Polarization signatures in the chromosphere during an X1.6 flare

S.L. Guglielmino[1], F. Zuccarello[1], M. Murabito[1], P. Romano[2]

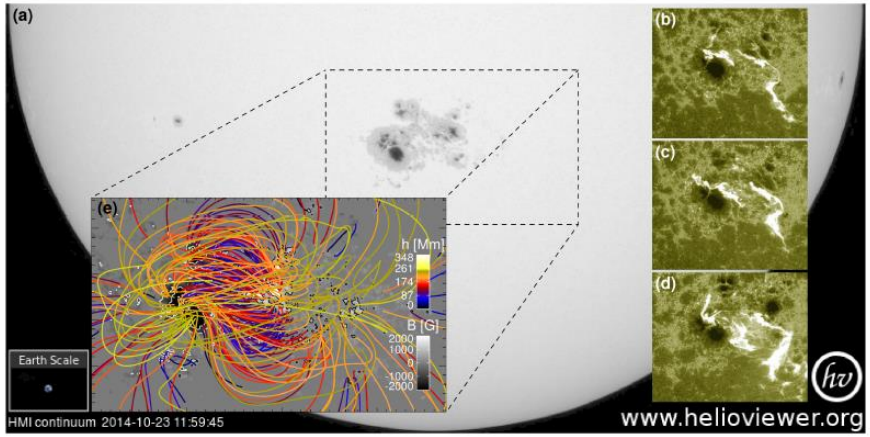
[1]Dipartimento di Fisica e Astronomia – Università di Catania, Italy
[2]INAF – Osservatorio Astrofisico di Catania, Italy

ABSTRACT

Measurements of the magnetic fields in the chromosphere have met serious problems and still present large uncertainties, in particular during solar flares. Very few studies addressed this question, due to the scarcity of spectropolarimetric data from the ground. We report on full spectropolarimetric observations acquired by the IBIS/DST along the Ca II 8542 line together with spectroscopic measurements along the Hα line and photospheric spectroscopic measurements along the Fe I 6173 line during SOL2014-10-22T14:28. This flare was classified as X1.6 and occurred in the complex active region NOAA 12192. We analyze polarization signatures along the Ca II line profile to derive new information on the chromospheric magnetic properties of flares, comparing them with photospheric characteristics.

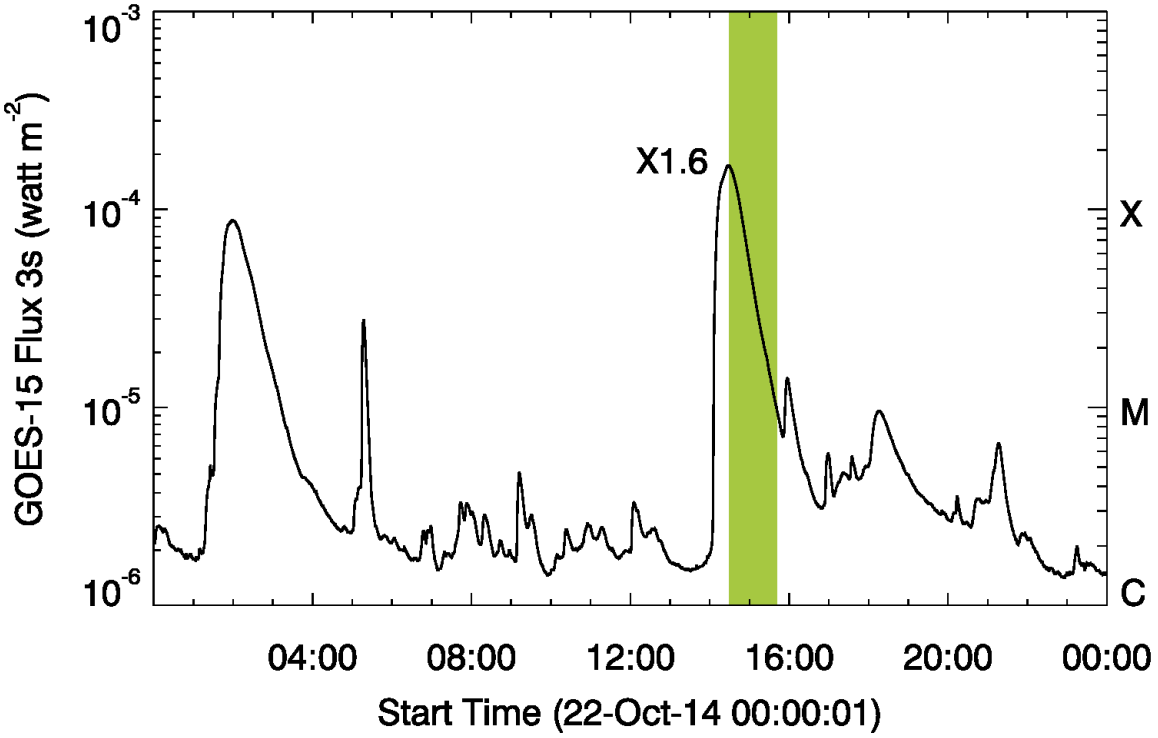
AR NOAA 12192 – generalities

- Active region (AR) NOAA 12192 of 2014 October hosted the largest sunspot group in 25 years.
- It has been the most prolific flaring site of Cycle 24 so far, being the source of 29 M- and 6 X-class flares.
- It appeared on the visible solar disc on 17 October 2014.
- AR NOAA 12192 was a recurrent AR: it already existed in the preceding Carrington rotation as NOAA 12172.
- The total unsigned magnetic flux of the AR at its max was found to be 2 x 10^{23} Mx on 27 October 2014.



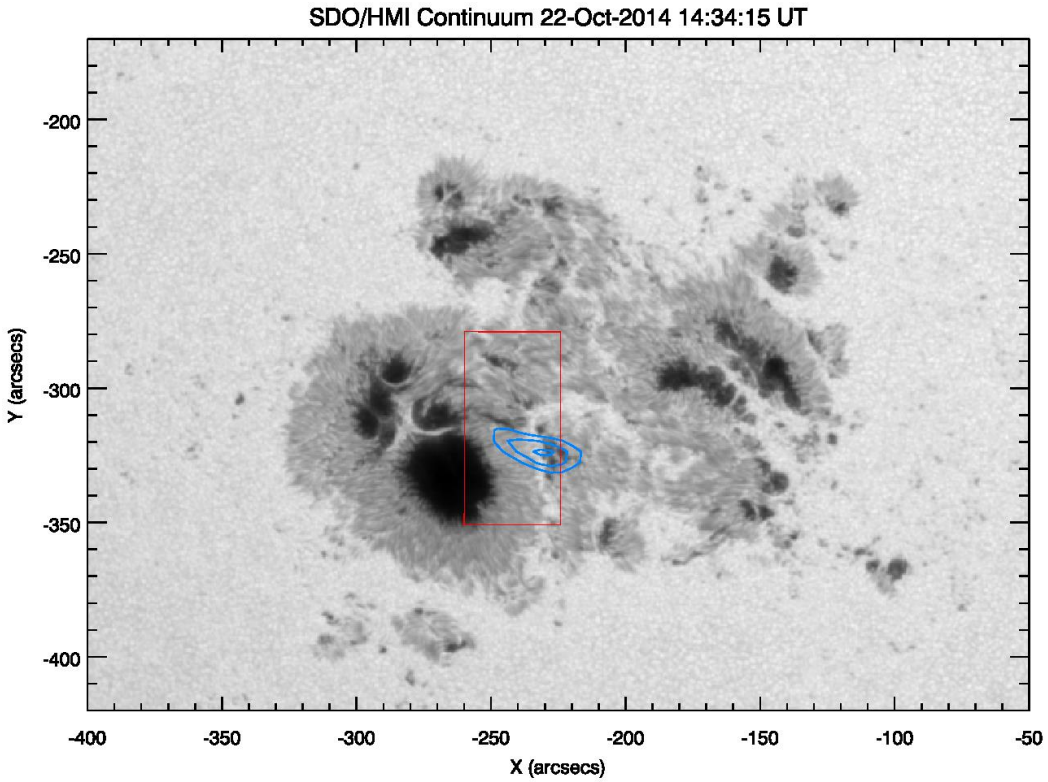
Thalmann et al. (2016)

AR NOAA 12192 – 22 October 2014



The IBIS instrument at the NSO/Dunn Solar Telescope (DST) observed at high spatial and temporal resolution the inner region of AR NOAA 12192 during the X1.6 flare SOL2014-10-22T14:02.

AR NOAA 12192 – 22 October 2014



SDO/HMI continuum intensity map of AR NOAA 12192, close in time with the peak of SOL2014-10-22T14:02 flare. The red box indicates the field-of-view (FOV) of the IBIS instrument. The blue contours represent the RHESSI intensity in the 25-50 keV channel.

X1.6 flare – IBIS dataset

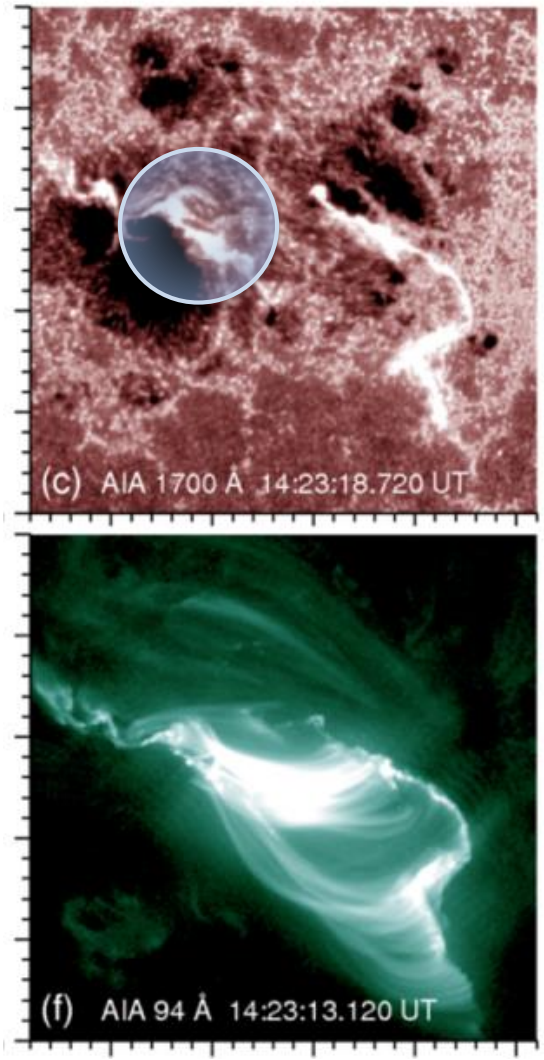
Instrument	Channel	Spectral points	Polarimetry
IBIS@DST	Fe I 6173 Å	20	I Q U V
	Hα 6563 Å	25	I only
	Ca II 8542 Å	25	I Q U V

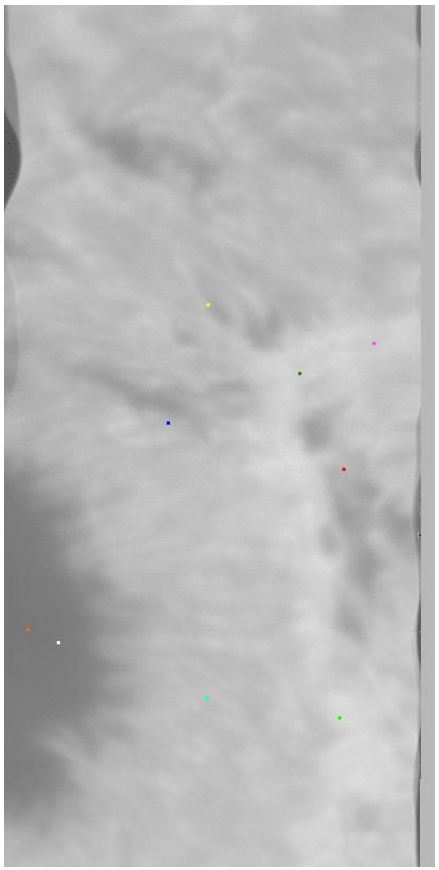
- Pixel size **0.09 arcsec**
- Spatial resolution **max ≈0.25 arcsec**
- Time cadence **50 seconds**
- Start observing time **14:29:41 UT**

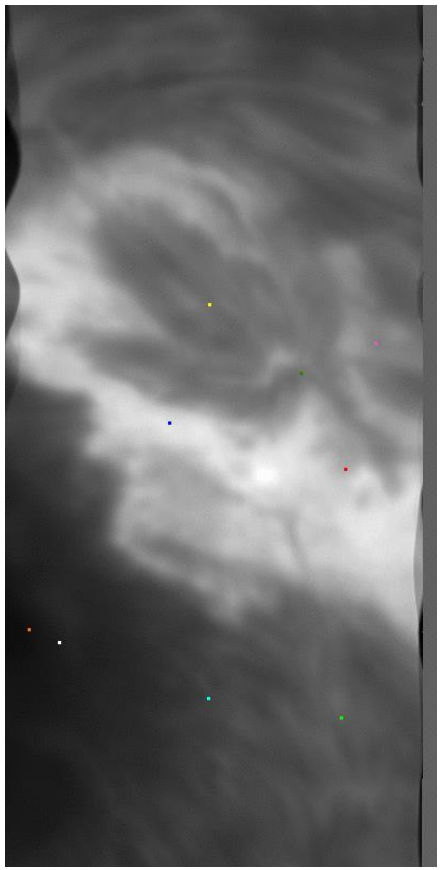
  (peak of X1.6 flare at 14:28 UT)
- Reduced data **28 sequences**

  14:29:41 – 14:54:58 UT

X1.6 flare – IBIS/Ca II 8542 Stokes *I*

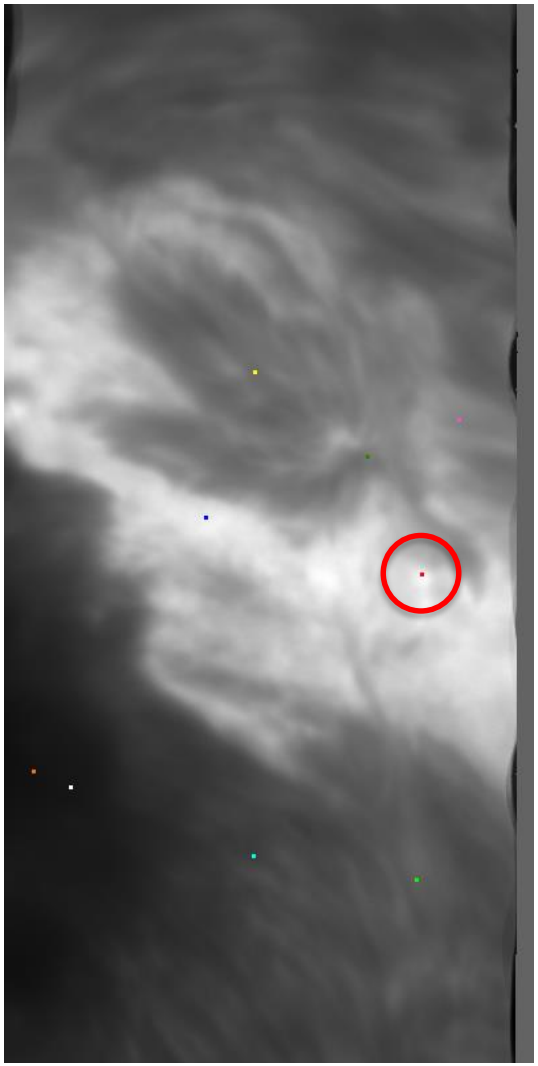


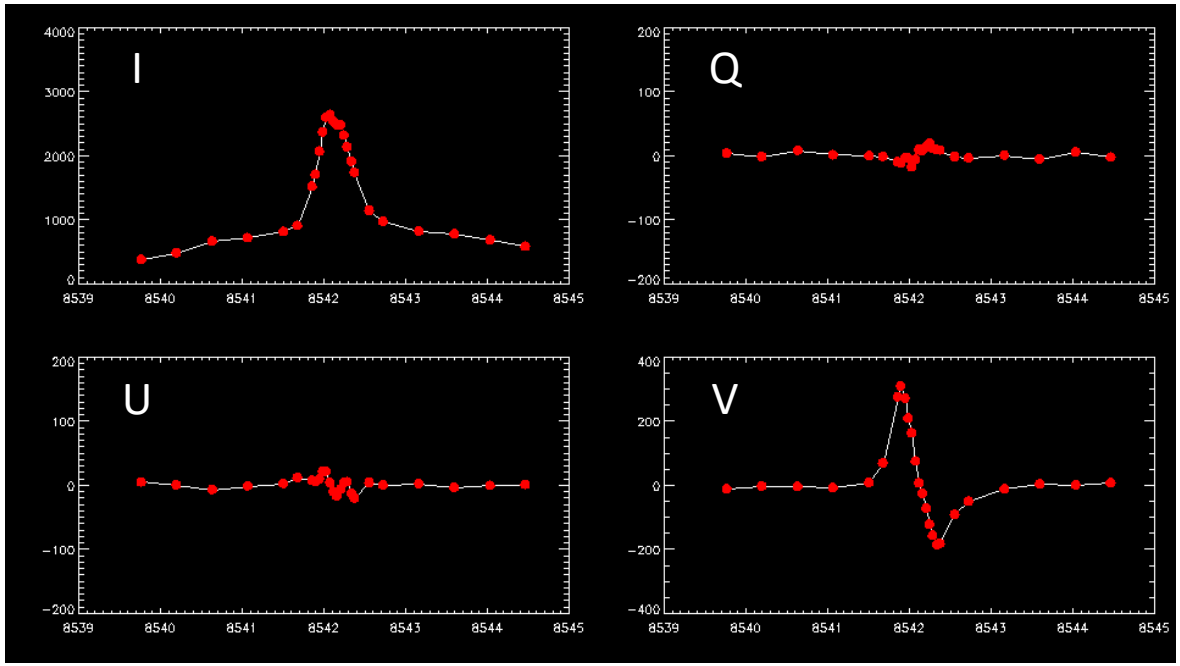




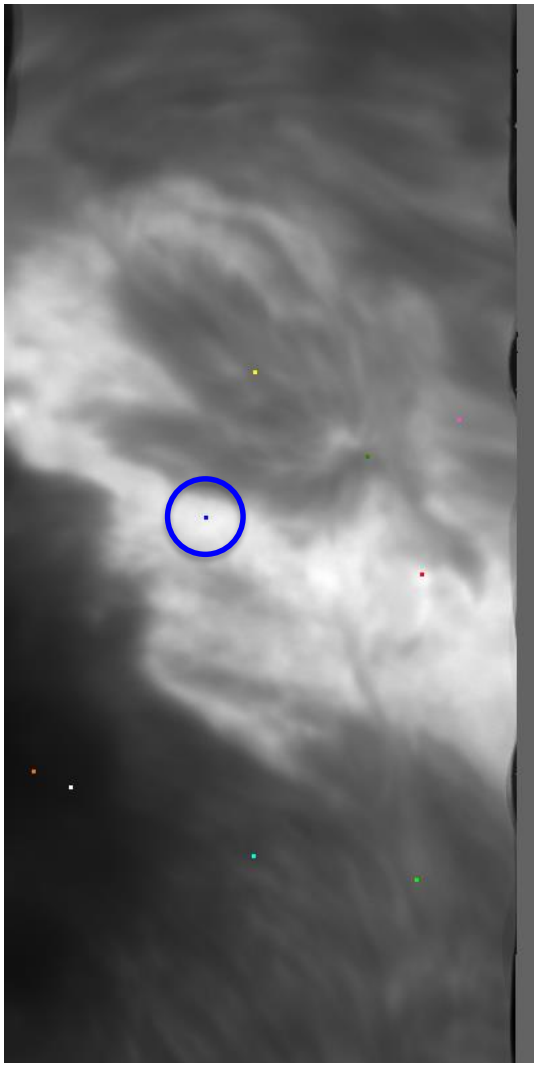
From the comparison with AIA maps from Thalmann et al. (2015), we found that IBIS observed the eastern flare footpoint.

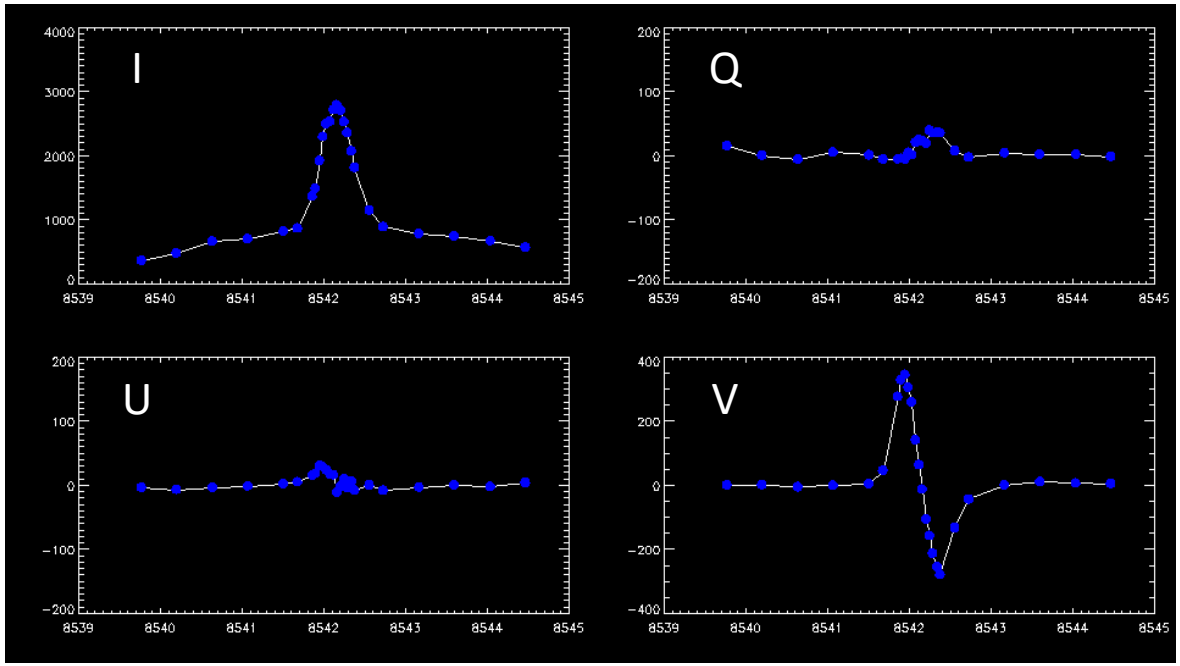
X1.6 flare – IBIS/Ca II 8542 full Stokes





X1.6 flare – IBIS/Ca II 8542 full Stokes





Conclusions and Future Work

- Despite the rather poor seeing, we are able to detect **clear Stokes *V* signals** along the eastern flare **footpoint**.
- We have to check the signals in the wings, to verify the existence of problems with calibration. This will also allow us to evaluate the S/N ratio.
- We will determine a rough estimate of B_{LOS}, using the center-of-gravity or weak-field approximation method.
- We will extend the analysis of the polarization signals in the **region of interface** between the flare footpoint and the undisturbed chromopheric environment, searching for the linear polarization signals predicted by models.
- We will apply these investigations to other flare events of different GOES class and magnetic configuration.

Bibliography

- Kleint (2017), ApJ, 834, 26
- Jiang et al. (2016), ApJ, 828, A62
- Myagkova et al. (2016), Sol. Phys, *first online*
- Liu et al. (2016), ApJ, 826, A119
- Panesar et al. (2016), ApJL, 822, L23
- Inoue et al. (2016), ApJ, 818, A168
- Li et al. (2015), ApJL, 814, L13
- Veronig & Polanec (2015), Sol. Phys., 290, 2923
- Chen et al. (2015), ApJL, 808, L24
- Sun et al. (2015), ApJL, 804, L28
- Thalmann et al. (2015), ApJL, 801, L23

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