AIP Leibniz-Institut für Astrophysik Potsdam

Spectropolarimetric Observations of Filaments with GREGOR

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and the GREGOR-team

The GREGOR consortium

- GREGOR is a 1.5 m solar telescope operated by a German consortium in the Spanish Observatorio del Teide, Tenerife.
- Kiepenheuer Institut für Sonnenphysik, Freiburg (coordination).
- Leibniz Institut für Astrophysik Potsdam
- Max-Plank Institut für Sonnensystemforschung Göttingen
- until 2009: Institut für Astrophysik, Universität Göttingen
- Site: Instituto de Astrofísica de Canarias, La Laguna, Tenerife, Spain
- with contributions from: Astronomical Institute of the Czech Academy of Sciences, Ondřejov, Czech Republic and Istituto di Ricerche Solare, Locarno, Switzerland

The GREGOR team

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KIS Kiepenheuer-Institut für Sonnenphysik
AIP
MPS
Institut für Astrophysik Göttingen
Instituto de Astrofísica de Canarias IAC
asu Astronomical Institute of the Czech Academy of Sciences

The GREGOR Infrared Spectrograph

Grating spectrograph optimized for infrared spectroscopy and polarimetry

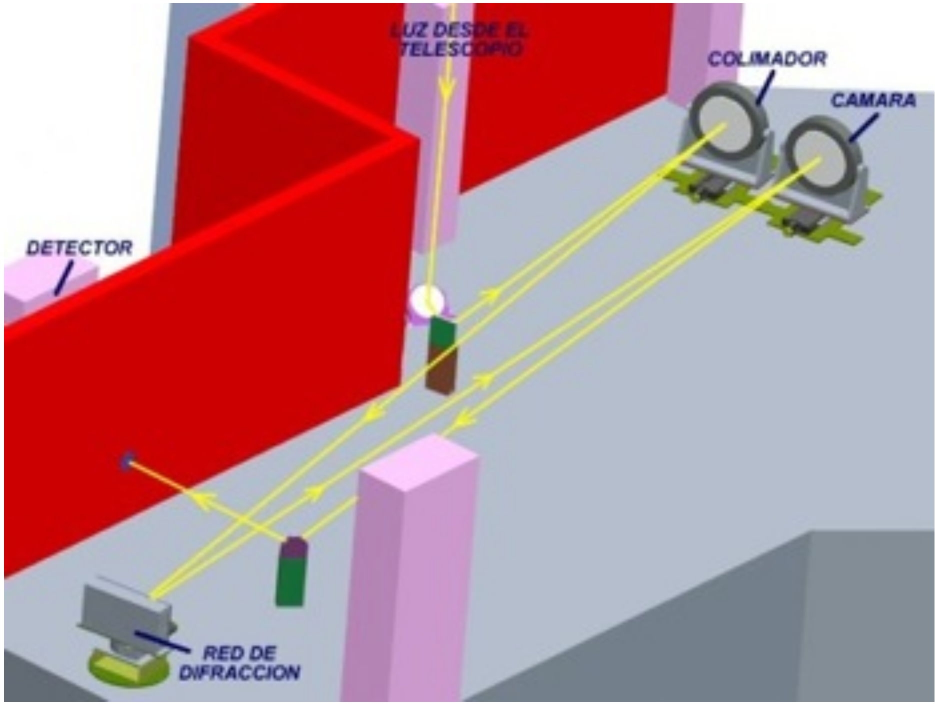
Grating: 316 rules /mm, Blaze $63^{o}.5$

focal length collimator and camera mirror: 5980 mm, scale ~0”,135 /pixel

Rockwell TCM 8600 camera, 1024 x 1020 pixel

Polarimeter 2 ferroelectric liquid crystals, polarizing beamsplitter (former TIP II)

Scanning: slit can be moved



The Observations

GREGOR telescope, Tenerife within the framework of SOLARNET and a PPP of DAAD and Slovak Academy of Sciences

May 24, 2015, GRIS in polarimetric mode

spectral range: 1082.4 - 1084.2 nm

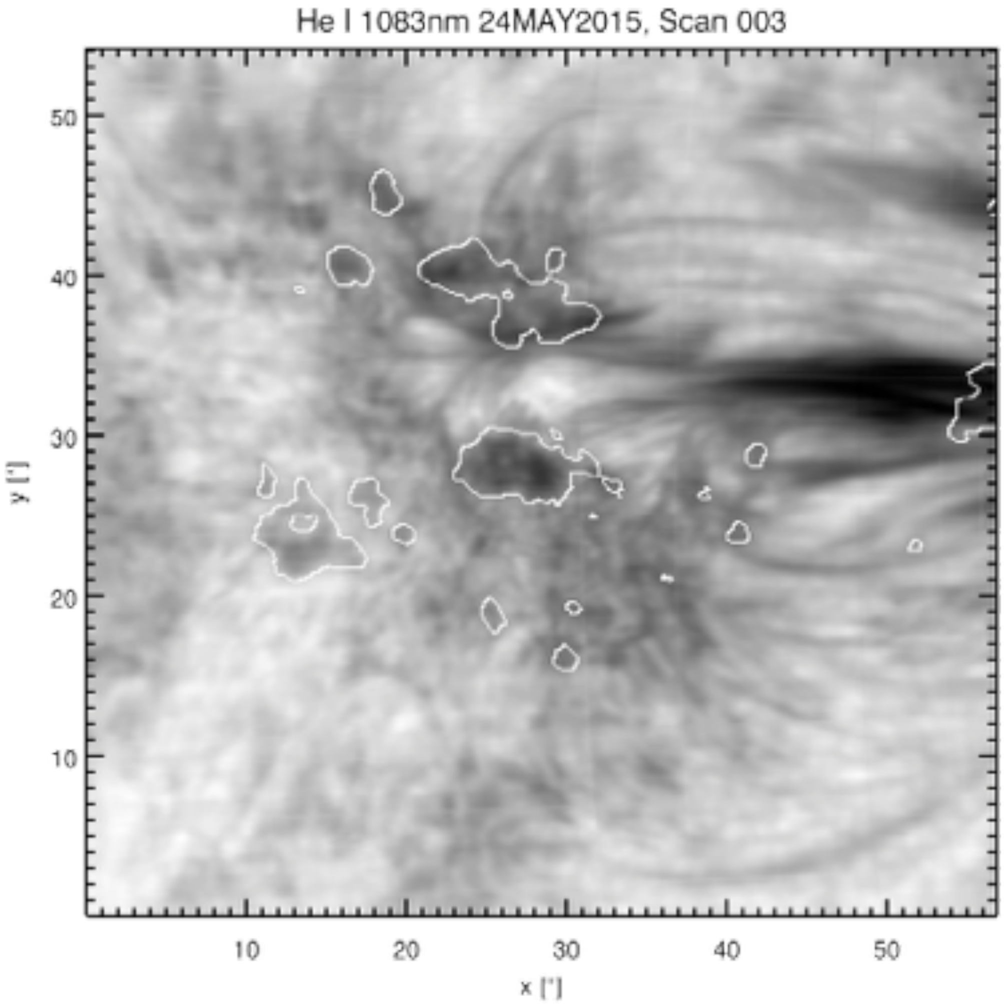
Si I 1082.7, He I 1082.9/1083.0, Ca I 1083.9

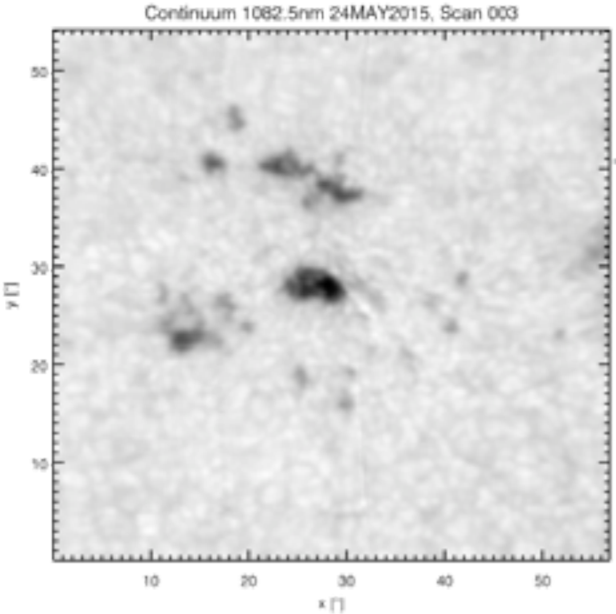
Target: following part of NOAA 12353, B = 7N, CMD -20W,

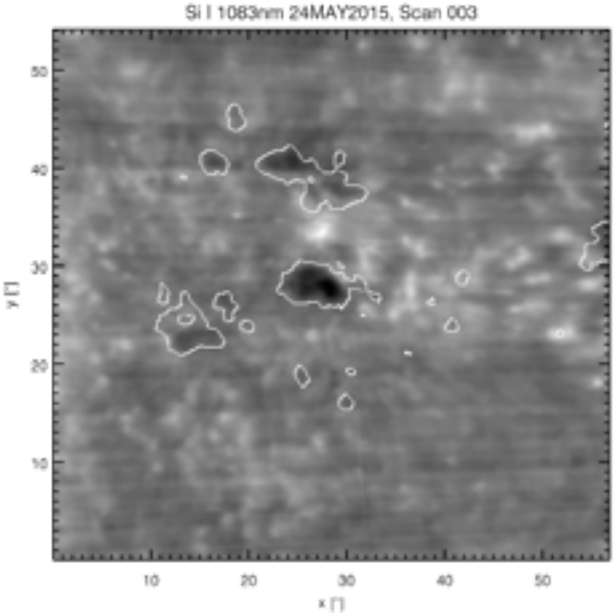
five scans between 08:06 and 10:08 UT

Context data from SDO (HMI and AIA) and BIC

Images


He I 1083nm 24MAY2015, Scan 003
y ["]
x ["]
10
20
30
40
50


Continuum 1082.5nm 24MAY2015, Scan 003
y ["]
x ["]


Si I 1083nm 24MAY2015, Scan 003
y ["]
x ["]

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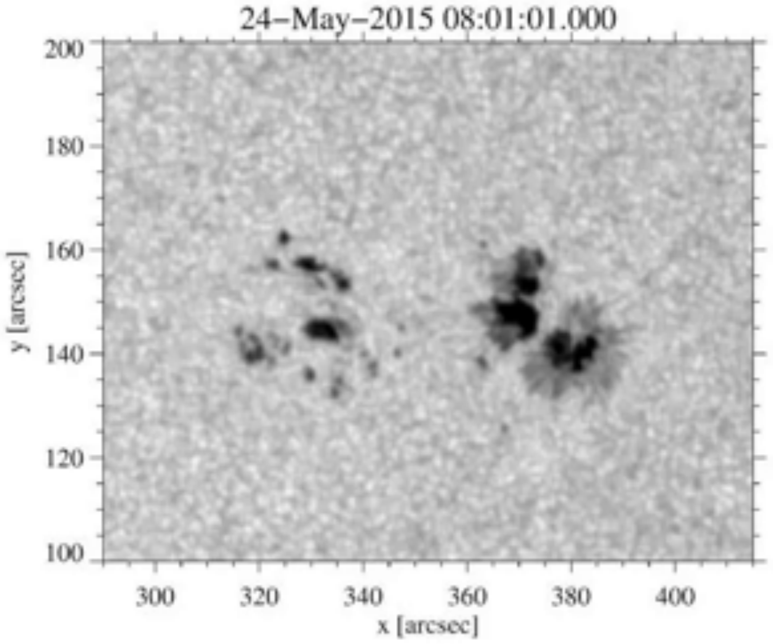
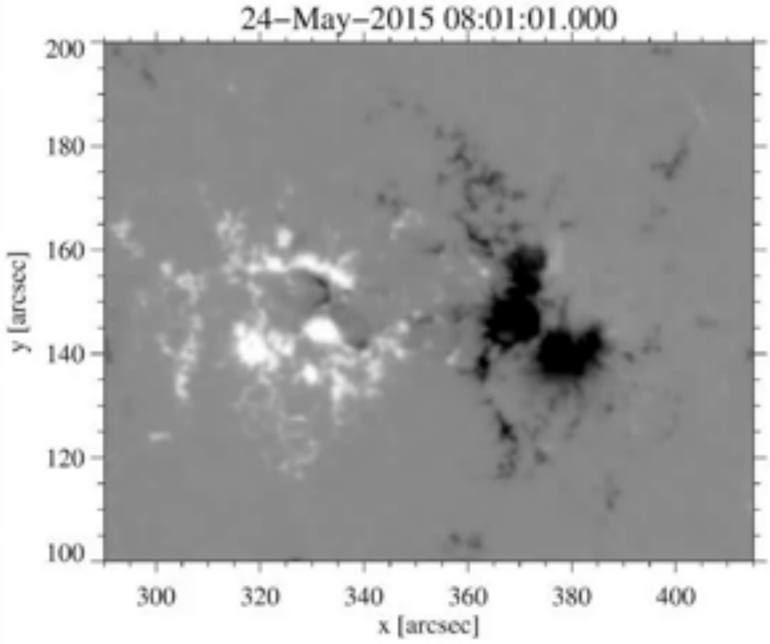
Temporal development

left: HMI-intensities

right: HMI-magnetogram

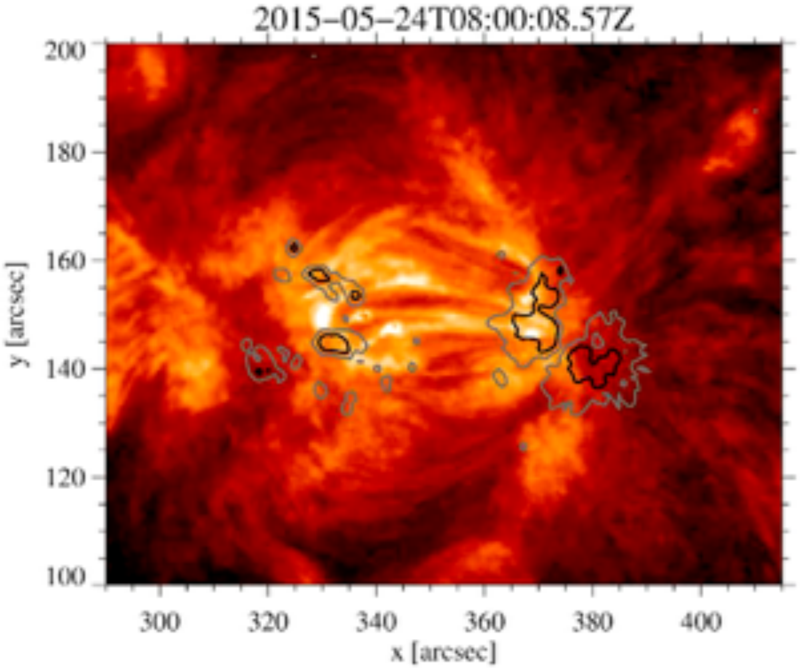




Temporal development (2)

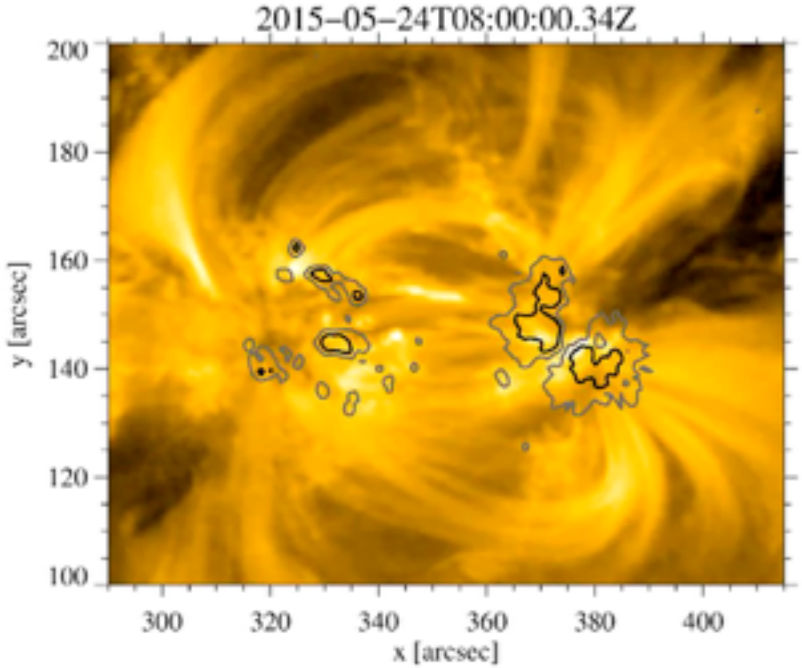
AIA 304Å (ionized helium)

60 - 80 kK, transition region

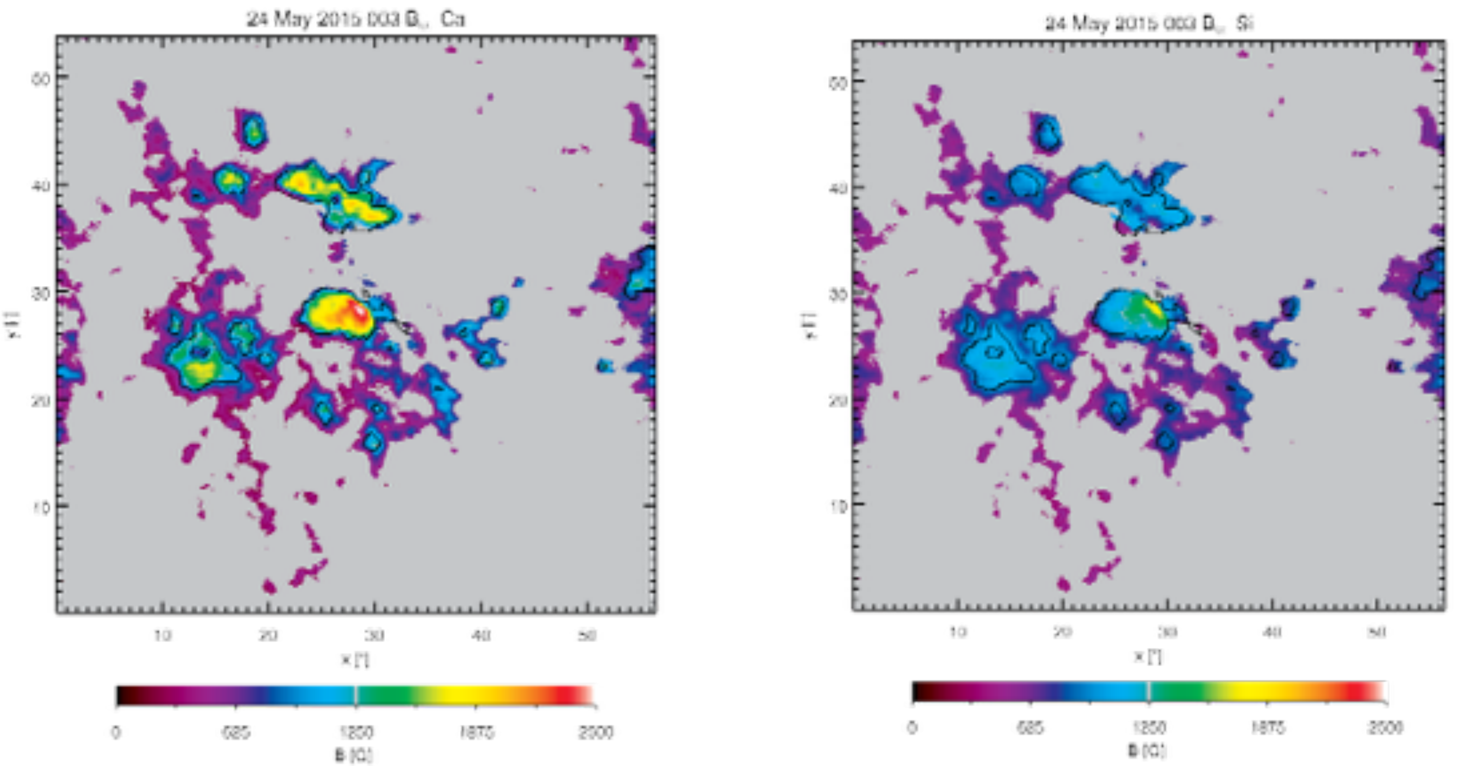


AIA 171A (Fe IX)

1 MK, Corona

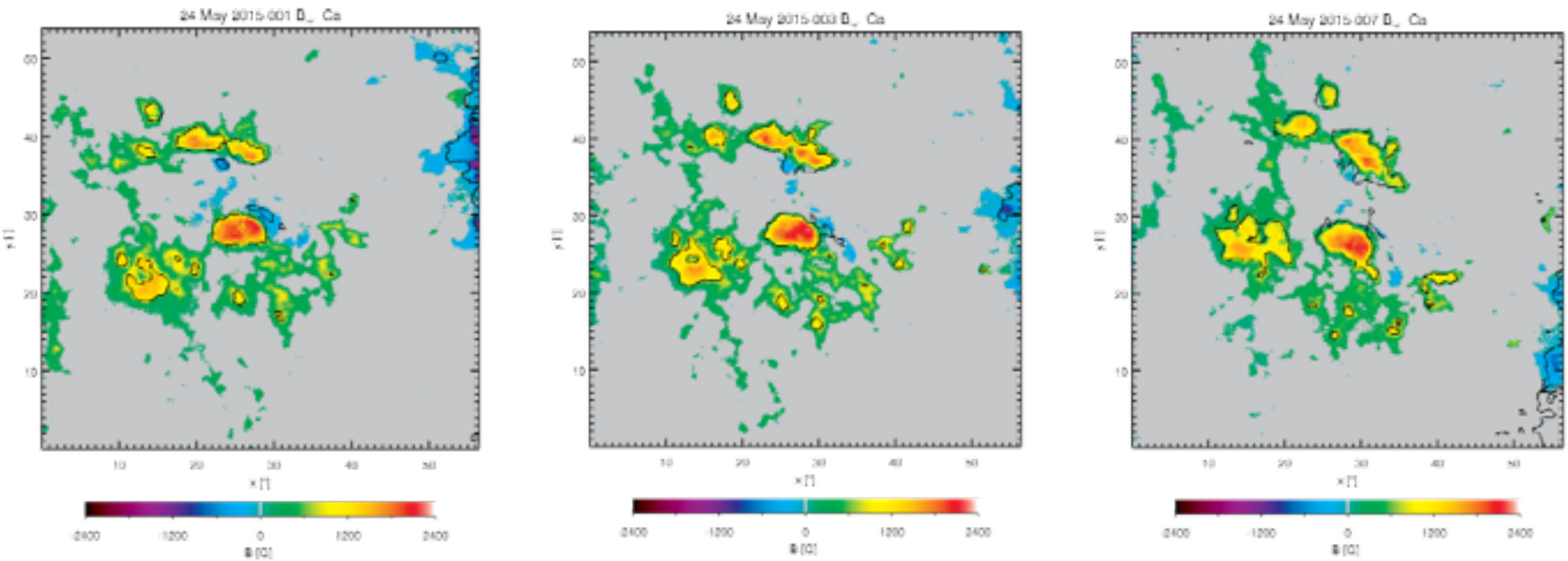


Total magnetic field strength



Magnetic field determined from the photospheric calcium line and the silicon line with the SIR-code (Stokes Inversion based on Response functions, Ruiz Cobo & del Toro Iniesta 1992). The calcium line originates from the deep photosphere and the silicon line from the upper photosphere.

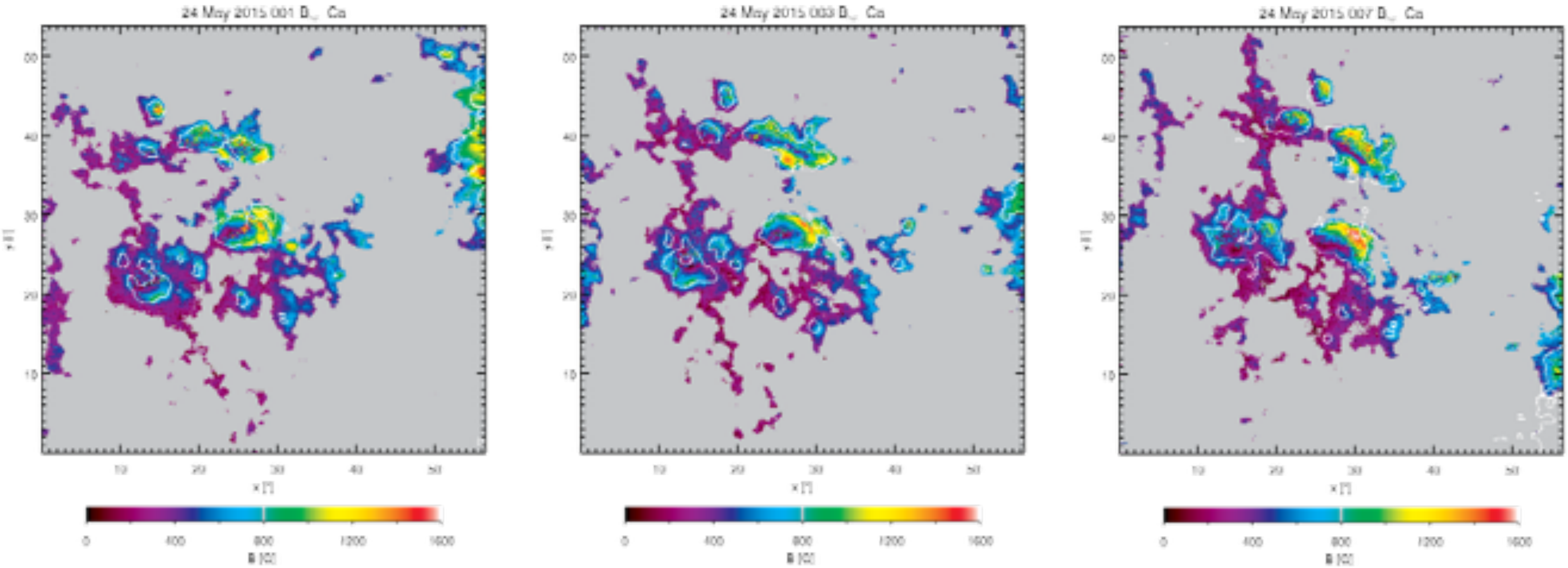
Vertical magnetic field



Vertical magnetic field at three different times from the calcium line.

(08:16 UT, 08:58 UT and 09:59 UT)

Horizontal magnetic field

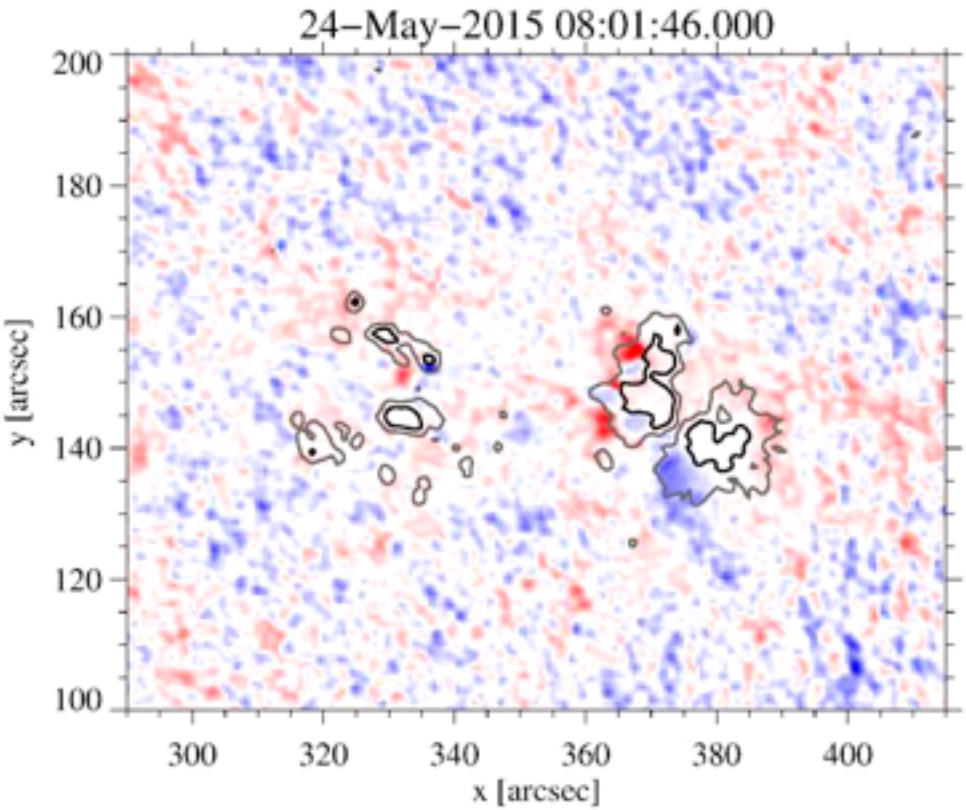


Horizontal magnetic field at three different times from the calcium line.

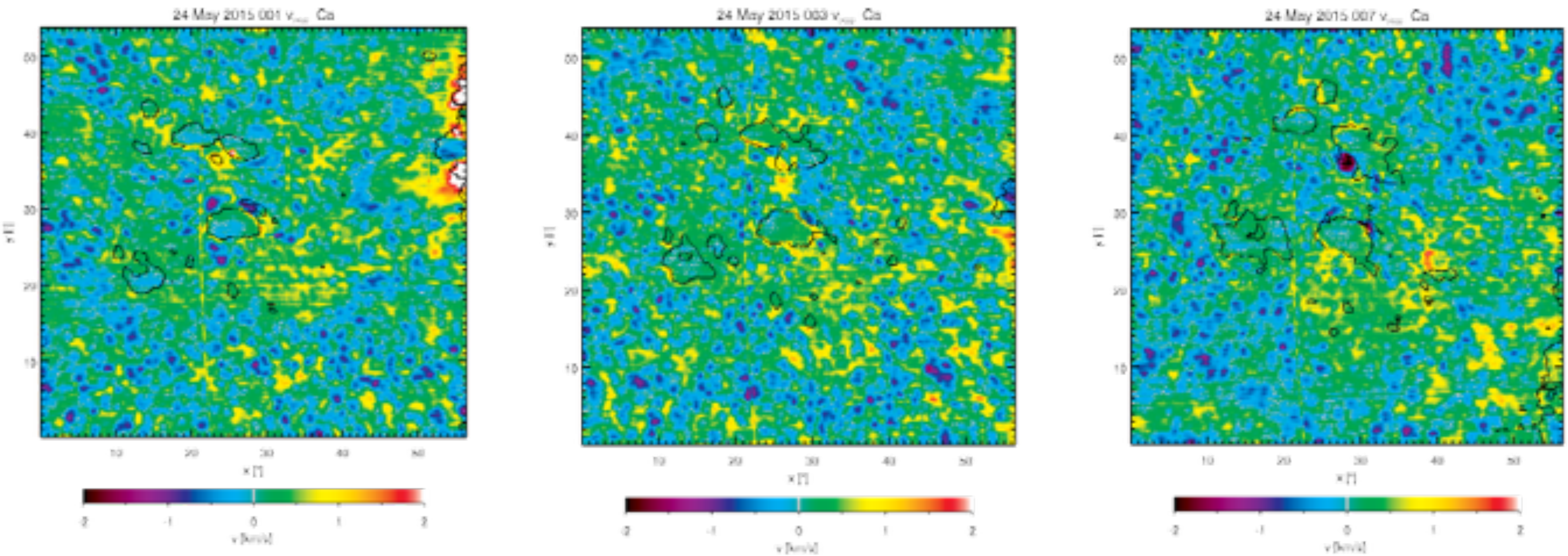
(08:16 UT, 08:58 UT and 09:59 UT)

Temporal development (3)

HMI-velocities



Photospheric velocities



Doppler velocities from the calcium line, SIR inversions.
Velocity reference: nearby water vapour line.
Velocities larger than 2 km/s are clipped.
Evershed effect of main spot should be a blue shift. Here we find redshifts next to the penumbra aside from the filament.

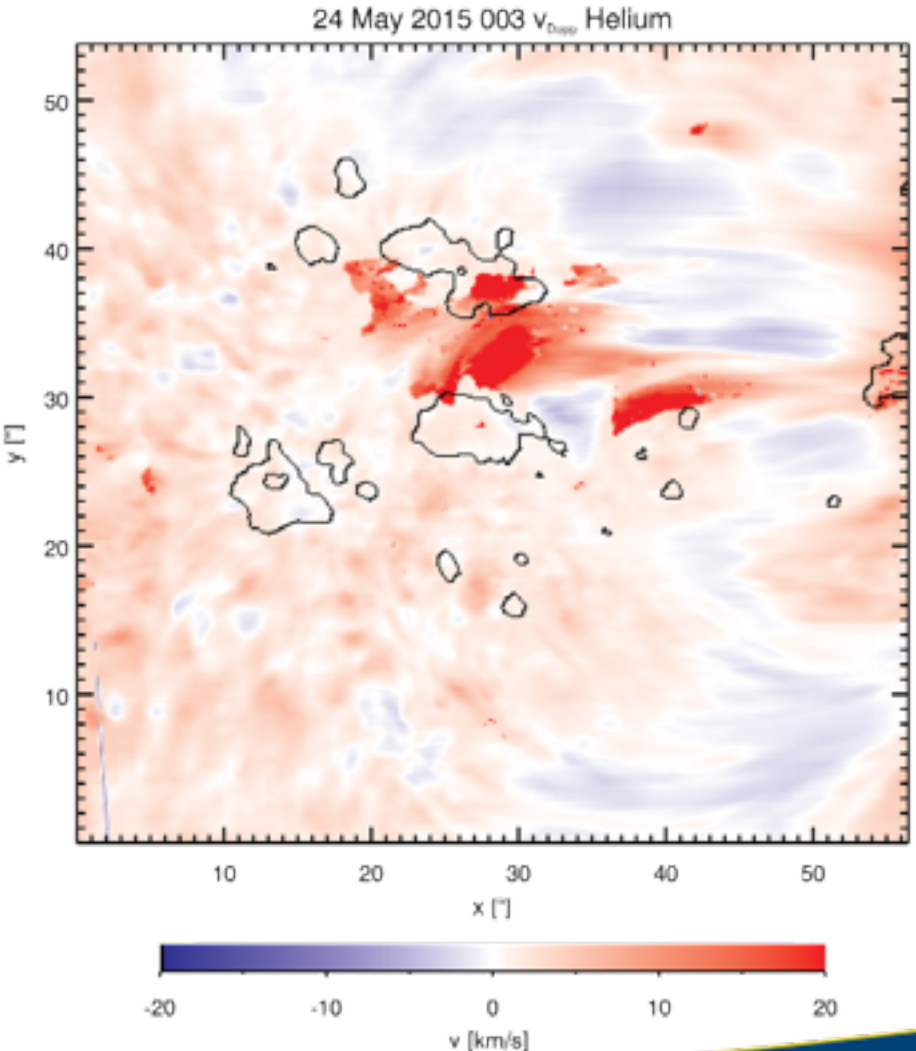
Velocities from the helium line

Fitting one or two Gaussians to helium line 1083.0 nm.

Sorting to different classes according to the shape of the line profile.

If two velocity components, the second one is displayed.

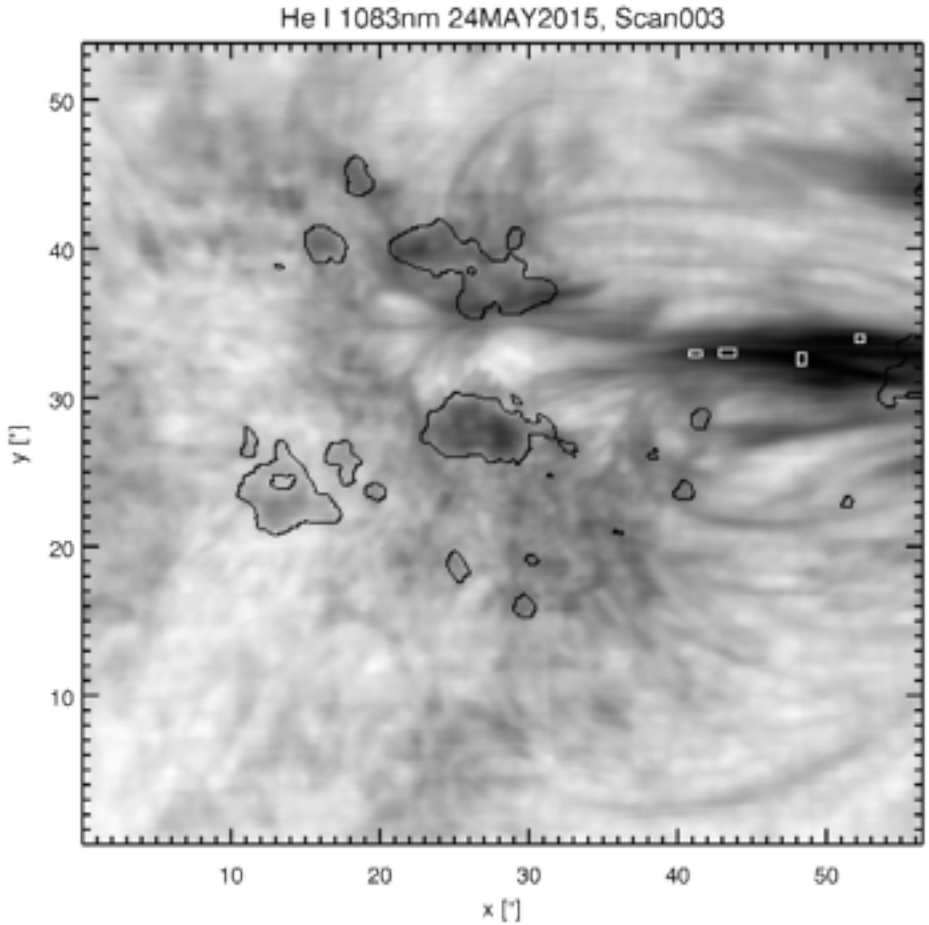
Velocities larger than 20 km/s are clipped.



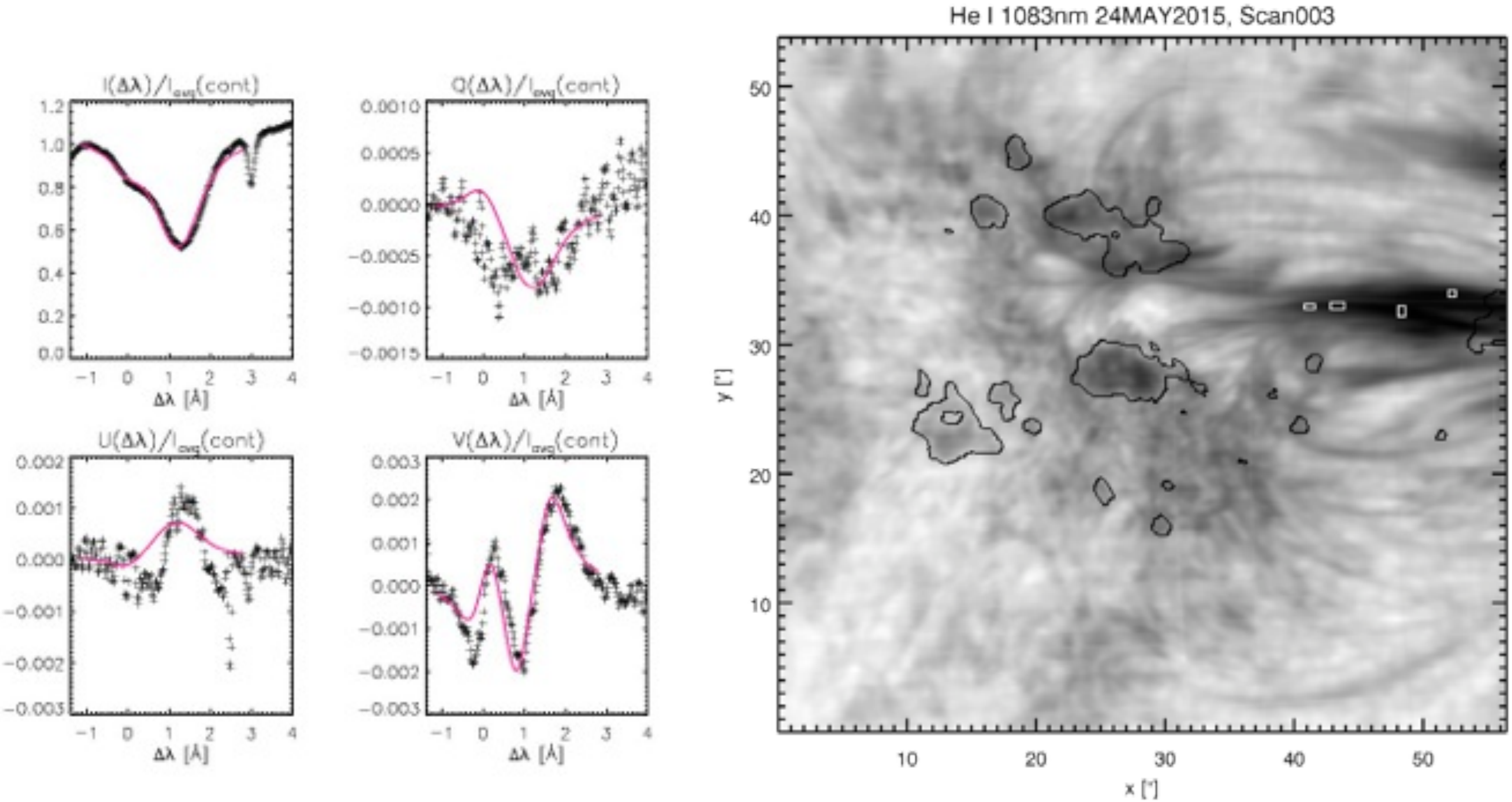
Inversions of the helium line

We use the HaZeL code (Hanle and Zeeman Light, Asensio Ramos et al. 2008).

Problem: the polarisation signal in helium is very weak, thus we inverted so far only averaged profiles from a very few selected areas (white rectangles)



Inversions of the helium line (2)



Early results from the helium line

selected area (left - right):	1	2	3	4
magnetic field strength [G]	110 ± 4	55 ± 4	72 ± 2	219 ± 4
height above photosphere [km]	11500 ± 800	14650 ± 900	3150 ± 450	14250 ± 850
Doppler velocity [km/s]	-0.06 ± 0.01	0.16 ± 0.01	-0.14 ± 0.01	0.18 ± 0.01
thermal broadening [km/s]	7.6 ± 0.5	7.0 ± 0.5	5.9 ± 0.4	6.5 ± 0.5

Magnetic field angles are also determined, but for this four cases they have huge error bars, so they are not shown.

Conclusions

- We observed a filament in a sunspot/pore group connecting different magnetic polarities, it was not along the neutral line.
- Negative magnetic polarity features occur between pores of positive polarity. Threads from the filament seem to end between magnetic polarities. This opposite polarity becomes weaker during our observing period.
- Brightenings in the transition zone (He II) move mostly away from the main spot.
- Between the pores we encounter strong redshifts in the chromosphere (He 1083.0nm)
- Photospheric redshifts are found next to the filament at the penumbral border, where, according to the geometry we expected blue shifts.
- The magnetic field strength in the filament is on the order of 100 G, the filament is 10 - 15 Mm above the photosphere.

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Thank you for your attention!