First co-temporal GREGOR and IRIS observations of a solar flare

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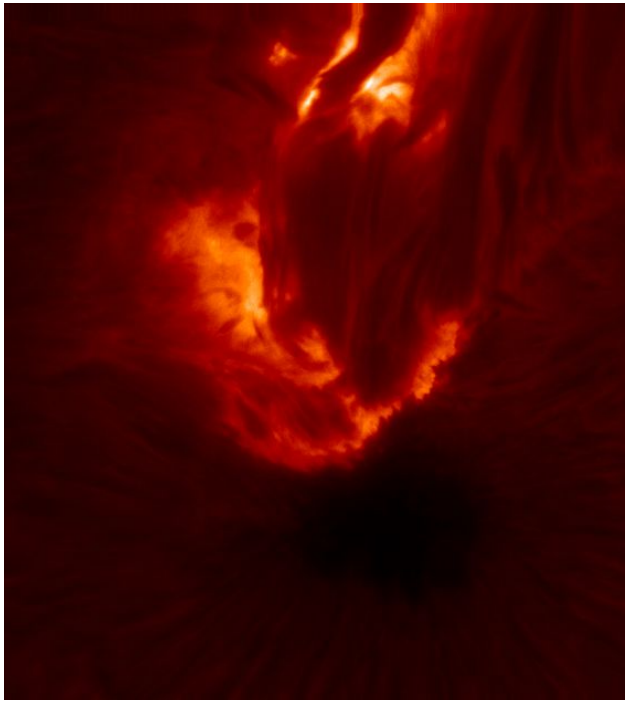

1. GREGOR observing campaign

GREGOR telescope, Observatorio del Teide (ES)

15 observing days, from 2 to 20 May 2022 (Mo-Fr)

Funded by the **SOLARNET Access Programme**

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1. IRIS and Hinode

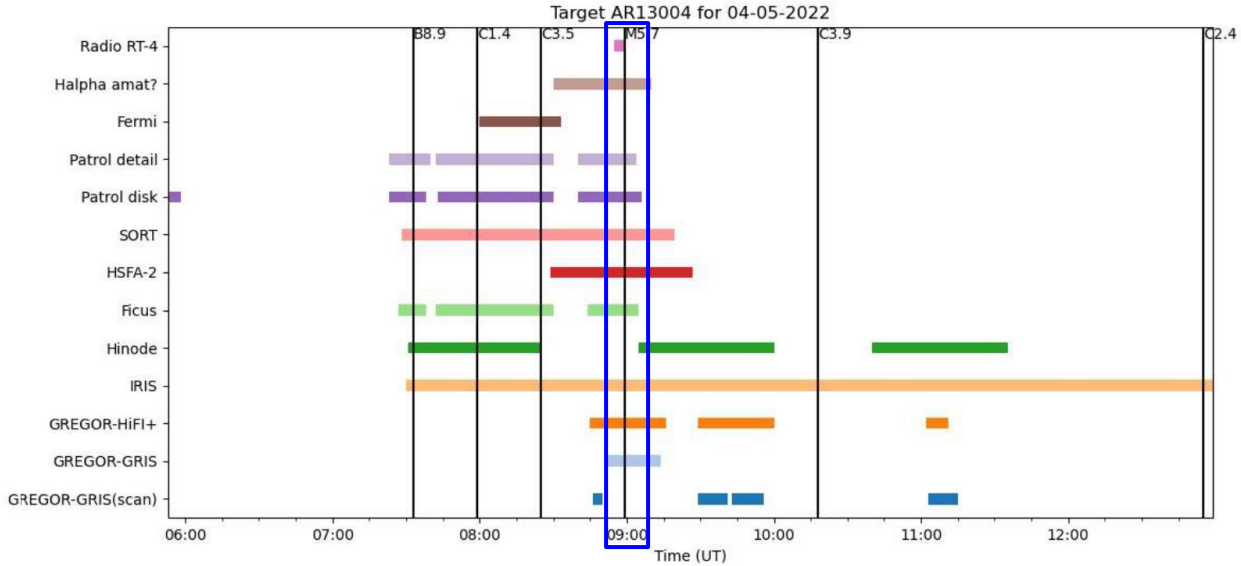
IHOP 422

8 coordinated days

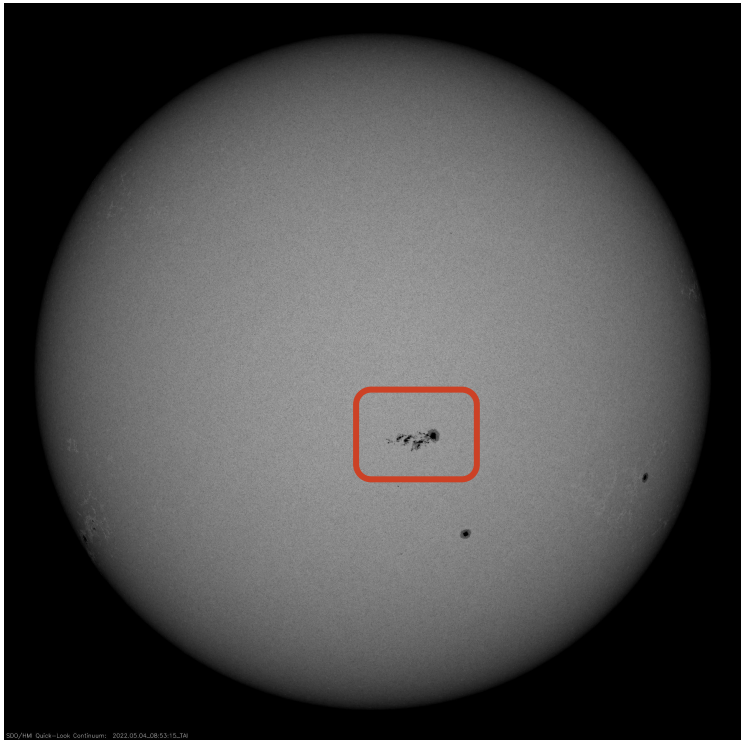
From 2 to 11 May 2022 (Mo-Fr)

1. More coordinated observations

- M5.7 flare, covered in radio, IR, optical, and EUV by several instruments
- behind the limb for Solar Orbiter



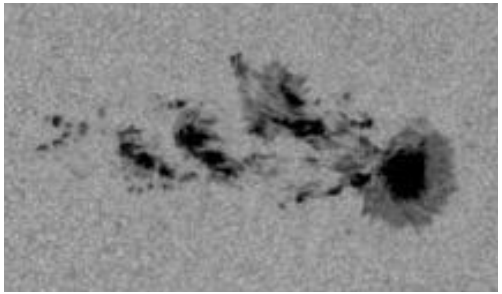
2. NOAA 13004

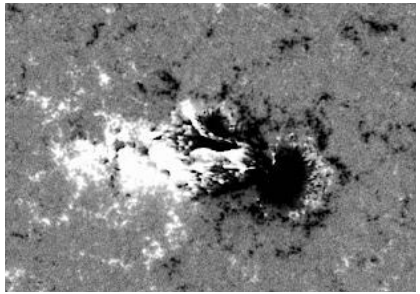


The active region NOAA 13004 emerged around 2 May 2022. During 3 May the leading proto-spot developed a penumbra.

The slit position should cross the PIL, where there is a higher probability to catch a flare.

<u>7 B-flares. 50 C-flares, 4 M-flares</u>





2. M5.7 flare on NOAA 13004

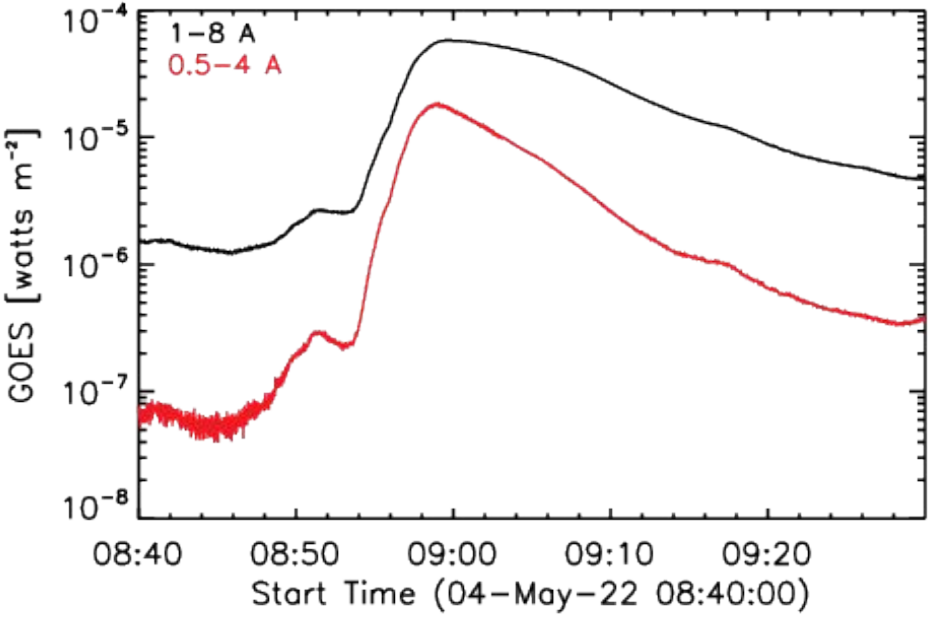
4 May 2022

M5.7 flare

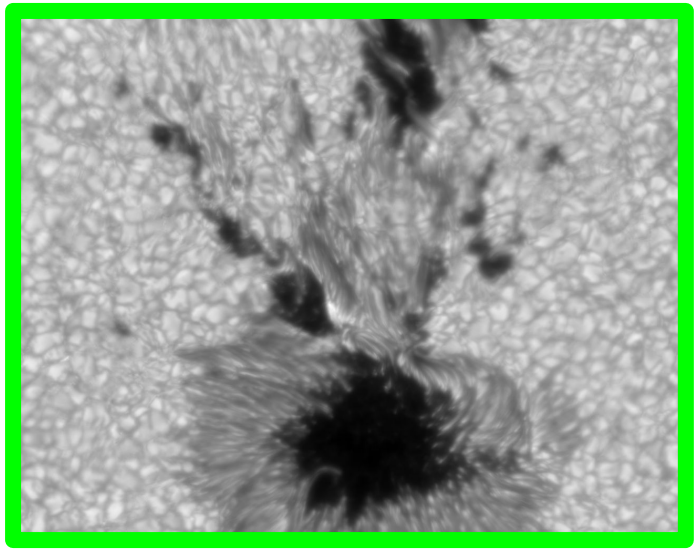
From ~8:45 UT

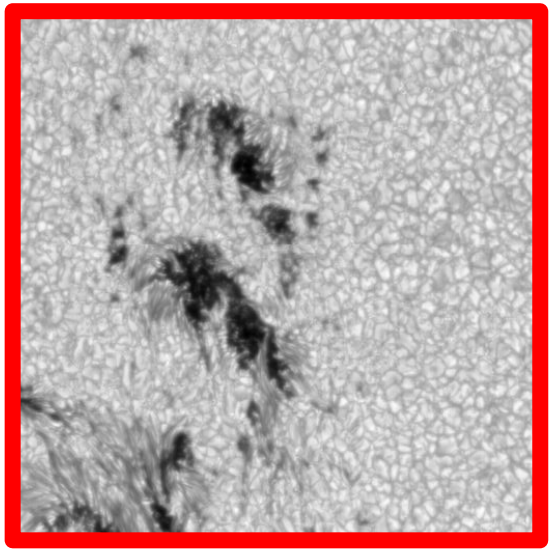
Impulsive phase ~ 8:54 UT

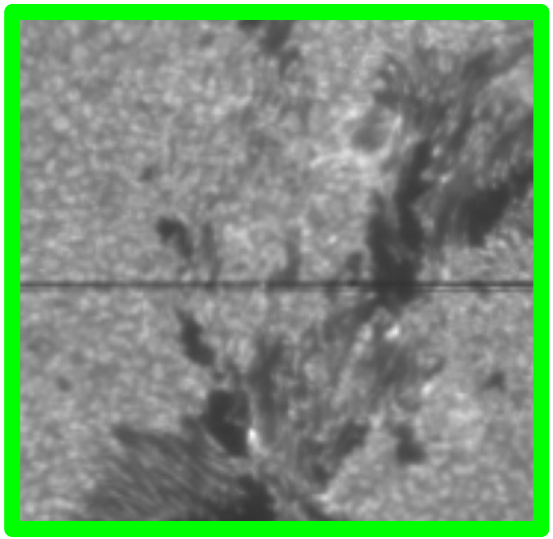
Maximum peak ~ 8:58 UT



2. GREGOR - Hinode - IRIS







3. Ground based observations: GREGOR

HiFI+ Imager

- HiFI+ 1 : 49 frames/s
  - ➔ G-band (450.6 nm)
  - ➔ Blue continuum (450.6 nm)
- HiFI+ 2 : 100 frames/s
  - ➔ Hα broad band (656.3 nm, FWHM 0.75 nm)
  - ➔ Hα narrow band (656.nm, FWHM 0.06 nm)
- HiFI+ 3: 100 frames/s
  - ➔ Ca II H 396.8 nm
  - ➔ TiO 705.7 nm

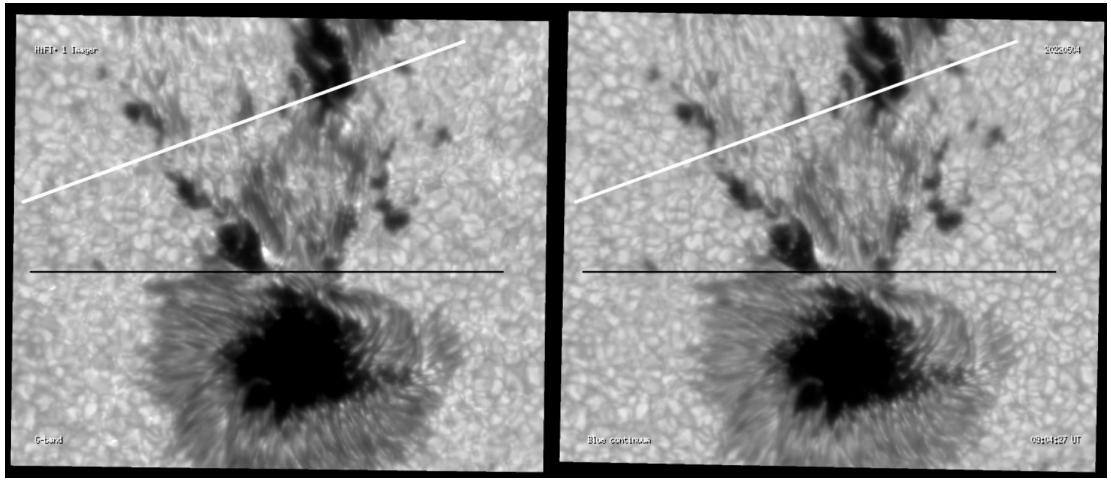
GRIS

- Spectropolarimetric data
- Slit (60” x 0.13 “)
- Sit-and-stare mode
- ~ 4.2 s temporal cadence
- Chromospheric (He I 1083 nm multiplet) and photospheric (Si I 1082.7 nm and Ca I 1083.9 nm) lines
- Slit-jaw camera at 988 nm

3. HiFI+

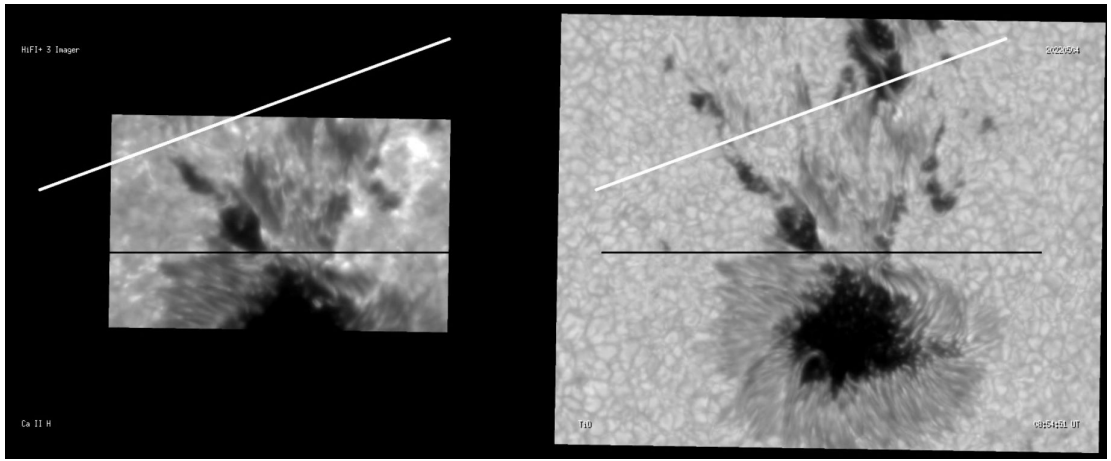
HiFI+ 1

Blue continuum, G-band
FoV: 70.7" × 59.6"



HiFI+ 3

Ca II H FoV: 48.2" × 30.8"
TiO FoV: 76.5" × 60.5"

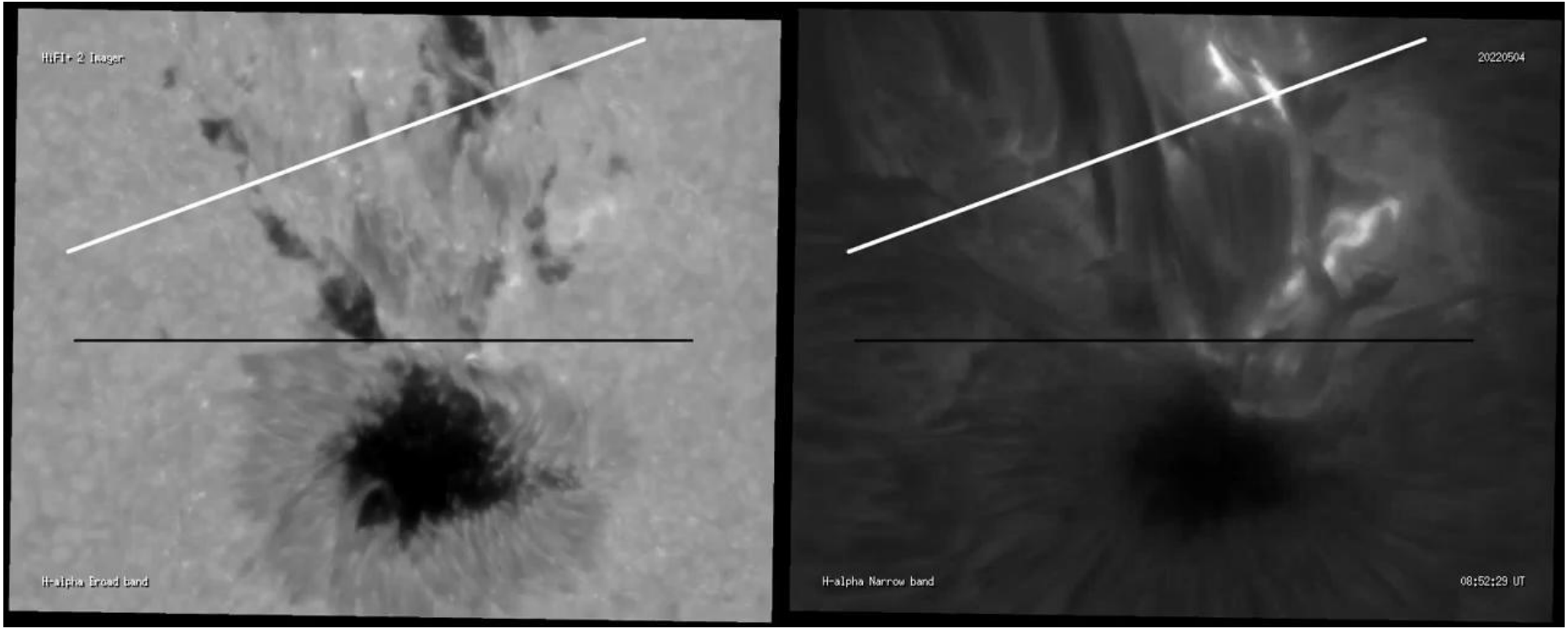


White lines: position of the IRIS slit
Black lines: position of the GREGOR slit

3. HiFI+ 2

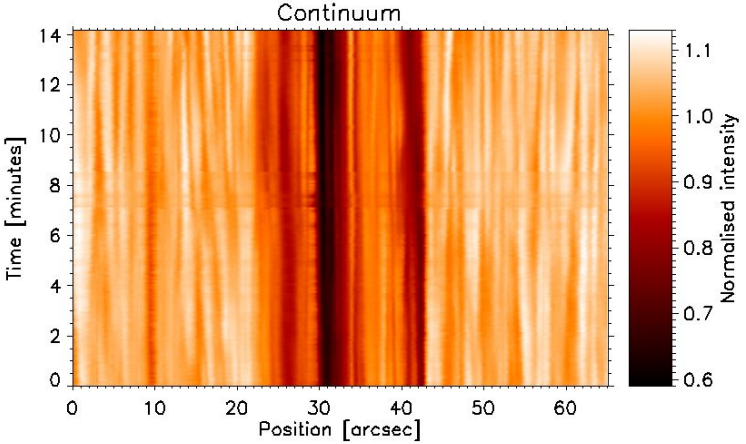
Hα NB and BB
FoV: 76.5" × 60.5"

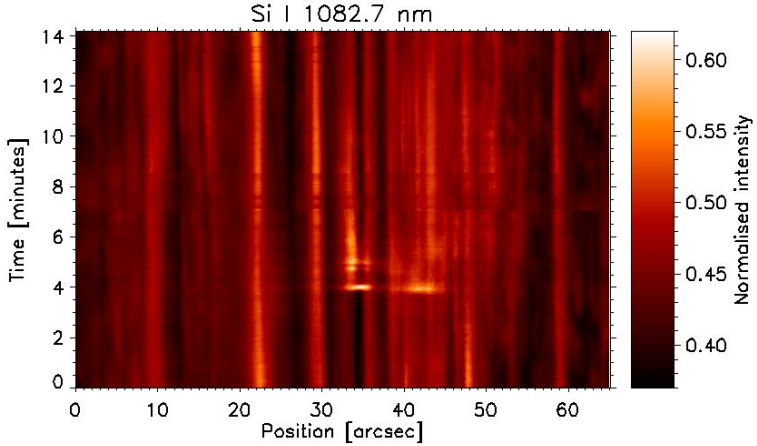
White lines: position of the IRIS slit
Black lines: position of the GREGOR slit

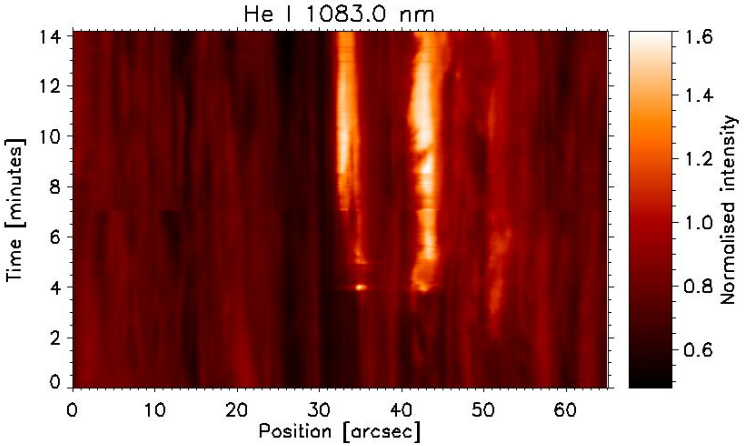


3. Intensities evolution

The GRIS continuum does not seem to be enhanced, however, we observe an emission in He I and brightenings in the Si I core.

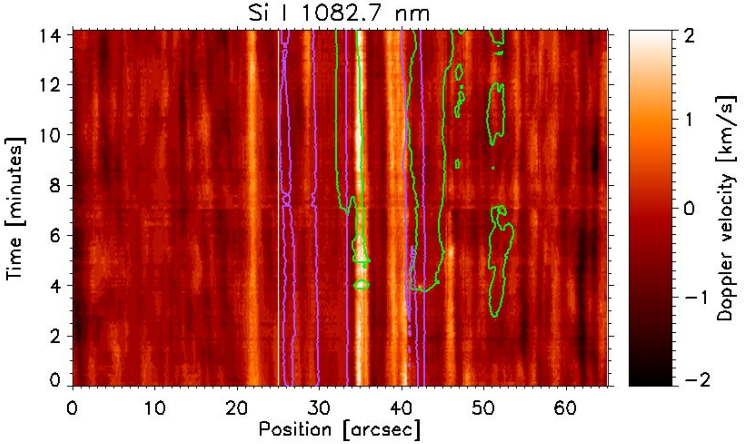


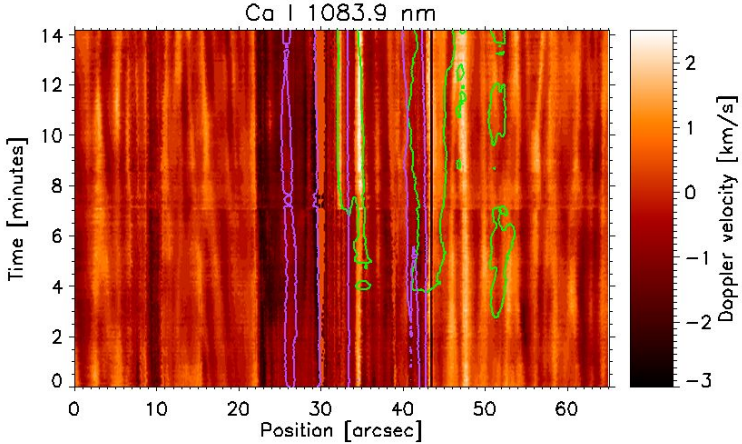


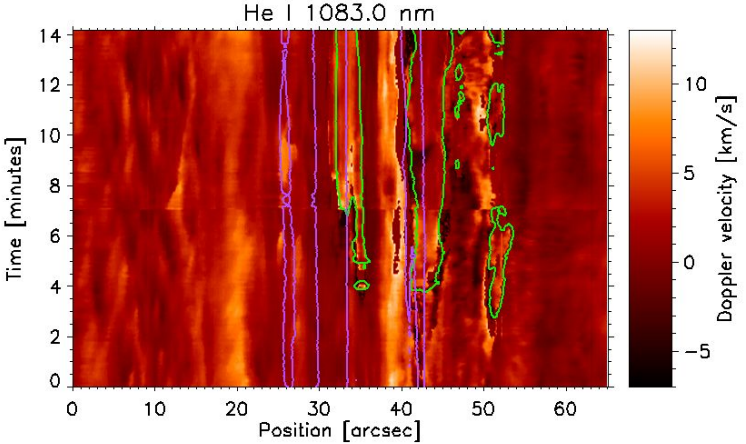


3. Velocities evolution

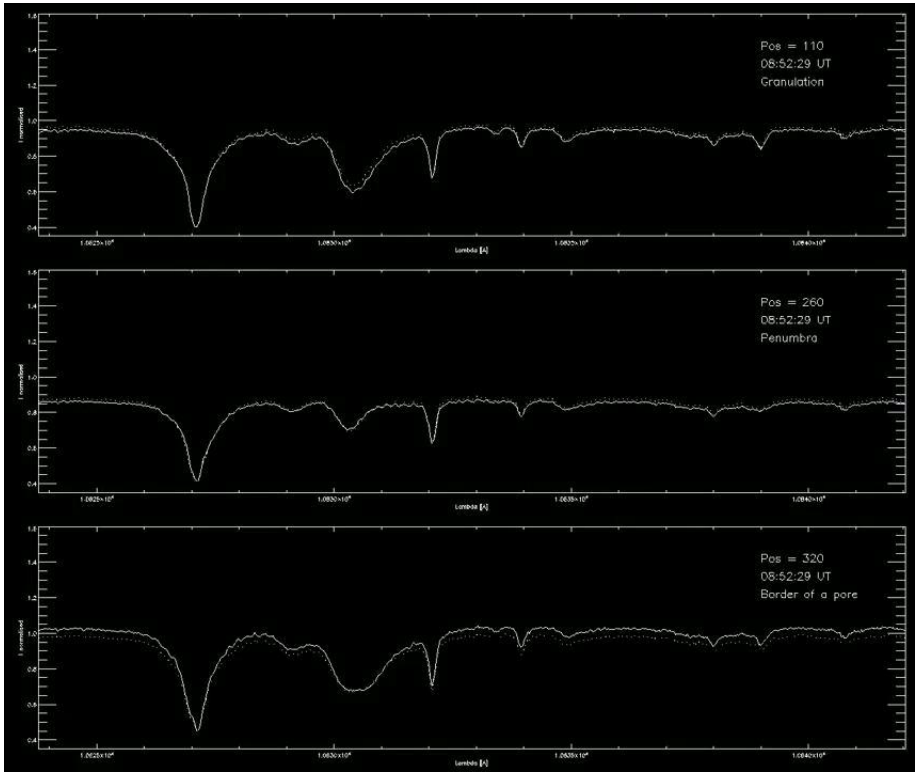
Contours: Green (He I emission) and purple (edges of pores).
Si I and Ca I do not show any response to the flare. He I brightenings are usually connected to downflows.

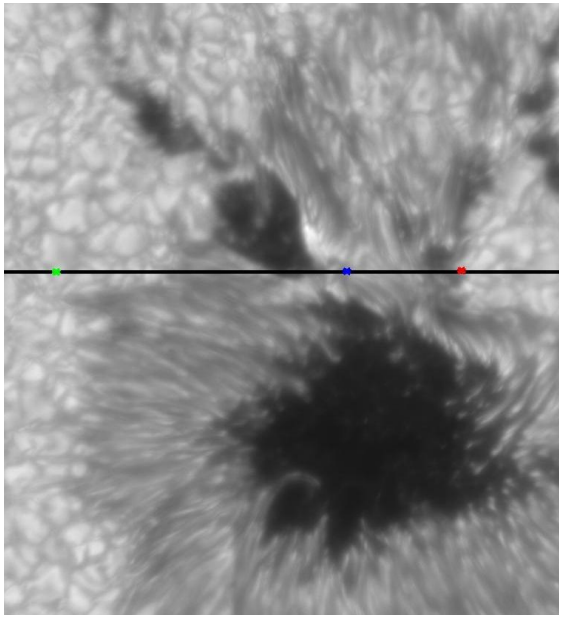


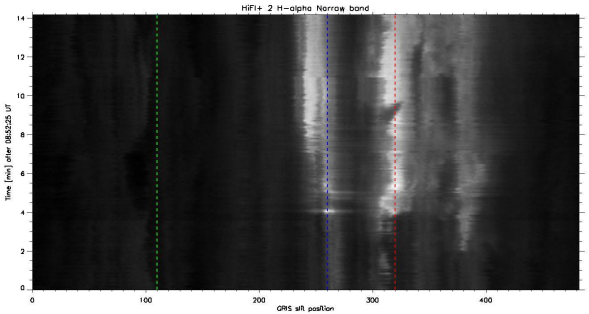




3. Spectral profiles



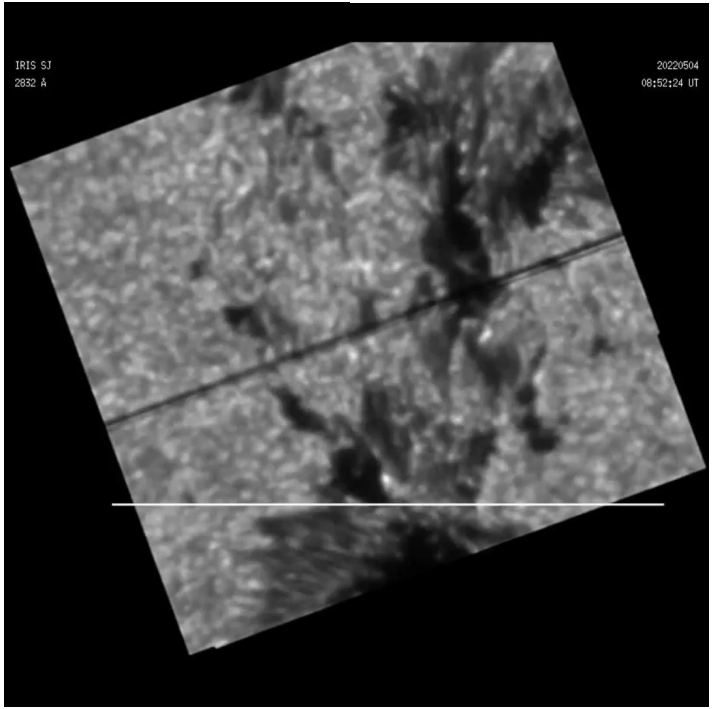




4. Spaced based observations: IRIS

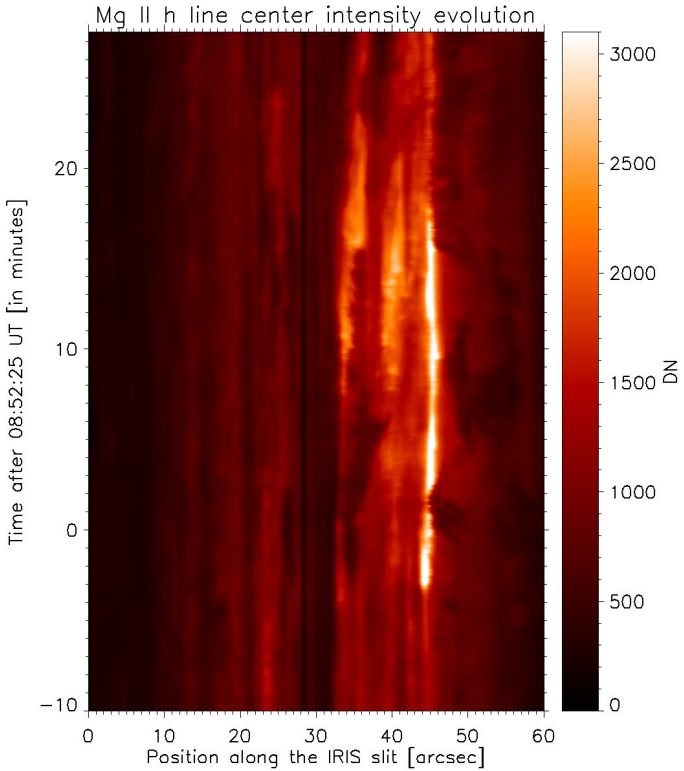
OBSID 3884855852

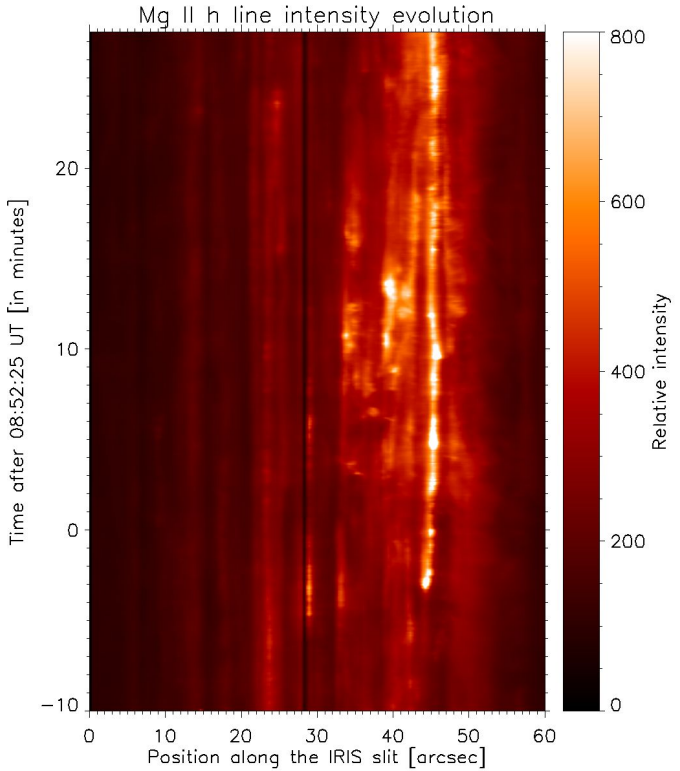
- Medium slit (0.3” x 60 “) in sit-and-stare mode
- Cadence of spectra and SJI: approx. 3.3 s
- Slit jaw images: at 2832 Å
- Spectra: NUV Mg II with high spectral resolution.



Black line: position of the IRIS slit
White line: position of the GREGOR slit

4. Mg II core and integrated line evolution

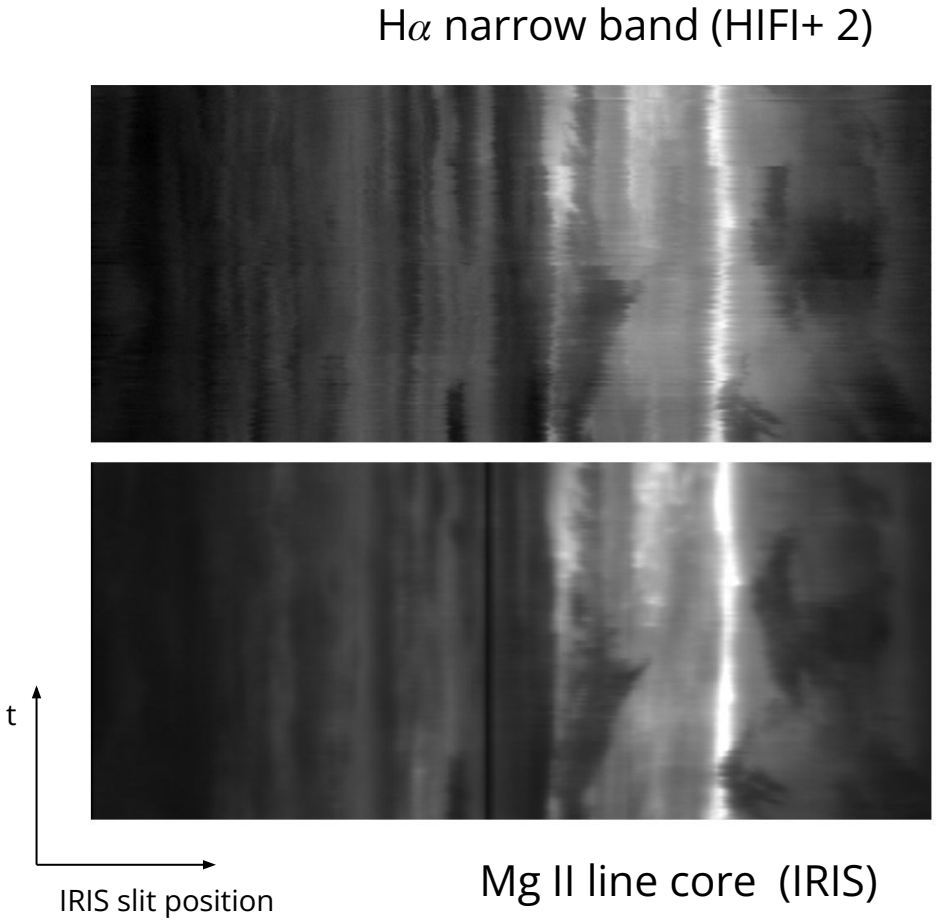




4. Mg II, Hα on IRIS slit

The temporal evolution of Mg II line on IRIS slit is very similar to the temporal evolution of Hα HiFI+2 narrow band images under the projection of IRIS slit.

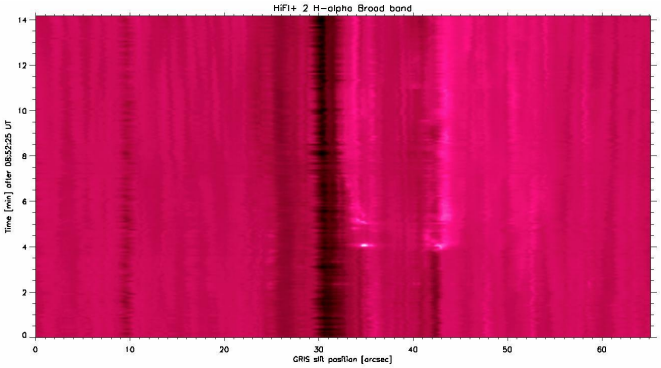
They present similar **brightenings** and **dark structures co-temporally and co-spatially.**

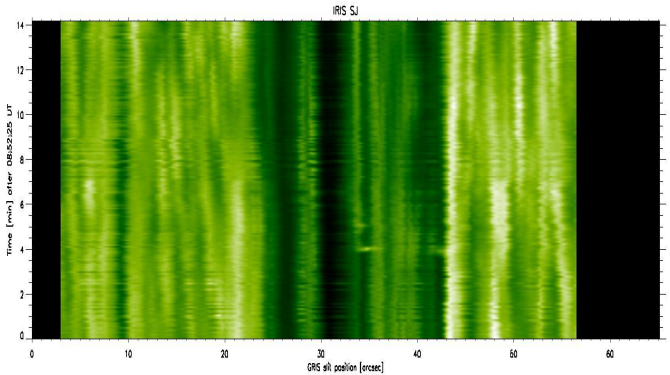


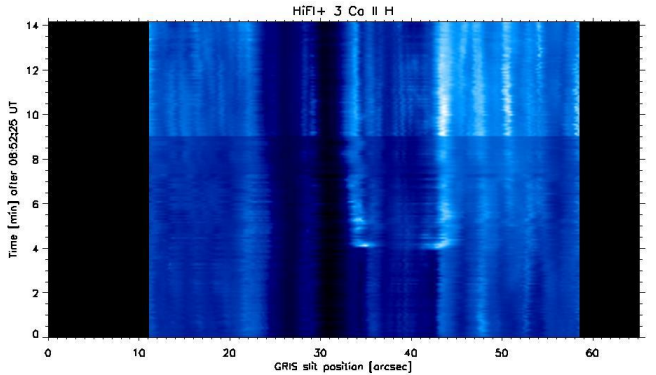
4. IRIS SJ, Ca II H and Hα on GRIS slit

Co-spatial brightenings in IRIS SJ, and in HiFI+ Ca II H and Hα along the GRIS slit.

Brightenings in IRIS SJ and Hα are **co-temporal**. There seems to be a ~4.2s delay respect to Ca II H.







5. Summary

- The coordinated IRIS-GRIS observations are **very rich in data**. The broad- and narrowband imaging and spectroscopy allows us to study the evolution of the thermal structure and dynamics of the flare ribbons.
- At a given location, the time changes of brightness in the lines **Hα**, **He I** 1083 nm, **Ca II H**, and **Mg II h, k are** very **similar** to each to other.
- A short **brightening** in the **Si I** 1082.7 nm line core is present only at the beginning of the flare.
- The **He I brightening** is mostly related to **downflows**.

6. Future plans

- Run inversions with **Hazel and SIR** to retrieve more precise information of the flaring atmosphere.
- Analyse the **dynamics** of the flaring plasma from IRIS spectra.
- Study IRIS and GRIS **continuum** to find signatures of continuum emission.
- Compare the **emissions and possible temporal delays** between HiFI+, IRIS SJ images and IRIS and GRIS spectra with the full extent of the data.
- Combine IRIS and GRIS data with **AIA and HMI**.

THANK YOU FOR YOUR ATTENTION !!