UNIVERSITÀ degli STUDI di CATANIA

INAF ISTITUTO NAZIONALE DI ASTROFISICA OSSERVATORIO ASTROFISICO DI CATANIA

Polarization signatures during the X1.6 flare observed in active region NOAA 12192

F. Ferrente[1], F. Zuccarello[1,2], S. L. Guglielmino[2], P. Romano[2], S. Criscuoli[3]

[1]Dipartimento di Fisica e Astronomia "Ettore Majorana", [2]INAF - Osservatorio Astrofisico di Catania, [3]NSO - National Solar Observatory, Boulder, CO, USA

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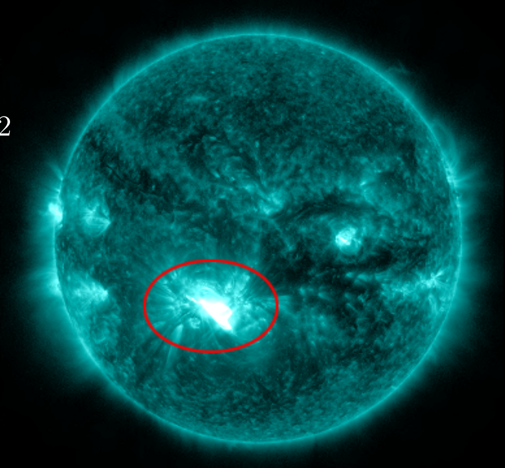
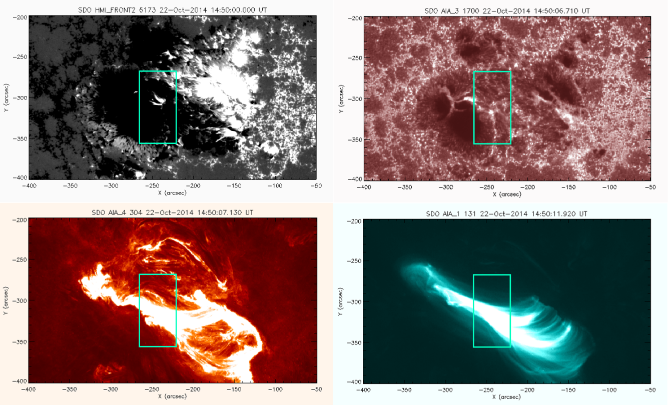
Introduction

On October 2014, during the solar cycle 24, the large and complex active region AR12192 appeared on the east limb of the Sun.
It produced 6 X-class and 30 M-class flares. The X-class flares produced by AR12192 were "confined flares".



AR12192

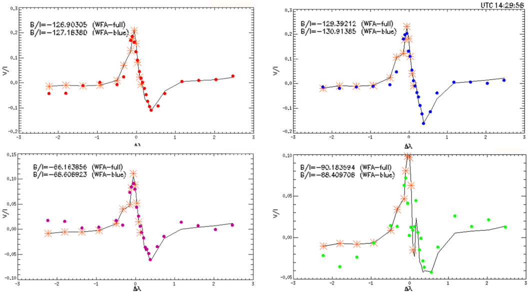


The upper-left panel shows a HMI/SDO magnetogram of the AR, the upper-right panel shows the AR observed at 1700Å, the lower left panel shows the AR observed at 304Å and the lower right panel shows the AR observed at 131Å. The green box shows the IBIS FoV.

Weak Field Approximation analysis

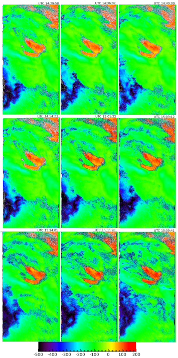
In the Weak Field Approximation we can get a relationship between V and $\frac{dI}{d\lambda}$, from which it is possible to obtain the value of the magnetic field B:

$$V = -\bar{g}\Delta\lambda_B \cos\theta \frac{dI}{d\lambda}, \qquad with \qquad \Delta\lambda_B = \frac{e}{4\pi m_e c} B\lambda_0^2 \tag{1}$$

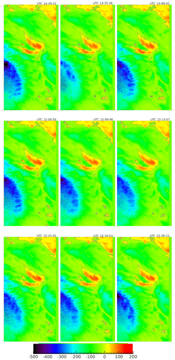


The panels show $\frac{V}{I}$ for the Ca II line at the observed wavelengths (coloured circles) in four different pixels. The full-WFA fits are represented by the solid lines, while the orange asterisks represent the blue-wing fits. $\Delta\lambda = \lambda - \lambda_0$, where λ_0 is the central wavelength 8542 Å.

Weak Field Approximation analysis



Temporal evolution of B_{LOS} obtained with the WFA for the CaII line.



Temporal evolution of B_{LOS} obtained with the WFA for the FeI line.

The figures show the longitudinal magnetic field distribution in chromosphere and in photosphere respectively, and its evolution. In both figures we can see the positive intrusion region.

Determination of the magnetic field changes

From previous studies (Sudol and Harvey, 2005; Kleint, 2017) it is known that the temporal variation of the magnetic field occurring during a flare can be characterized at the first order by a step function.

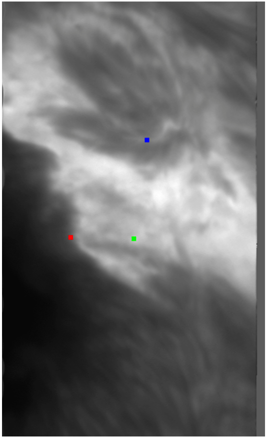
$$B(t) = a + bt + c\left\{1 + \frac{2}{\pi}\arctan[n(t - t_0)]\right\} \tag{2}$$

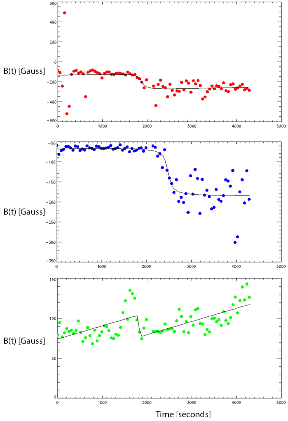
In particular:

- c is the half amplitude of the step, $2c$ is the amplitude of the step and it represents the measure of the change in the magnetic field, dB.
- $\frac{\pi}{n}$ is the time interval at which the stepwise change occurs, dt.

Determination of the magnetic field changes

Fit obtained for three points in the proximity of the flare ribbon, in chromosphere.
The x-axis shows the time in seconds, the y-axis shows the values of B(t) in Gauss.





Conclusions

Results

- A consistent change of the longitudinal magnetic field occurred in the ribbon in chromosphere.
- The location of the chromospheric changes are unrelated to the location of the changes in photosphere.
- We did not find an evident correlation between the magnetic field strength and the magnitude of the magnetic field changes;
- The distribution of the magnetic field change is more asymmetric in chromosphere than in photosphere.
- Fast and abrupt changes are more frequent than slow changes both in chromosphere and in photosphere.