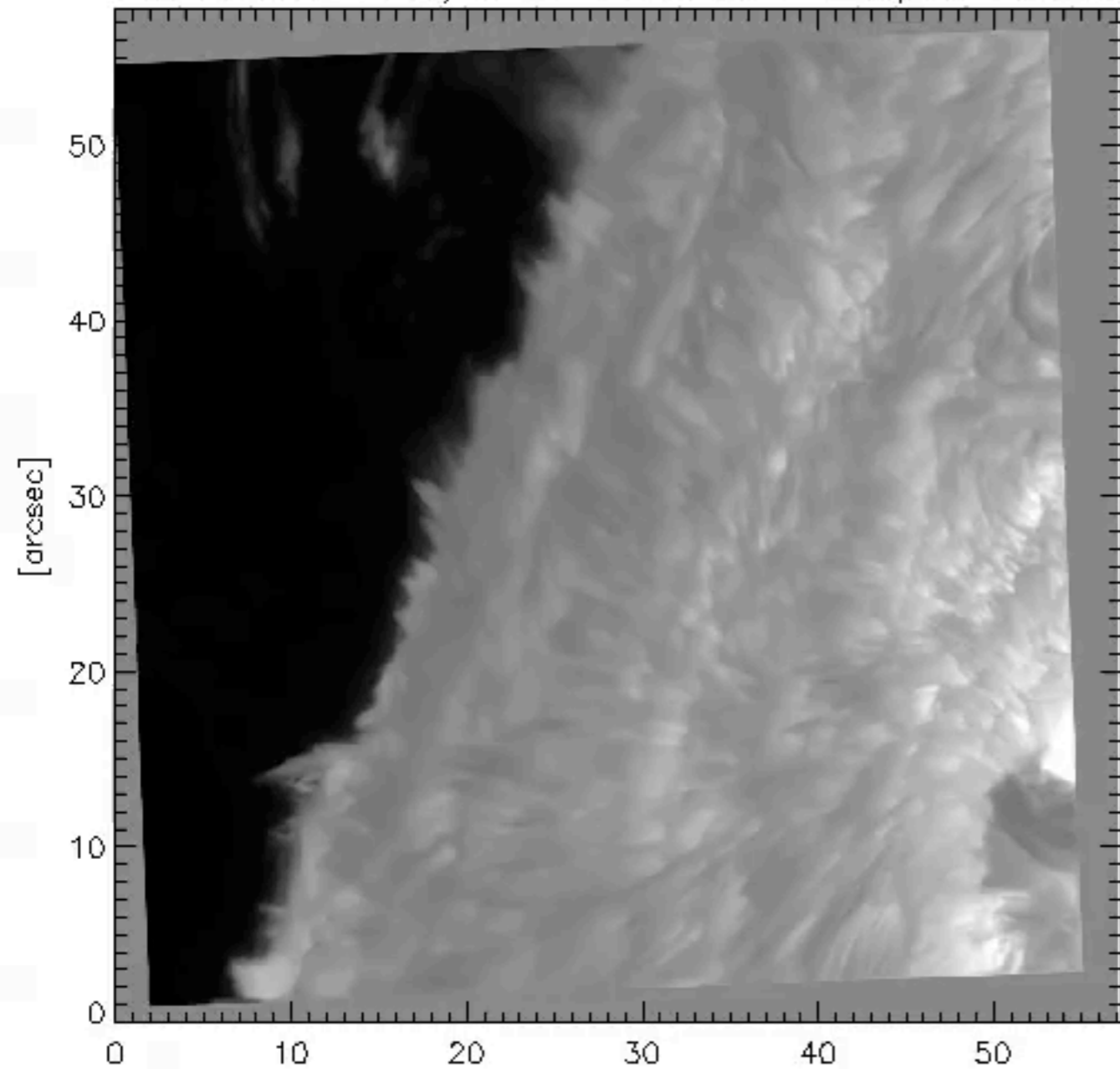


2014.08.29 : SST/CRISP 15:40:09 : H-alpha +0.800

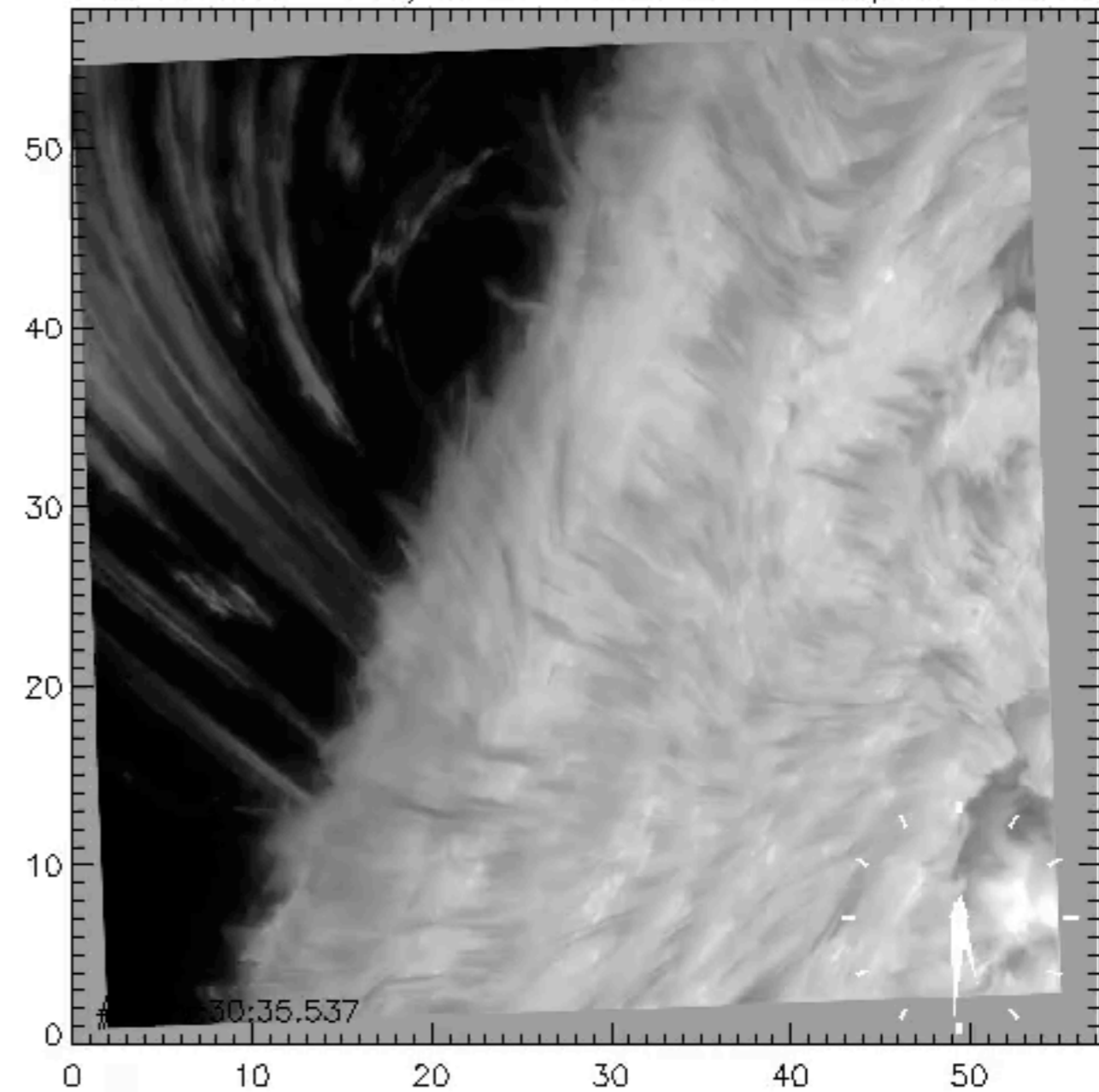


17:30 - 17:43, duration 13 min
39 line positions, 9 s cadence

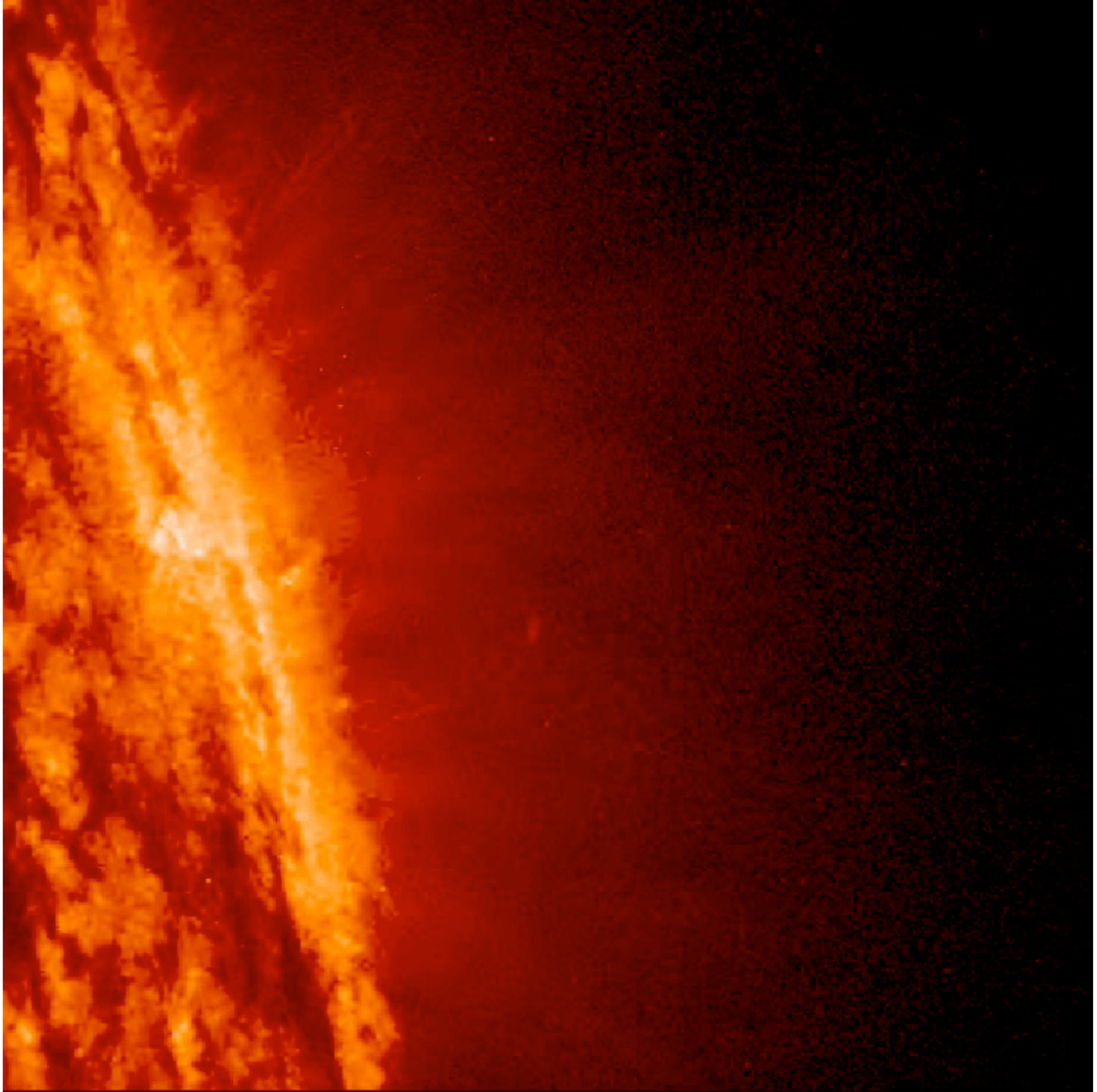
2014.08.29 ; SST/CRISP 17:30:30 ; H-alpha +0.000



2014.08.29 ; SST/CRISP 17:30:30 ; H-alpha +0.800



**23-Aug-2014: coronal rain
SST + IRIS**



AIA 304 - 2014/08/23 - 07:45:07Z

Coronal rain 23-Aug-2014

IRIS:

07:54 - 09:46, duration 01:51

OBS_DESC : Large sit-and-stare 0.3x120 1s Si IV Mg II h/k Deep x 8
120" slit

8s exposure

slitjaw SJI 1400 (Si IV) + SJI 2796 (Mg II)

SST:

07:52 - 10:00, duration 02:08

H-alpha 51 line positions, 11.6s cadence

IRIS:

10:04 - 11:20, duration 01:15

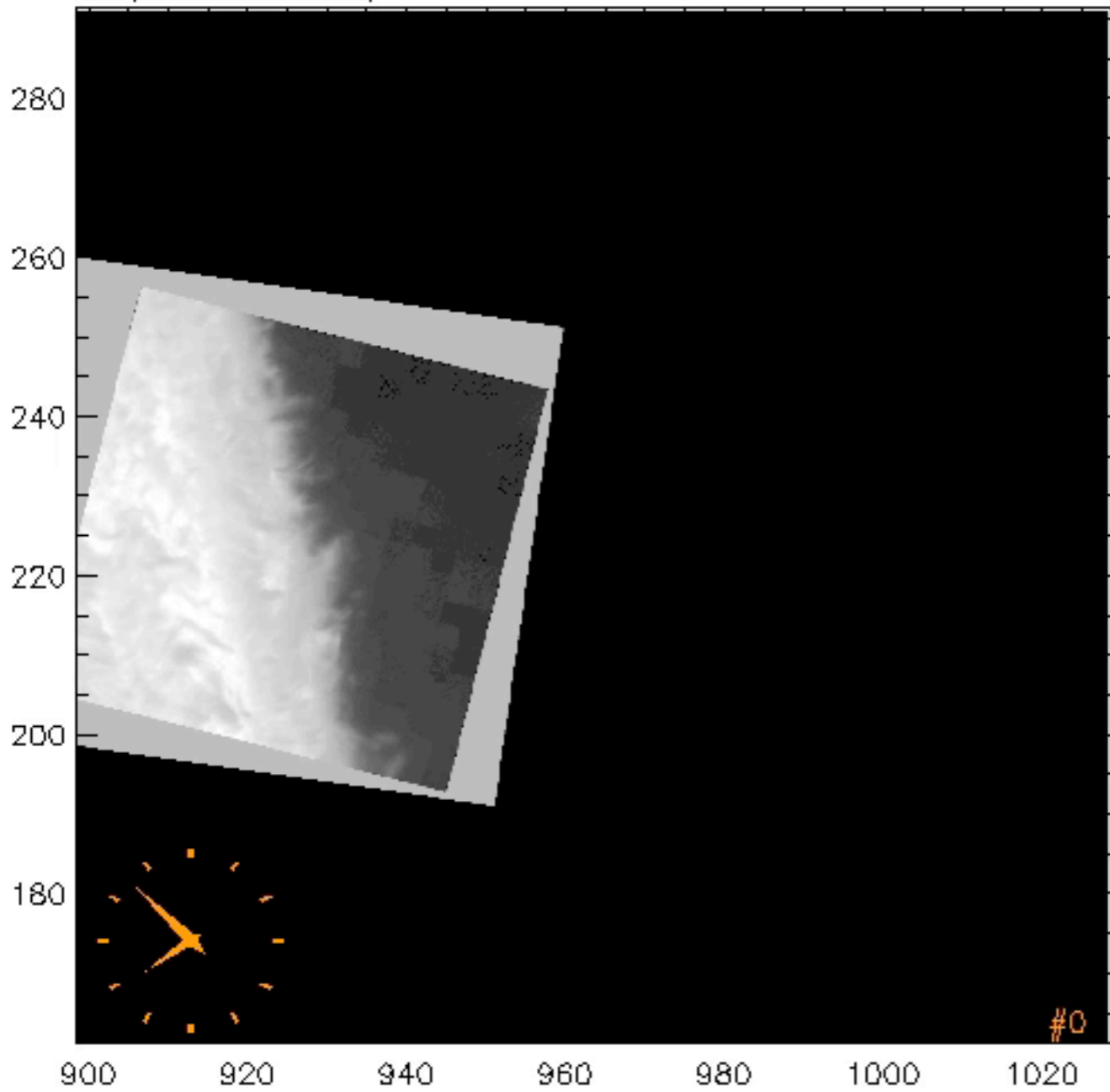
OBS_DESC : Large coarse 2-step raster 2x120 2s Si IV Mg II h/k Deep x 8 FUV
8s exposure

slitjaw SJI 1400 (Si IV) + SJI 2796 (Mg)

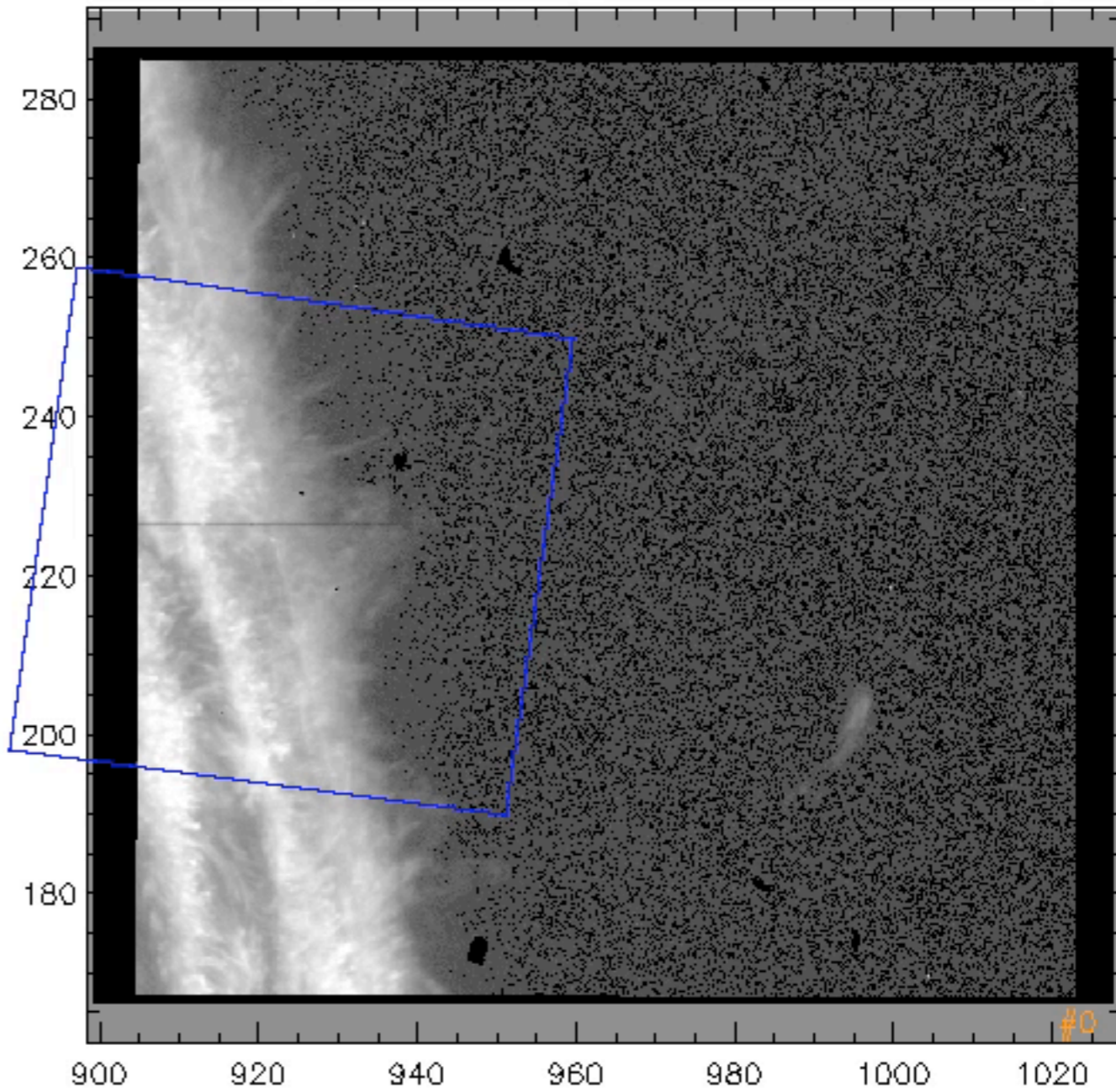
SST: 10:02 - 11:20, duration 01:18

H-alpha 51 line positions, 11.6s cadence

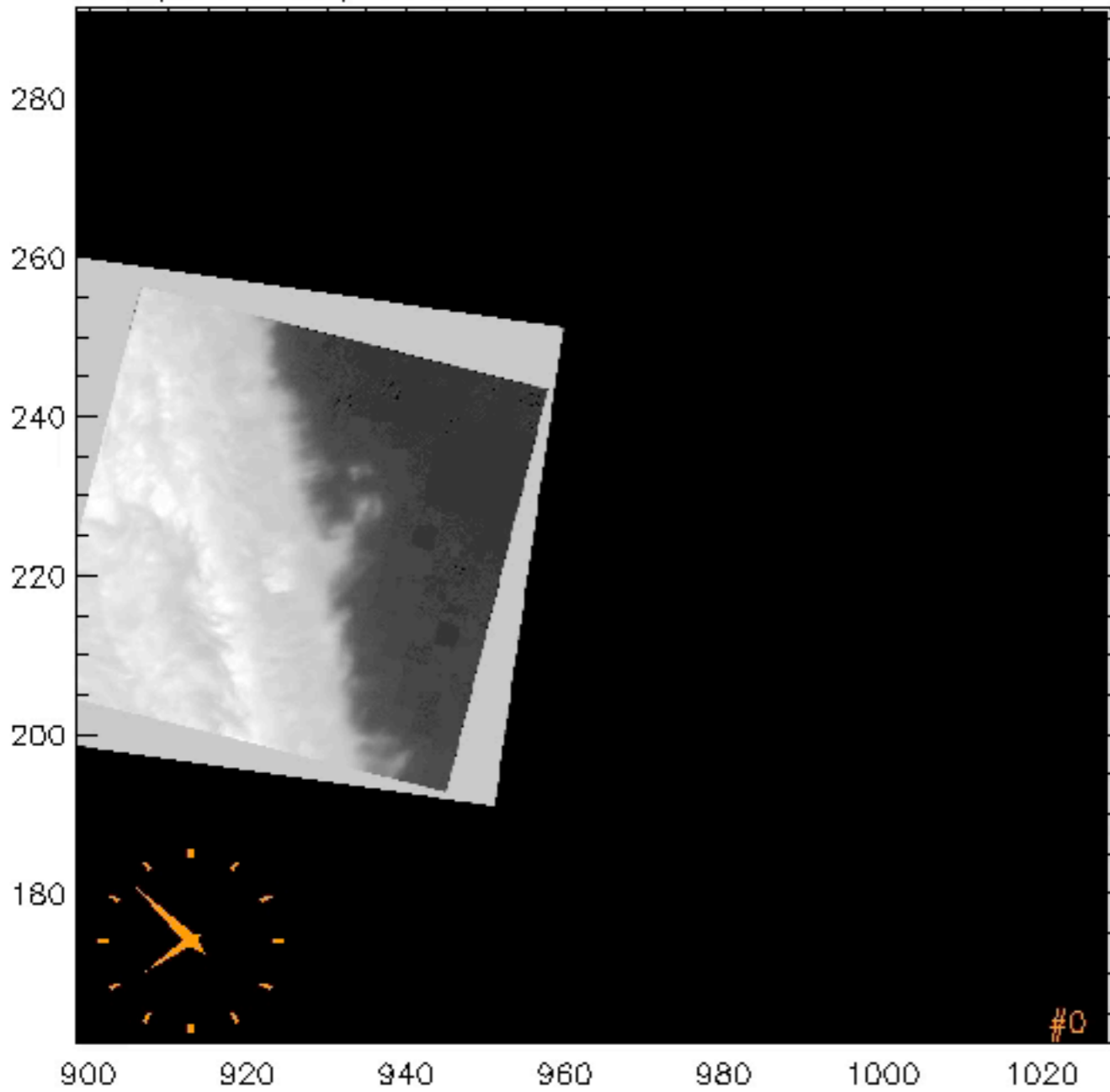
H α -22 km/s : 2014-08-23 07:52:04 : 07:52:10



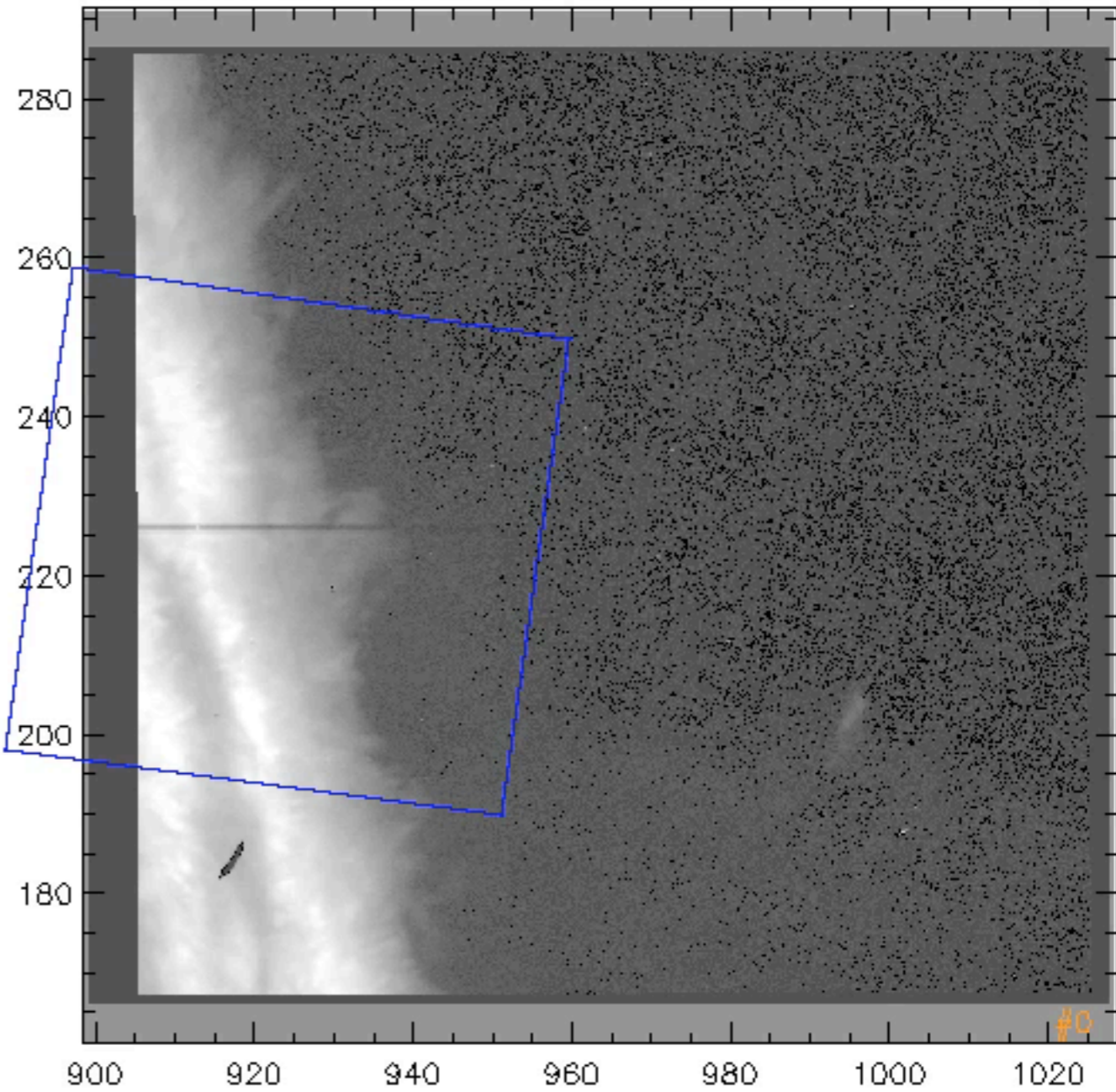
SJI 1400 20140823_075429_3820009453 : 07:54:29



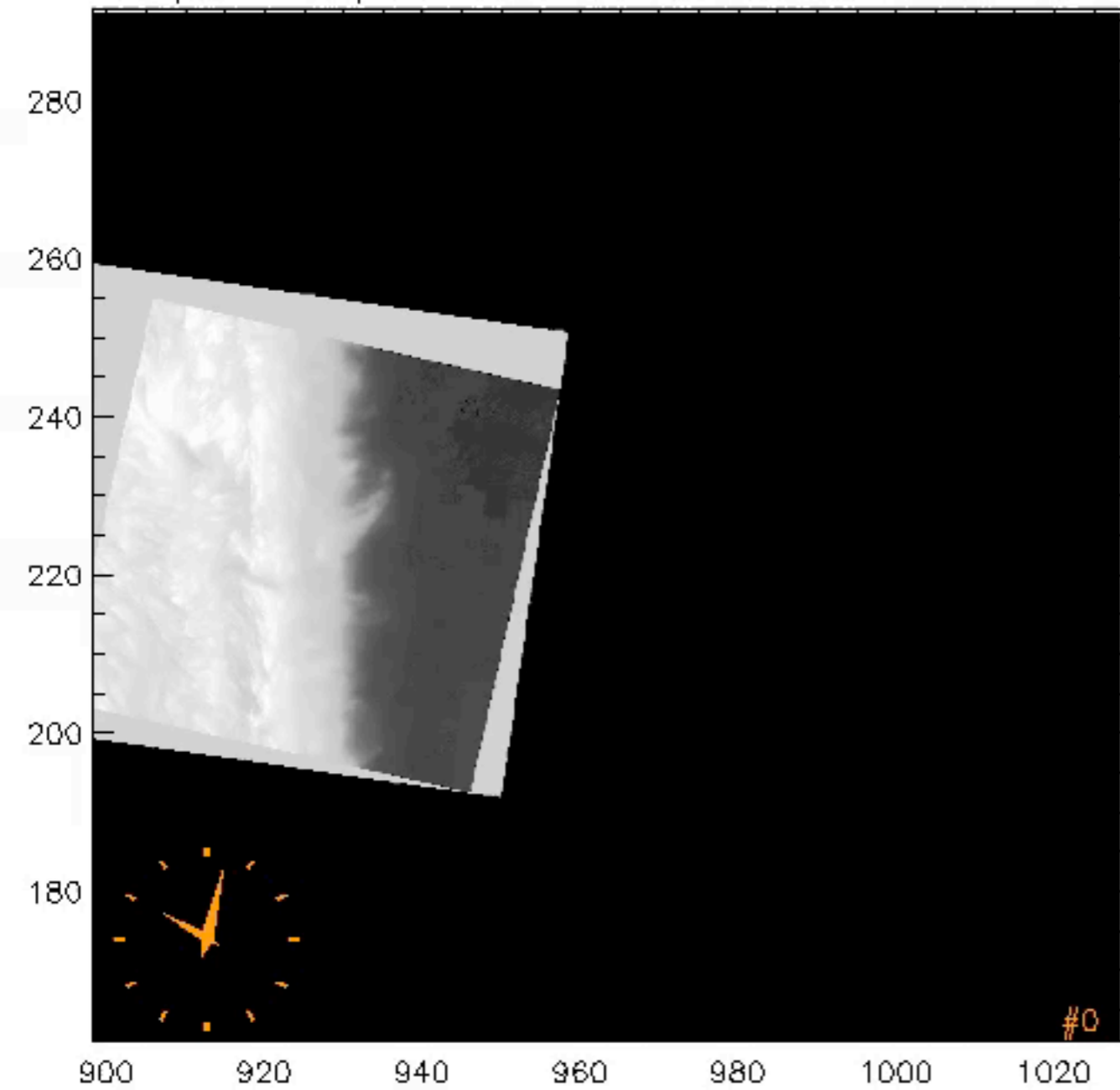
Halpha 4 km/s : 2014-08-23 07:52:04 : 07:52:10



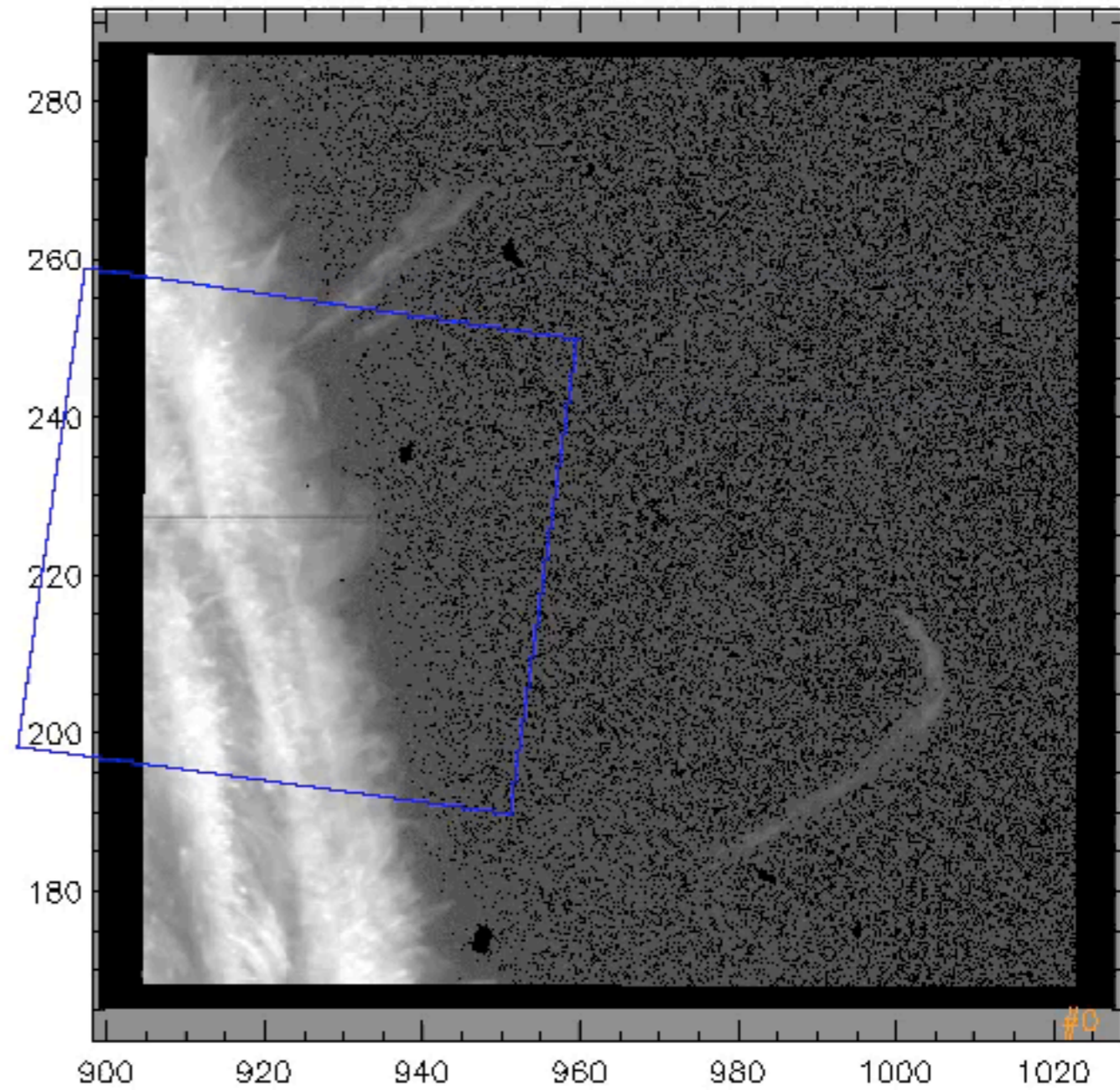
SJI 2796 20140823_075429_3820009453 : 07:54:39



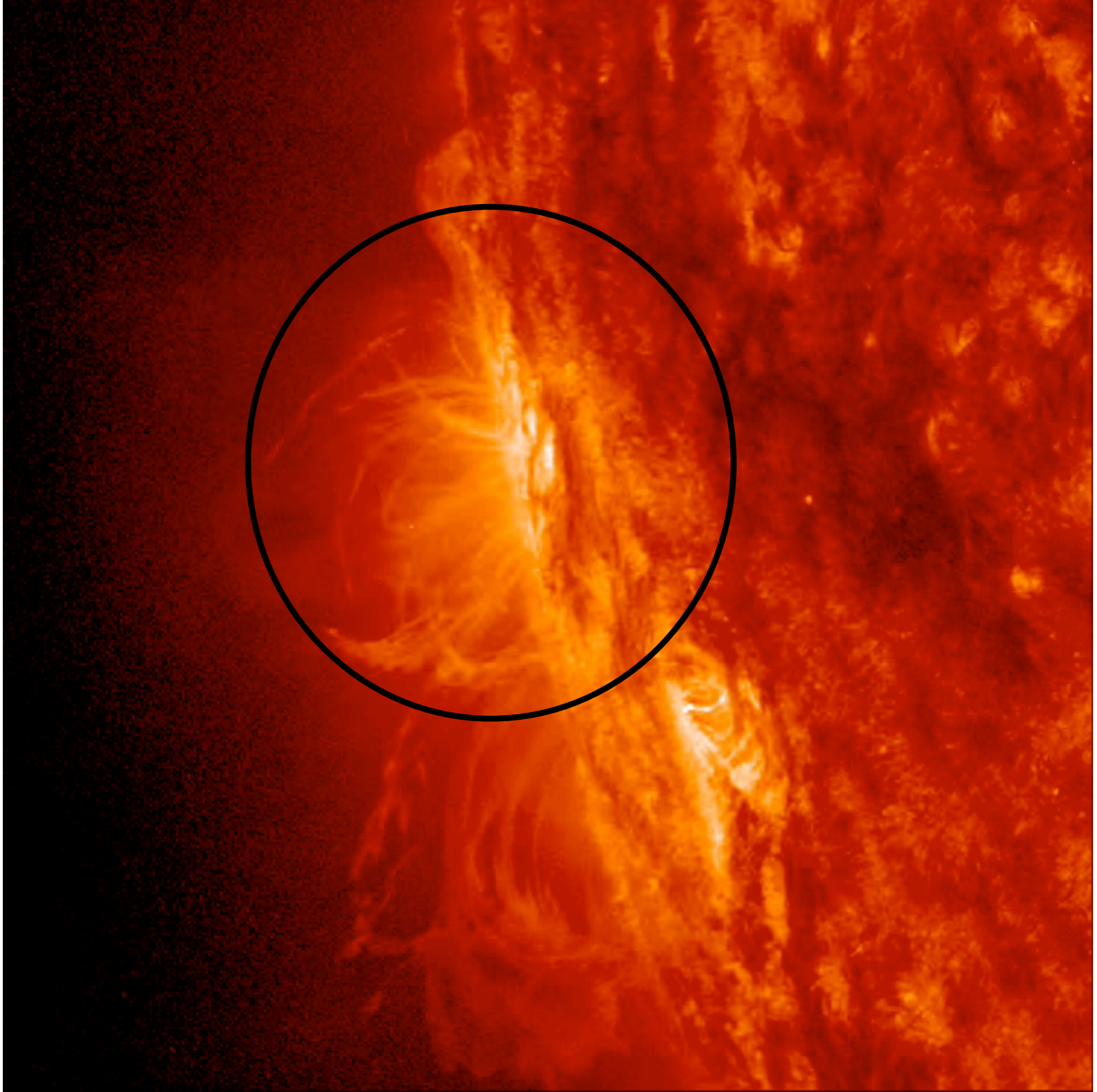
Halpha 4 km/s : 2014-08-23 10:02:03 : 10:02:09



SJI 1400 20140823_100444_3820259462 : 10:04:44



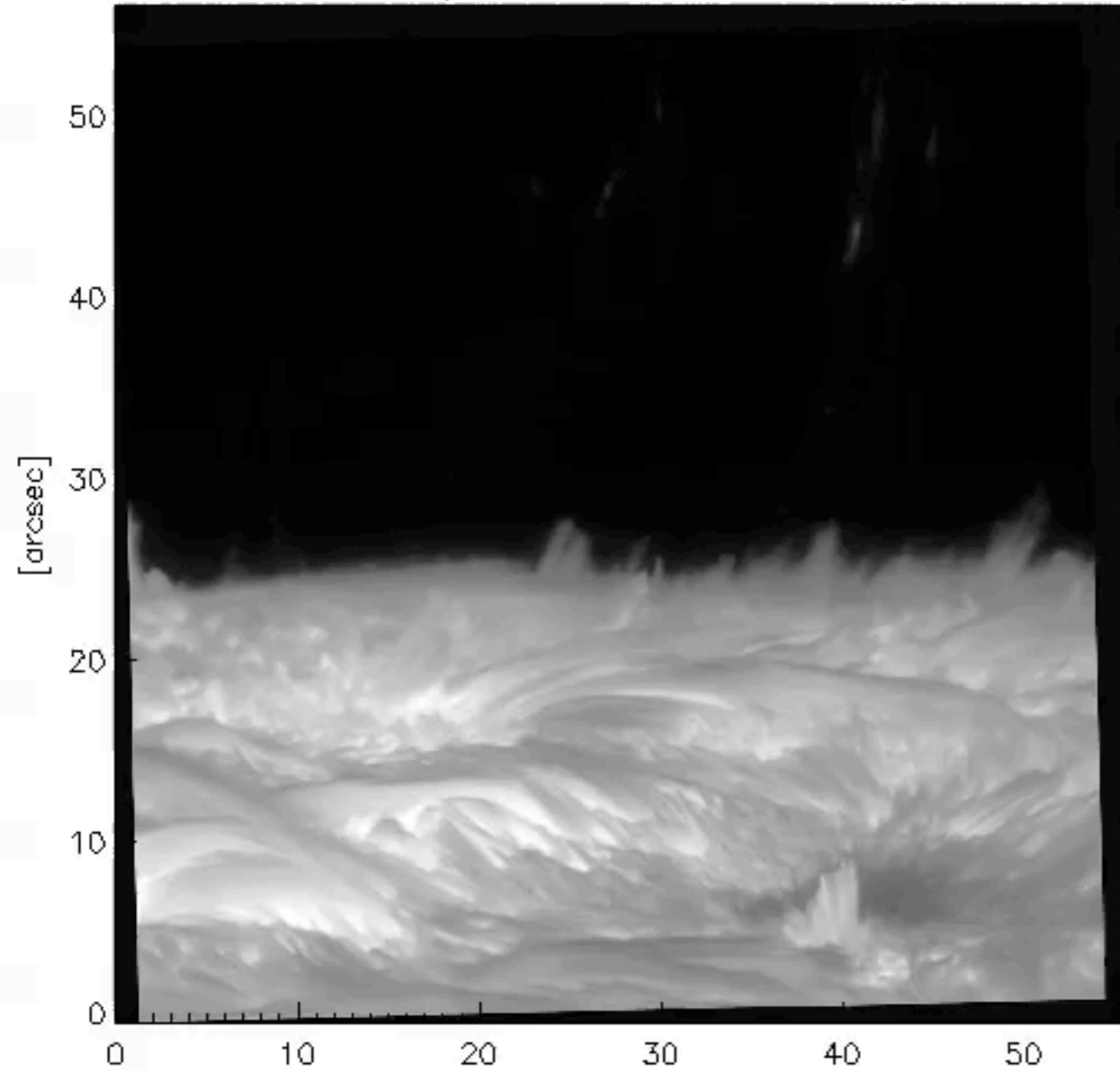
**23-Aug-2014: coronal rain
SST only**



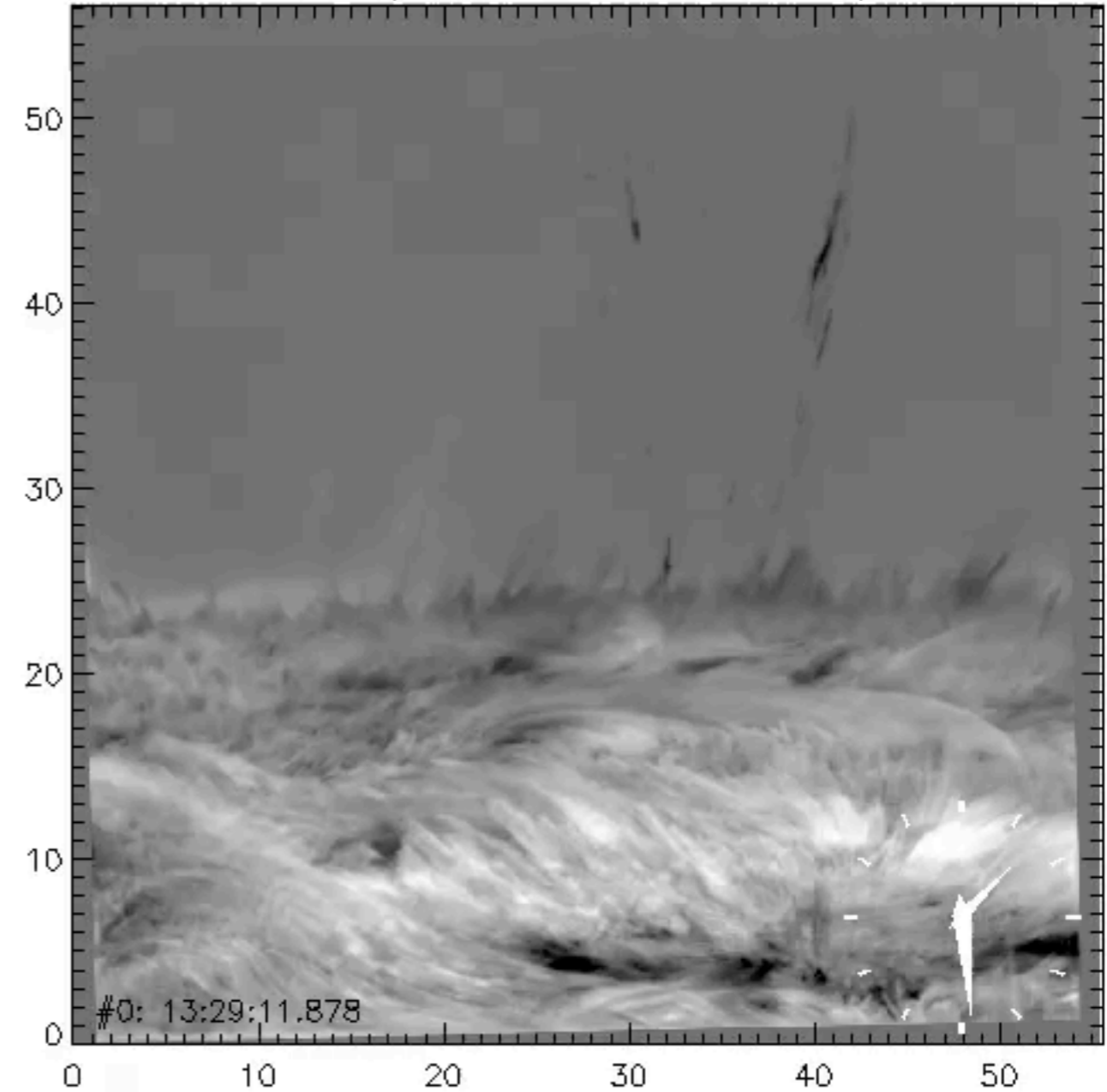
AIA 304 - 2014/08/23 - 13:25:07Z

13:29 - 13:47, duration 18 min,
51 line positions, 11.6 s cadence

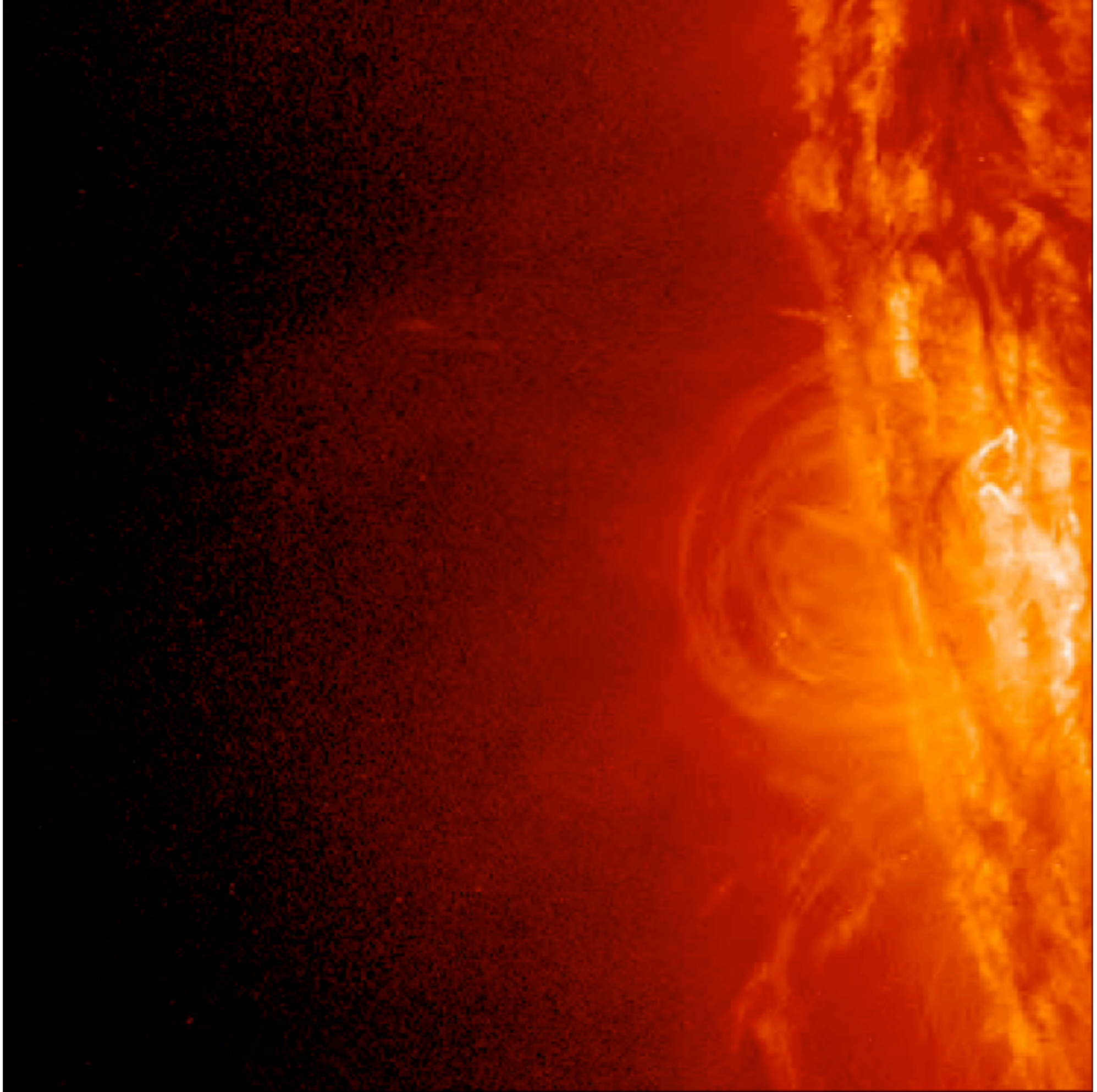
2014.08.23 : SST/CRISP 13:29:05 : H-alpha +0.000



2014.08.23 : SST/CRISP 13:29:05 : H-alpha +-0.560



**24-Aug-2014: M5.9 flare near limb
post-flare draining loops: SST only**



AIA 304 - 2014/08/24 - 11:45:19Z

M5.9 flare near limb 24-Aug-2014

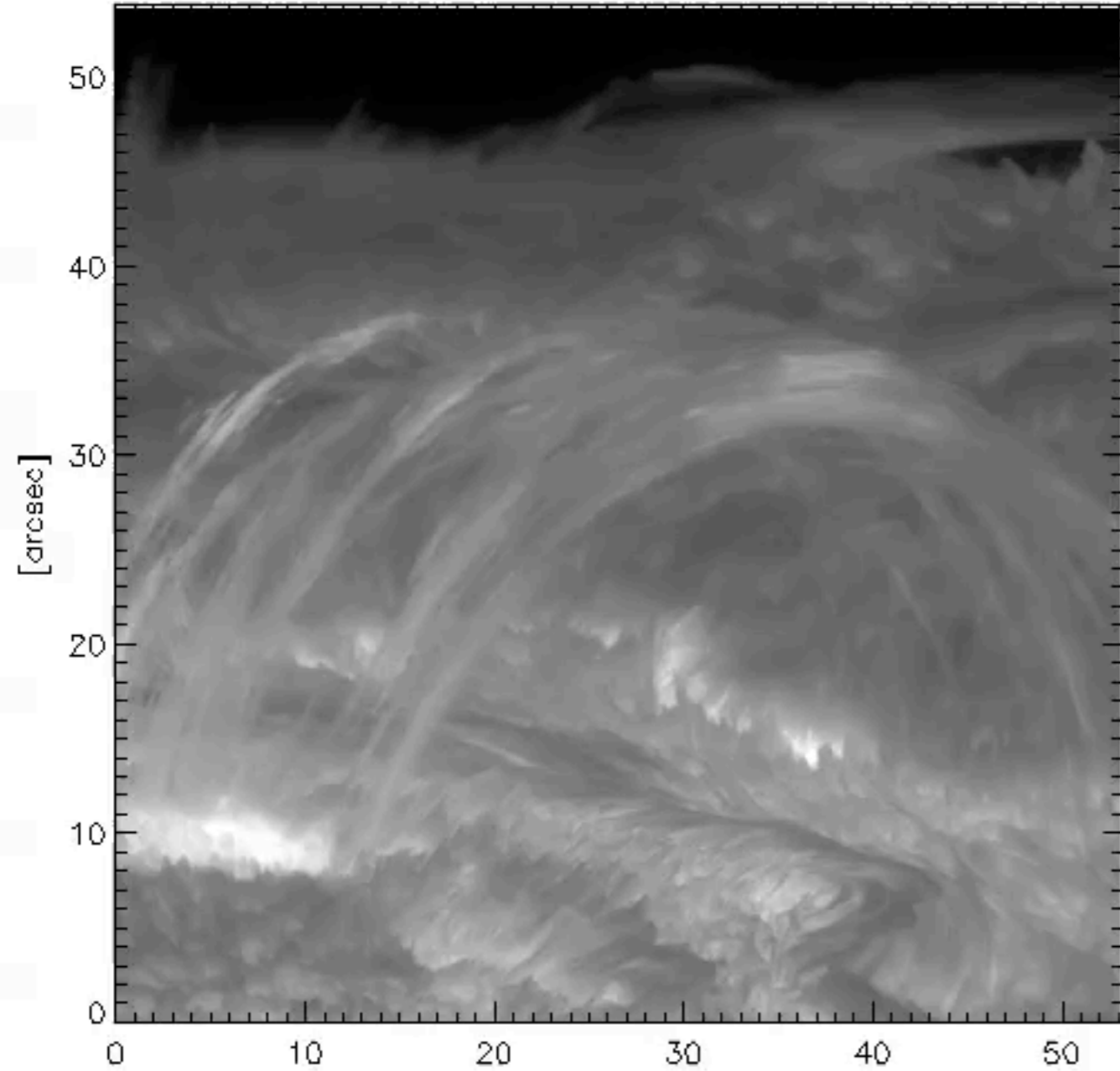
SST: post-flare draining loops

12:56 - 13:02 and 13:05 - 13:21, duration 5 + 16 min

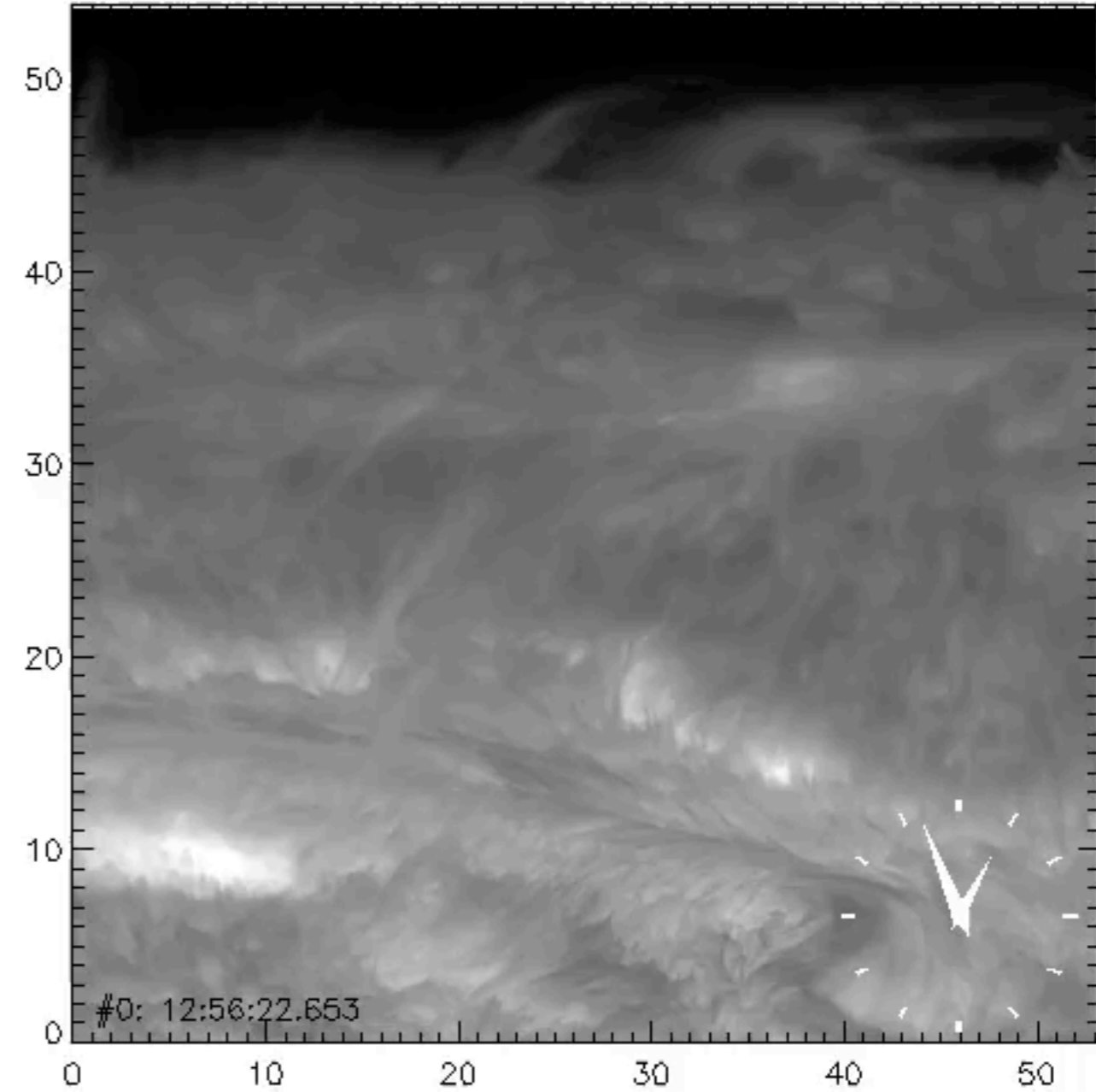
H-alpha 51 line positions, 11.7 s cadence

12:56 - 13:01, duration 5 min,
51 line positions, 11.6 s cadence

2014.08.24 : SST/CRISP 12:56:16 : H-alpha +0.000

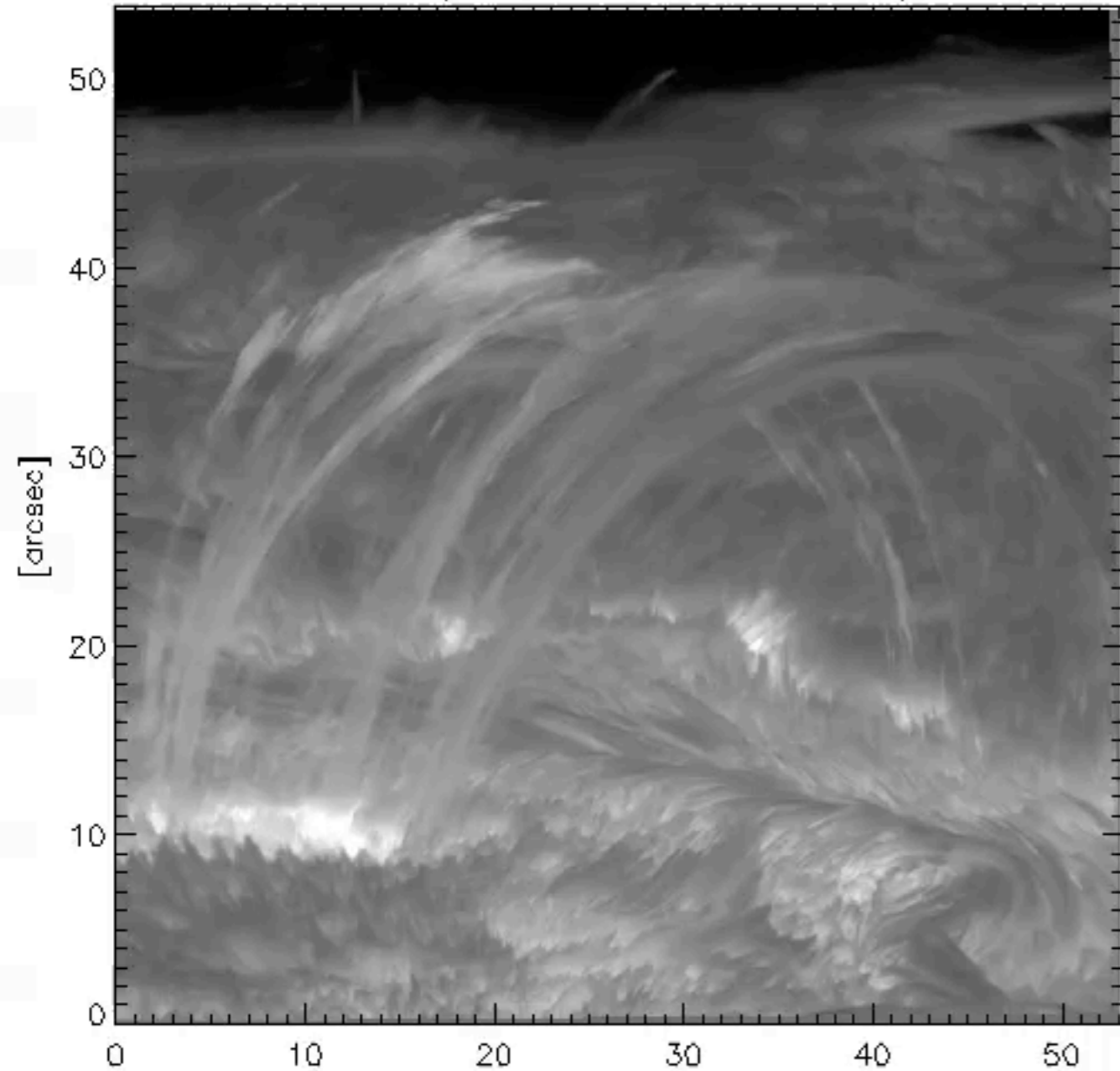


2014.08.24 : SST/CRISP 12:56:16 : H-alpha +0.400

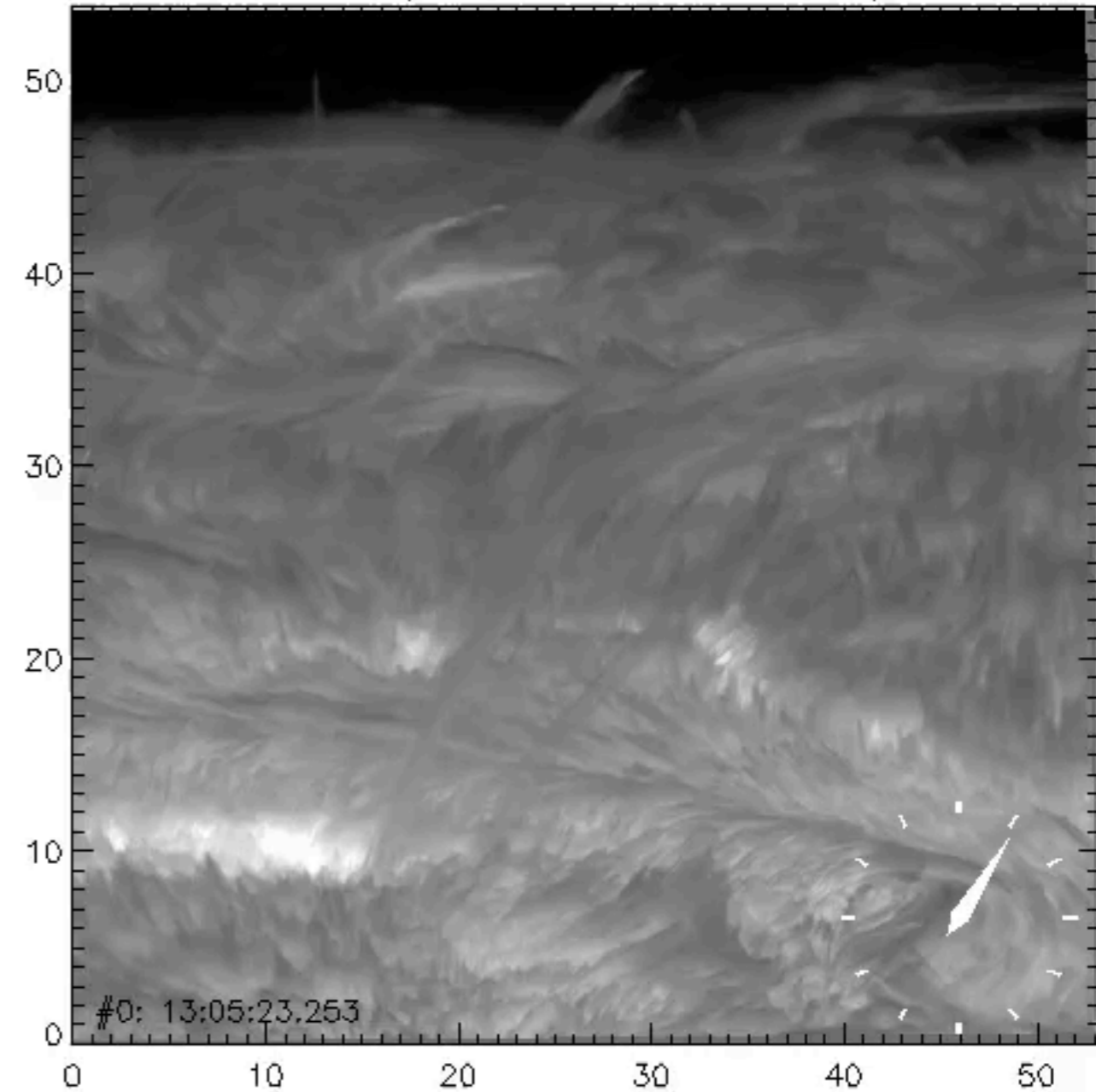


13:05 - 13:21, duration 16 min,
51 line positions, 11.6 s cadence

2014.08.24 : SST/CRISP 13:05:17 : H-alpha +0.000



2014.08.24 : SST/CRISP 13:05:17 : H-alpha +0.400

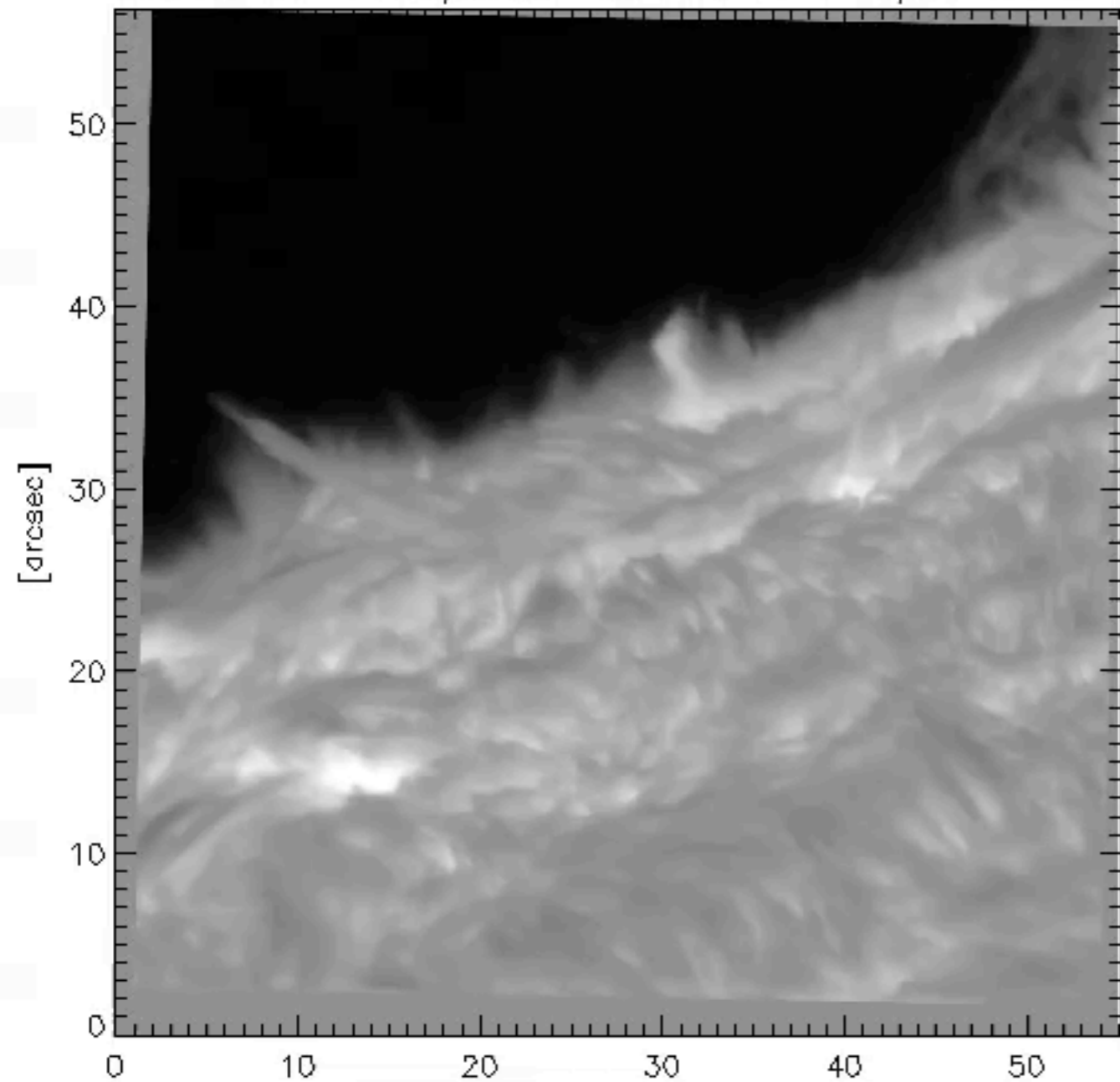


Other data (not relevant for this meeting?)

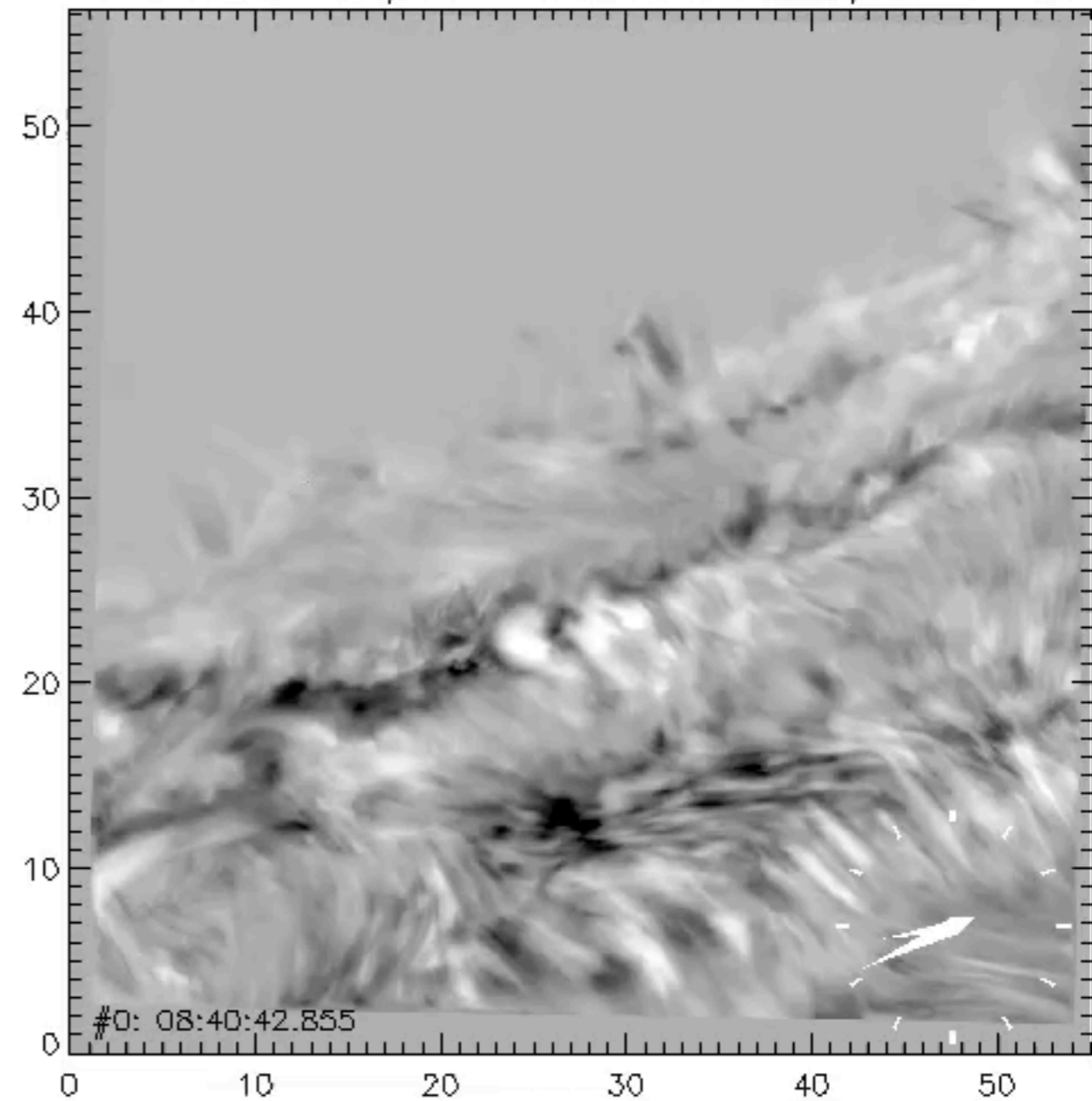
- 29-Aug-2014: surge
- 29-Aug-2014: prominence

08:40 - 09:01, duration 21 min,
51 line positions, 11.6 s cadence

2014.08.29 : SST/CRISP 08:40:36 : H-alpha +0.000

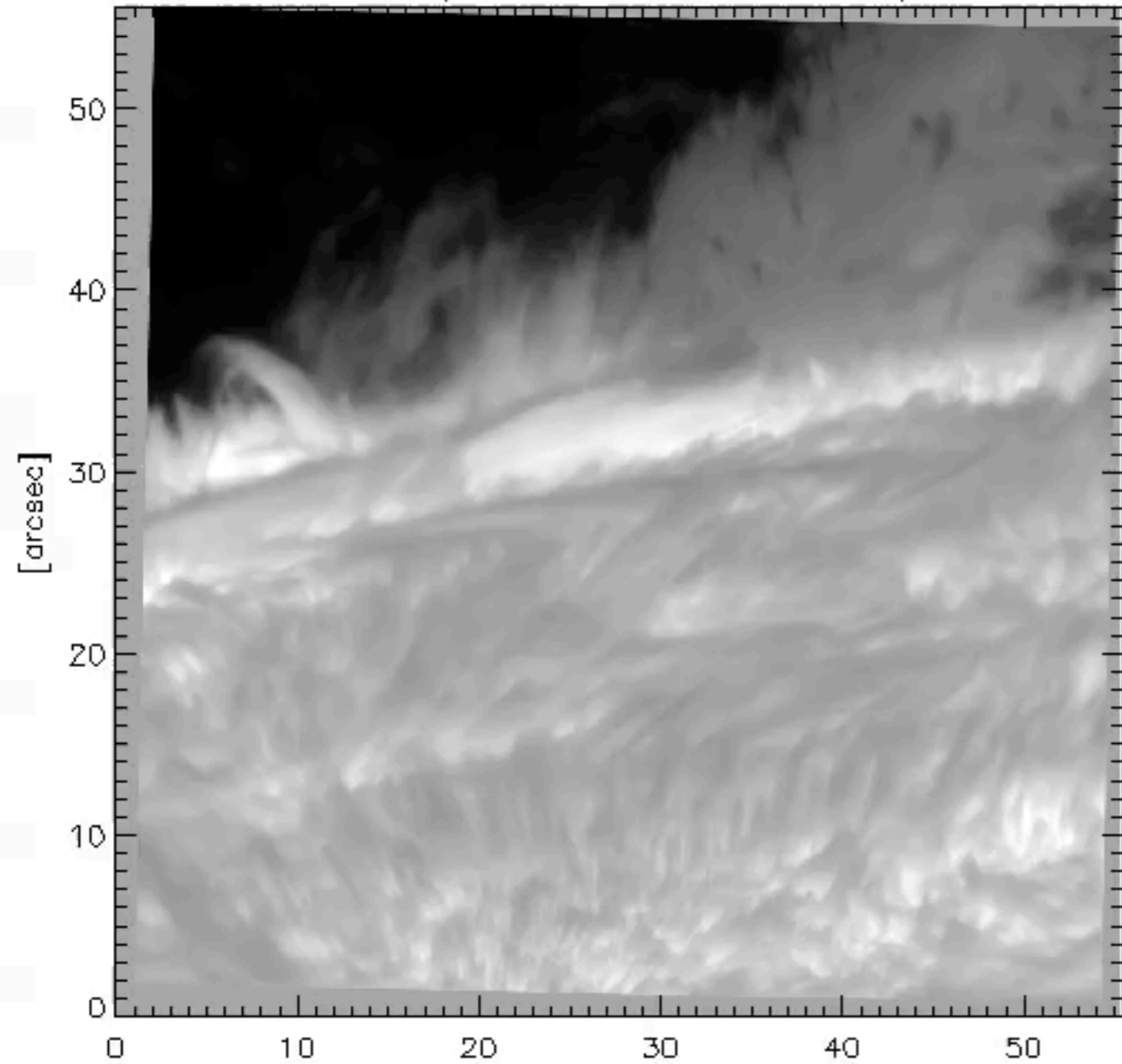


2014.08.29 : SST/CRISP 08:40:36 : H-alpha +/-0.560



10:00 - 10:20, duration 20 min,
51 line positions, 11.6 s cadence

2014.08.29 : SST/CRISP 09:59:54 : H-alpha +0.000



2014.08.29 : SST/CRISP 09:59:54 : H-alpha +-0.560

