Plasma and magnetic field interaction in large- and small-scale on the lower solar atmosphere

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Supervisors:
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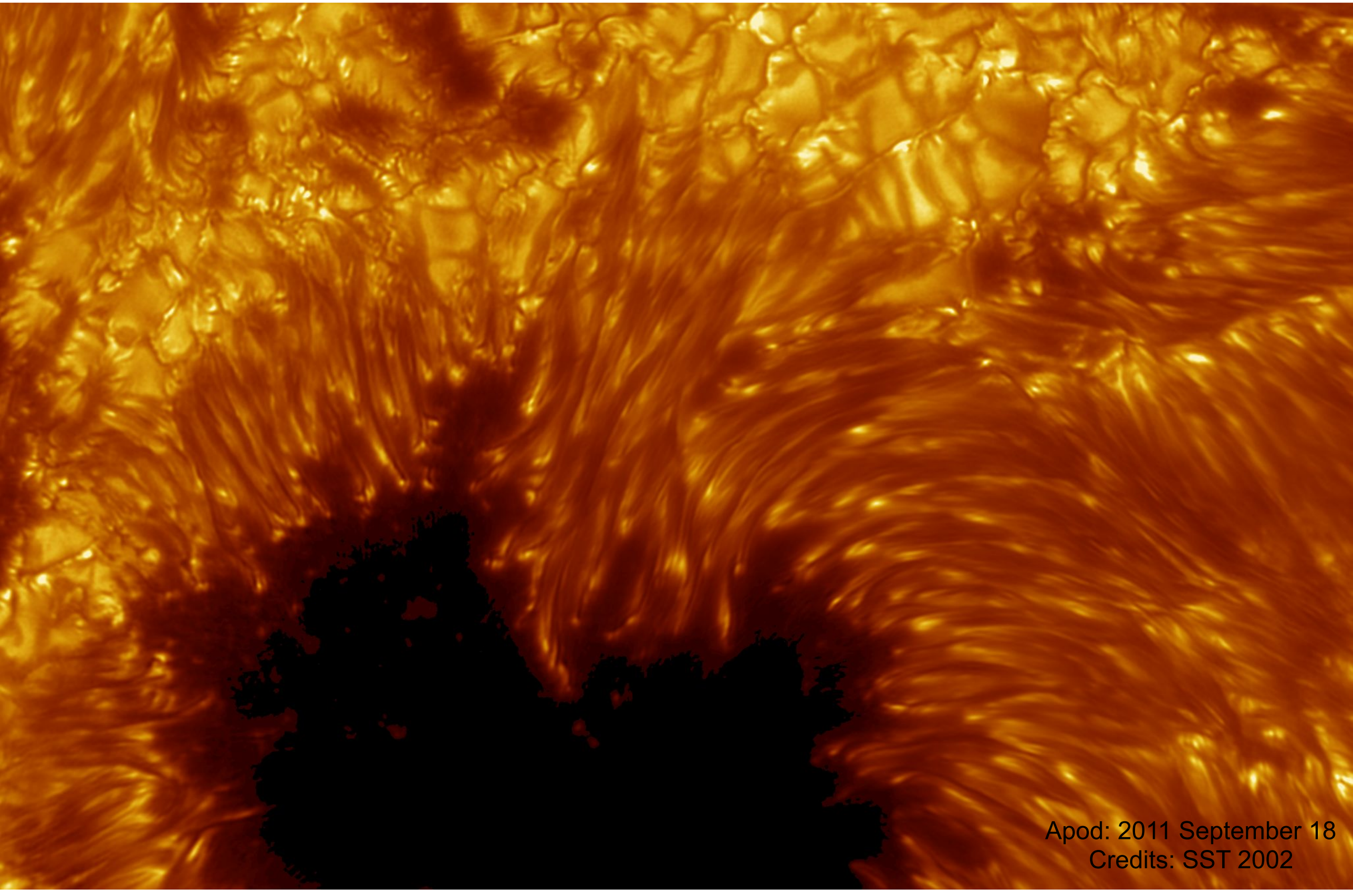
SOLARNET's Summer School and Training for Solar Observers – A week above the Clouds between Aug 5 – Aug 9, 2019. Tenerife, Spain

FWF Der Wissenschaftsfonds
SOLARNET
UNI GRAZ
IGAM/IP

Motivation

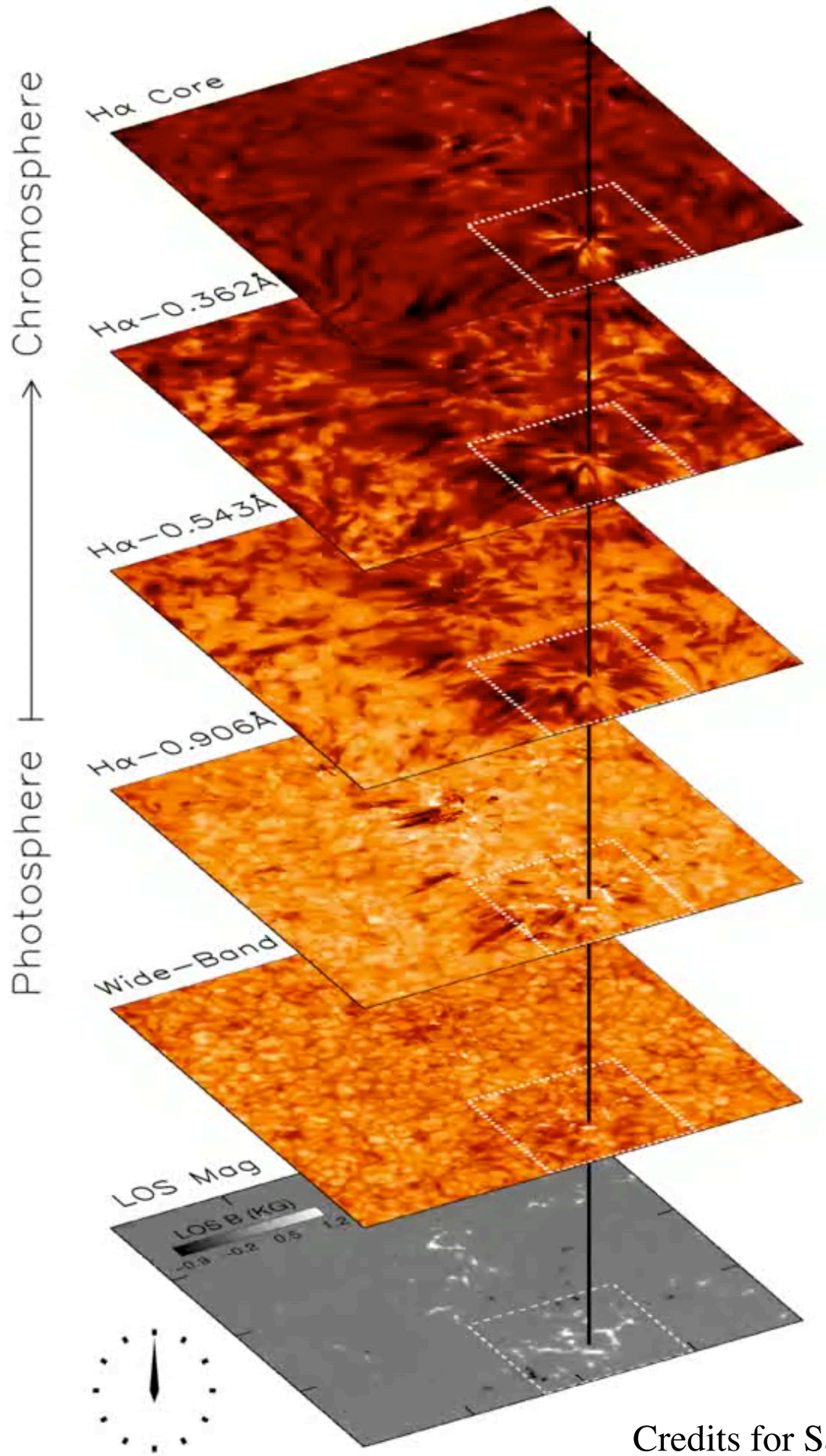
Physical important processes are happening on large- and small-scales (temporal and spatial)

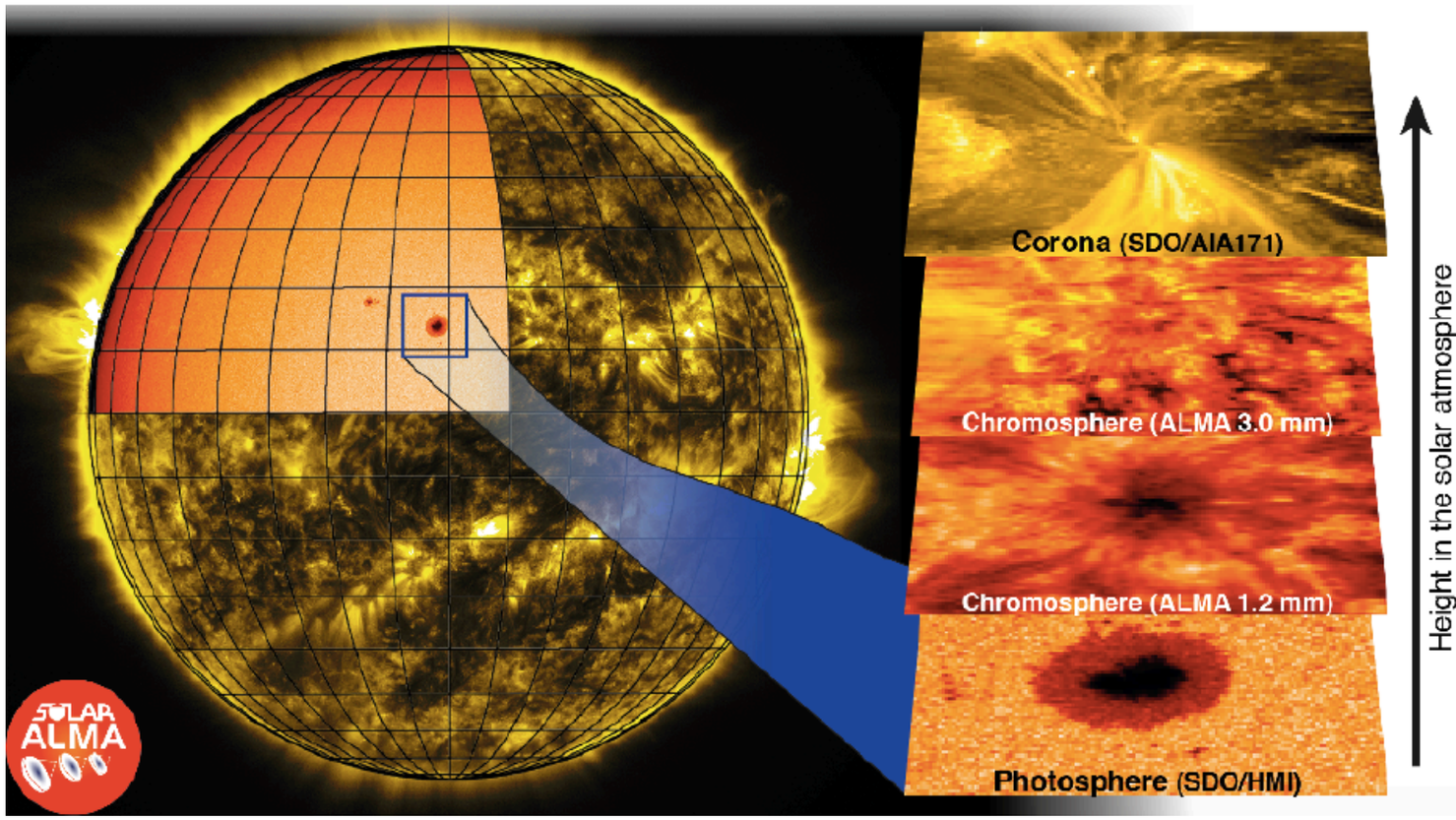


Apod: 2011 September 18
Credits: SST 2002

Multi-spectral studies

A better and full understanding of the solar evolution and activity could be drived by the study of the phenomena on different and co-temporal spectral lines.

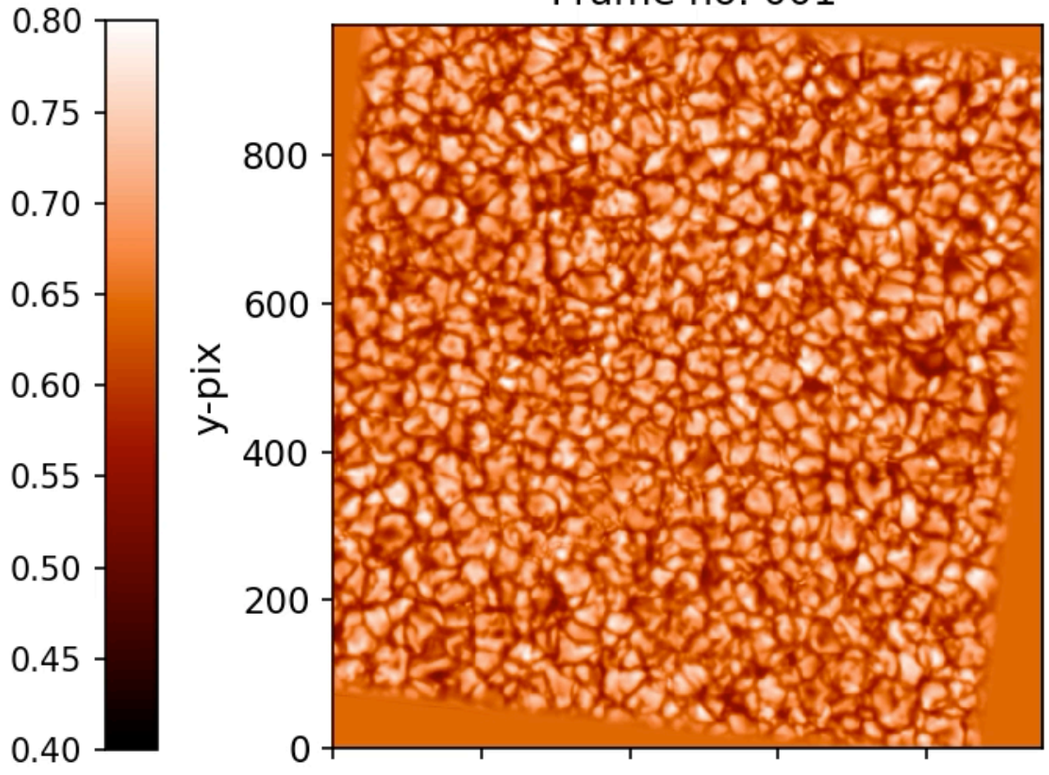




Alma database

Credits for Samanta, T. (IIA)

Fe I 6173 *Å* (Stokes I)
Frame no: 001



Fe I 6173 *Å* (Stokes V)
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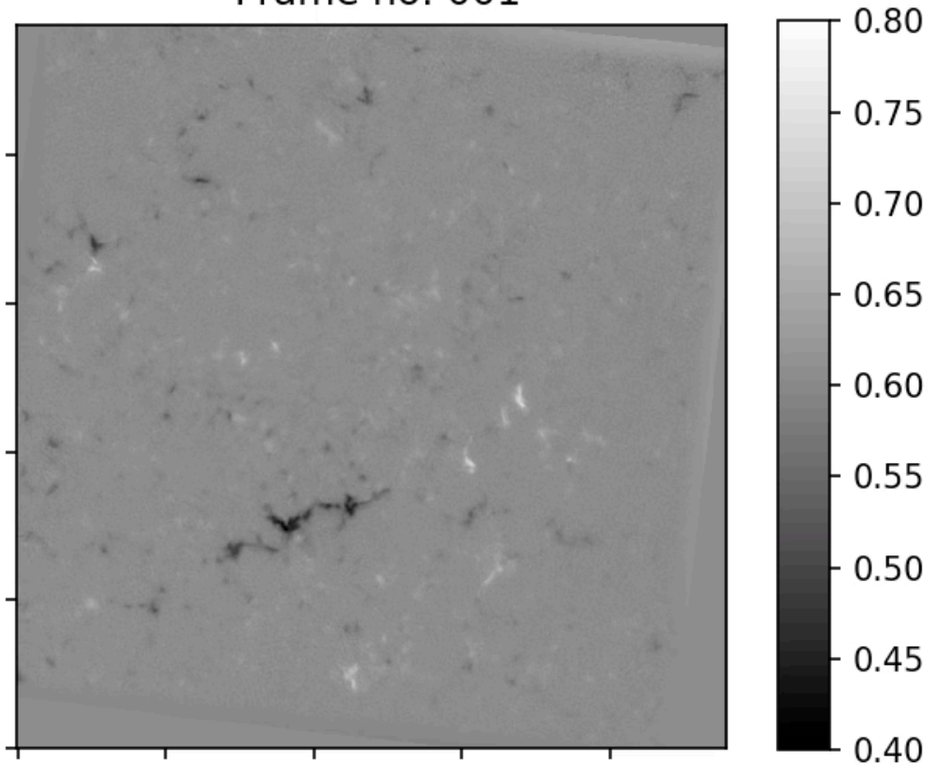
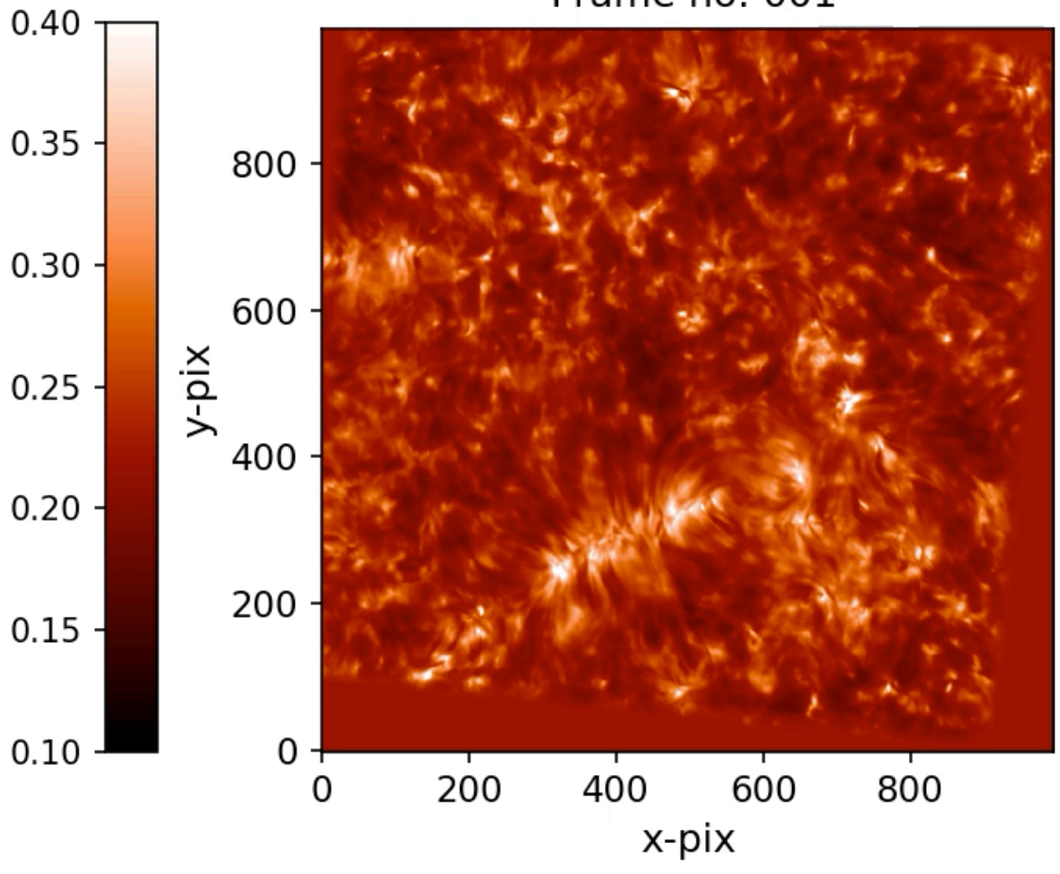


Ca II 8542 *Å* (Stokes I)
Frame no: 001



Ca II 8542 *Å* (Stokes V)
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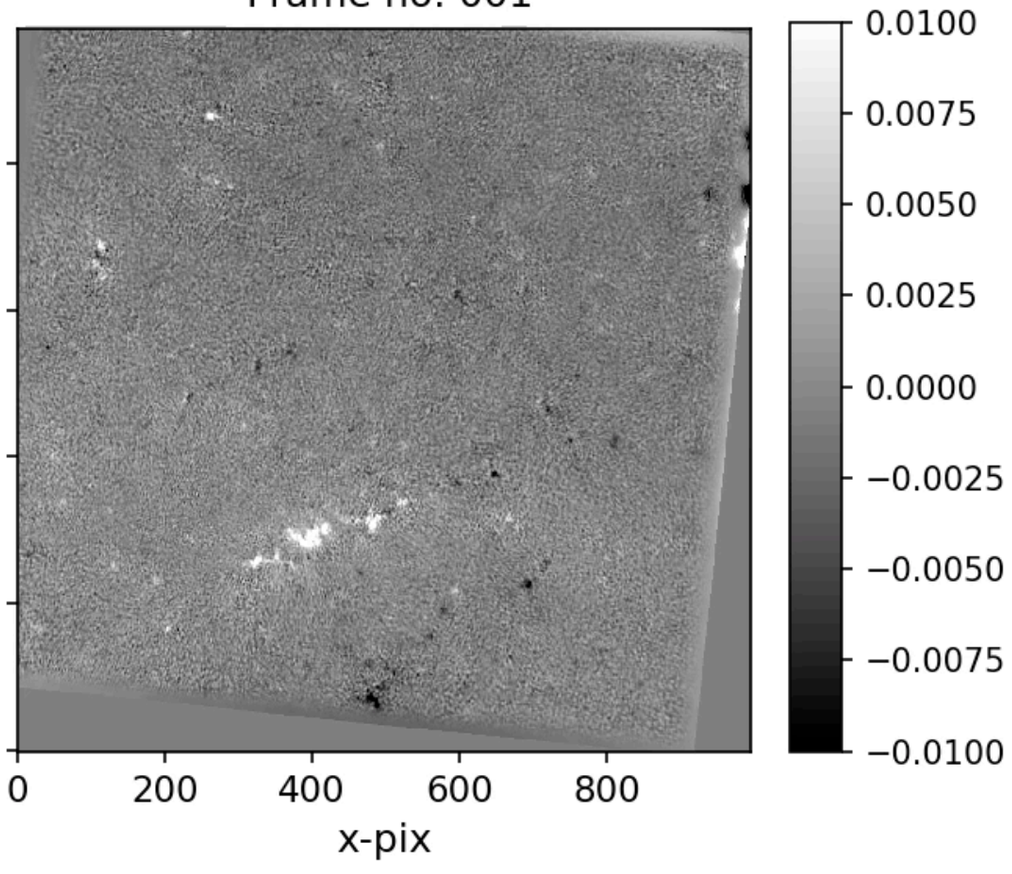
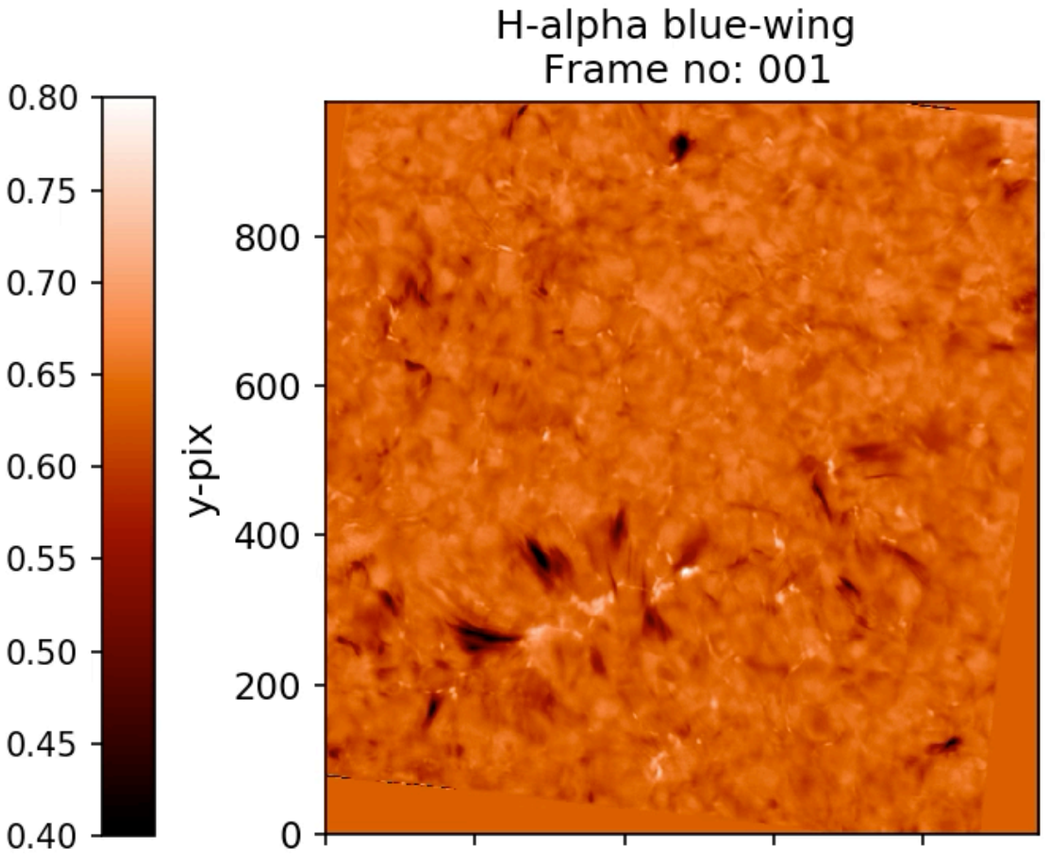
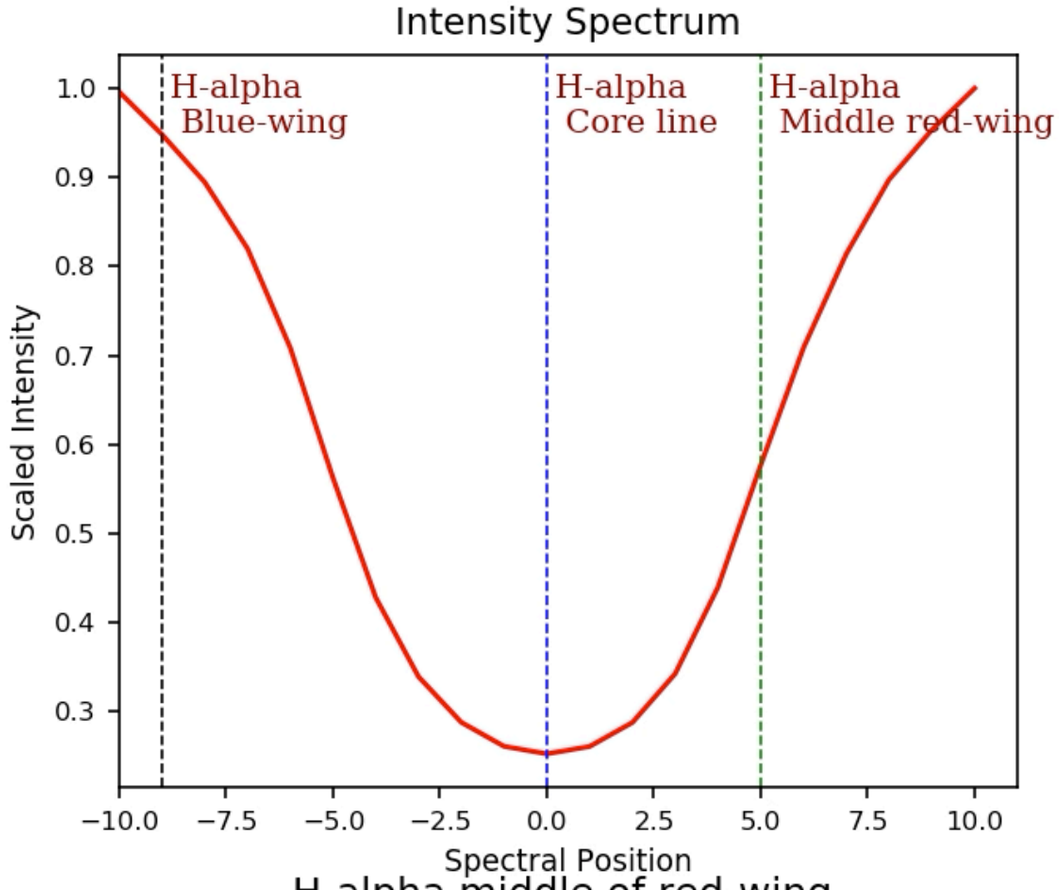
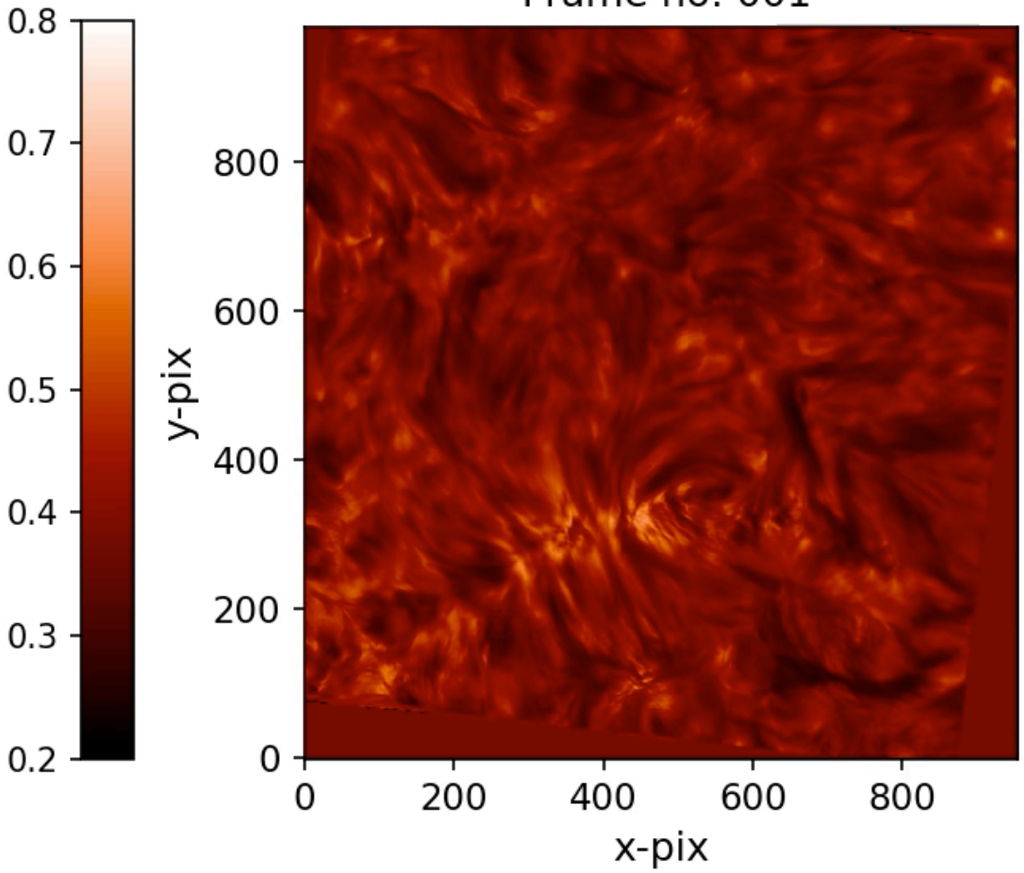
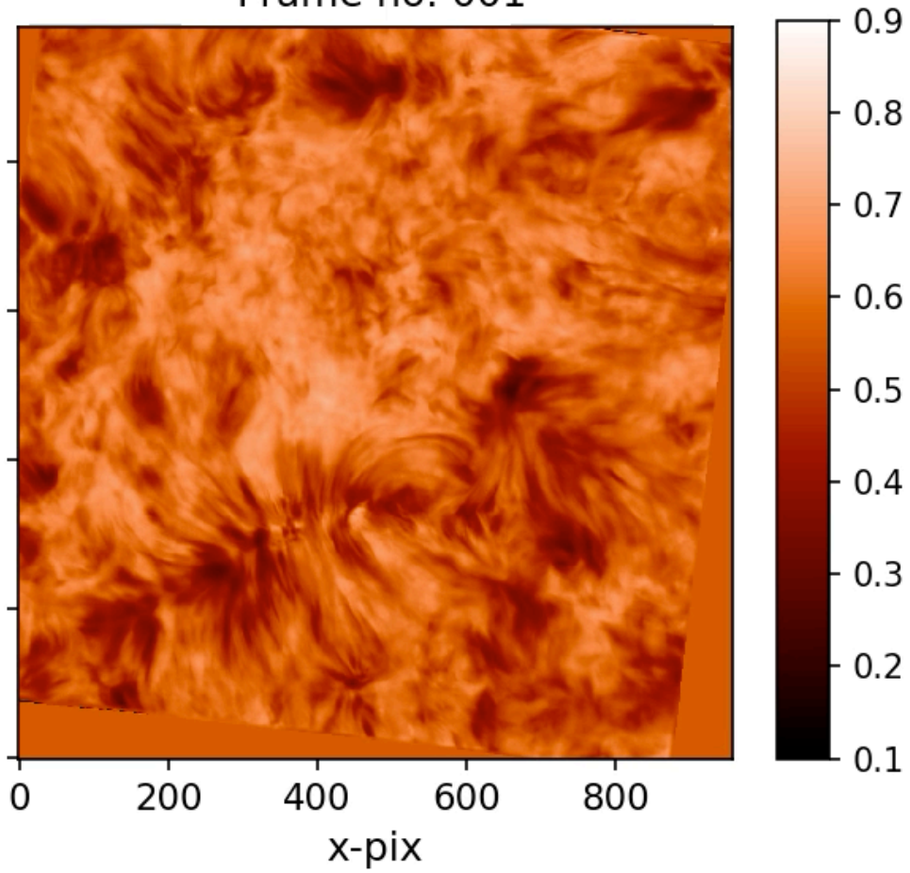



H-alpha blue-wing
Frame no: 001
y-pix
0
200
400
600
800
0.80
0.75
0.70
0.65
0.60
0.55
0.50
0.45
0.40


Intensity Spectrum
H-alpha
Blue-wing
H-alpha
Core line
H-alpha
Middle red-wing
Scaled Intensity
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
−10.0
−7.5
−5.0
−2.5
0.0
2.5
5.0
7.5
10.0
Spectral Position


H-alpha core line
Frame no: 001
y-pix
x-pix
0
200
400
600
800
0.8
0.7
0.6
0.5
0.4
0.3
0.2


H-alpha middle of red-wing
Frame no: 001
x-pix
0
200
400
600
800
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1

What kind of information we can obtain from observational data with LCT and Inversion techniques?

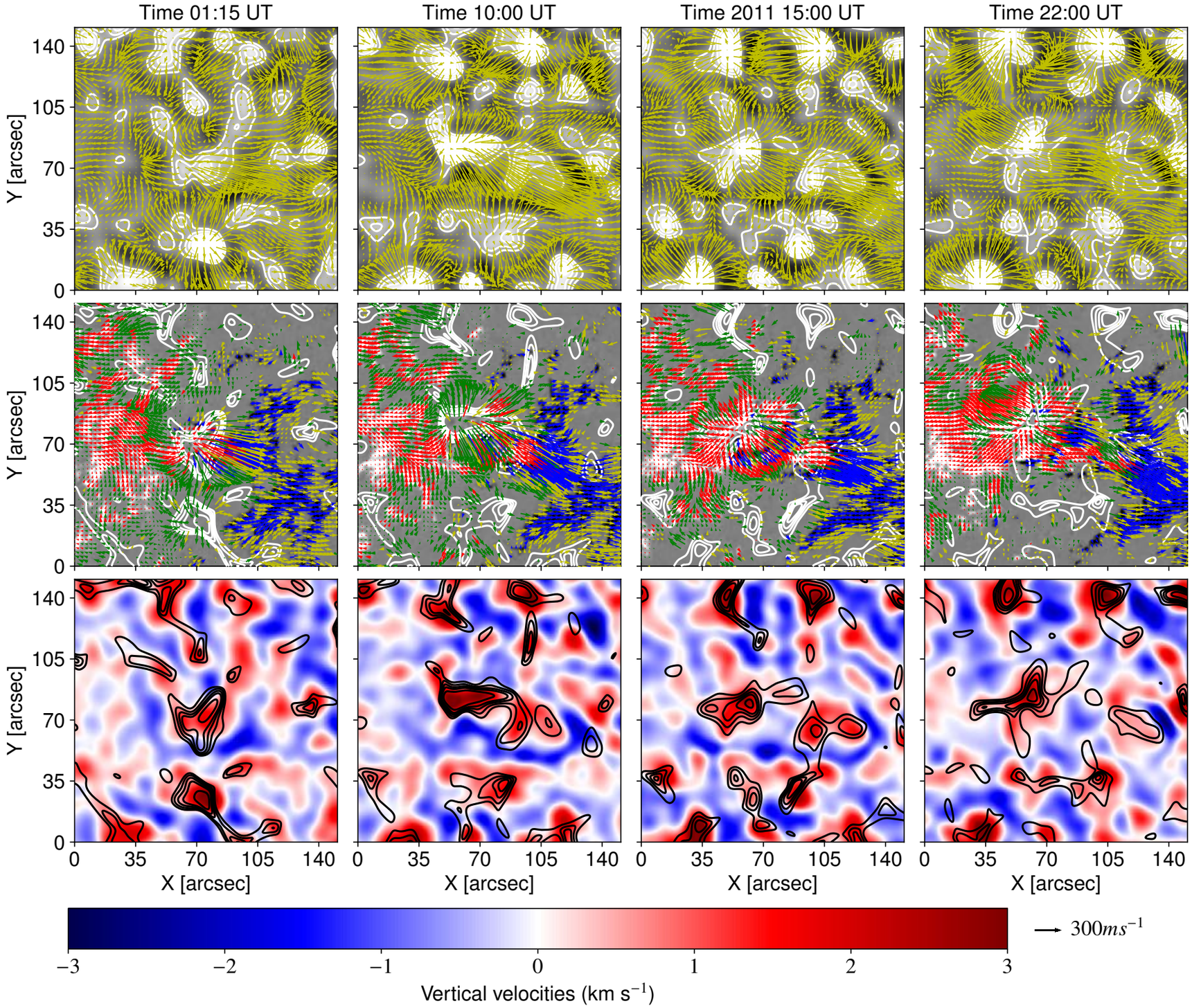
My main topic!!!

- ☆ From LCT we can infer plasma dynamics due to proper motions detected and calculated from the intensity variations of the images

Starting to learn!!

- ☆ Inversion of Stokes parameter techniques let us analize the response of certain spectral lines to variations of temperature, magnetic field vector, doppler velocity among others

Flow field temporal evolution



We applied local correlation tracking (LCT) to the study of the dynamics of plasma as well as magnetic elements related to AR 11190.

Flow field temporal evolution

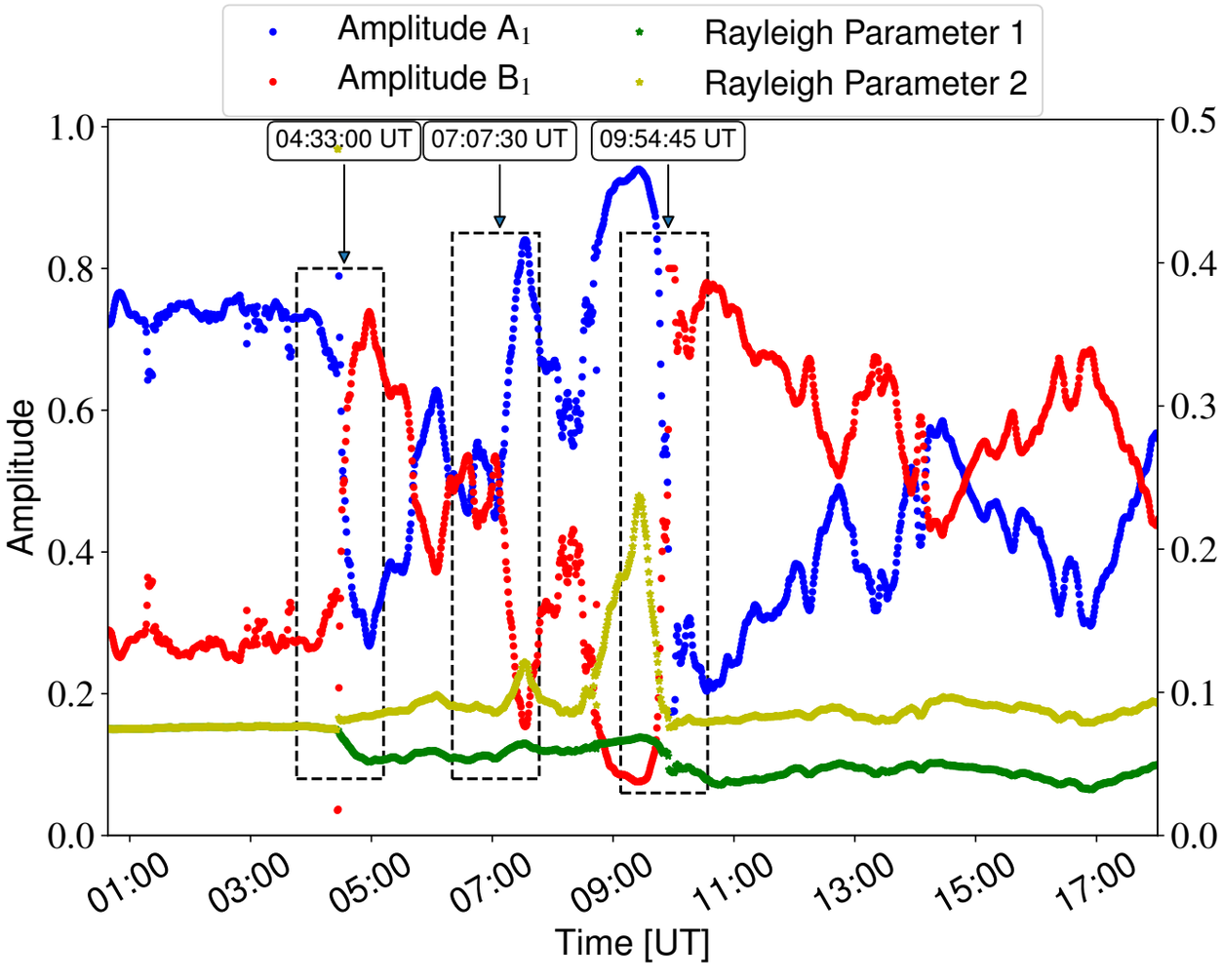
Assumptions

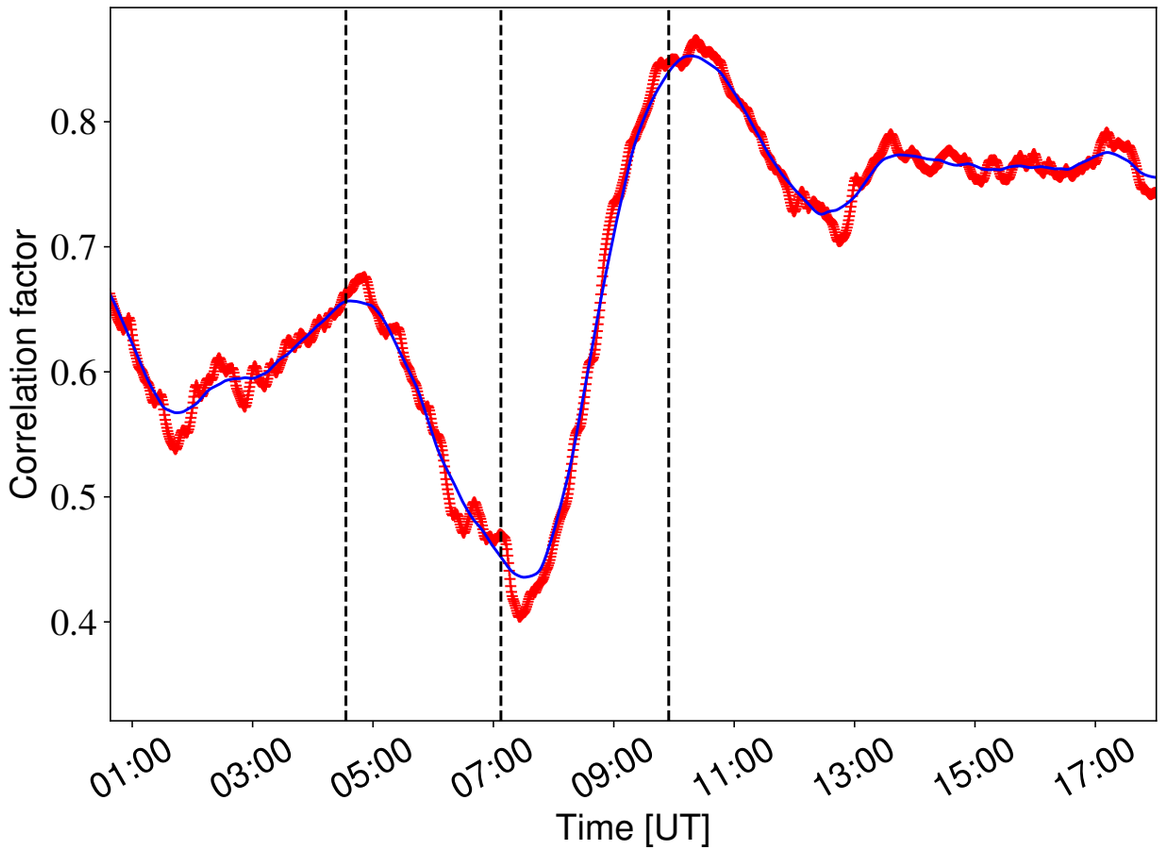
$$f(v,\sigma_{R_1}) + f(v,\sigma_{R_2}) = A_1 \cdot \frac{v}{\sigma_{R_1}^2} \exp\left(\frac{-v^2}{2\sigma_{R_1}^2}\right) + B_1 \cdot \frac{v}{\sigma_{R_2}^2} \exp\left(\frac{-v^2}{2\sigma_{R_2}^2}\right),$$

Eq 1: Sum of two rayleigh distributions

$$f(v,\sigma_{R_3}) + f(v,\mu_G,\sigma_G) = A_2 \cdot \frac{v}{\sigma_{R_3}^2} \exp\left(\frac{-v^2}{2\sigma_{R_3}^2}\right) + \frac{B_2}{\sqrt{2\pi}\sigma_G} \exp\left(\frac{-(v-\mu_G)^2}{2\sigma_G^2}\right).$$

Eq 2: Sum of one rayleigh distribution plus a gaussian distribution





Campos Rozo, J. I. et al. 2019

Going to small scales…

Gregor campaign observation
September 18-29, 2017

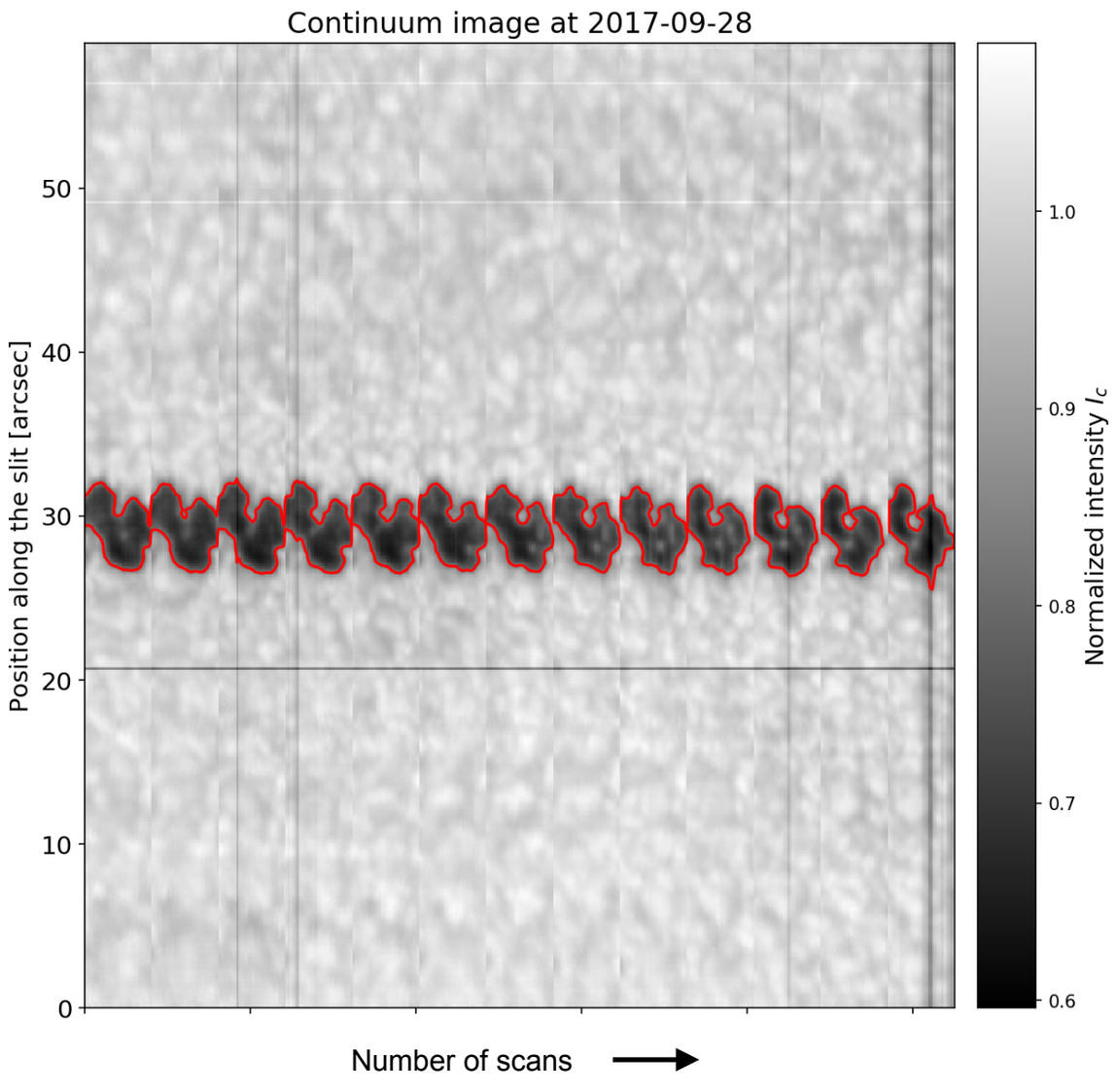
Observing team:

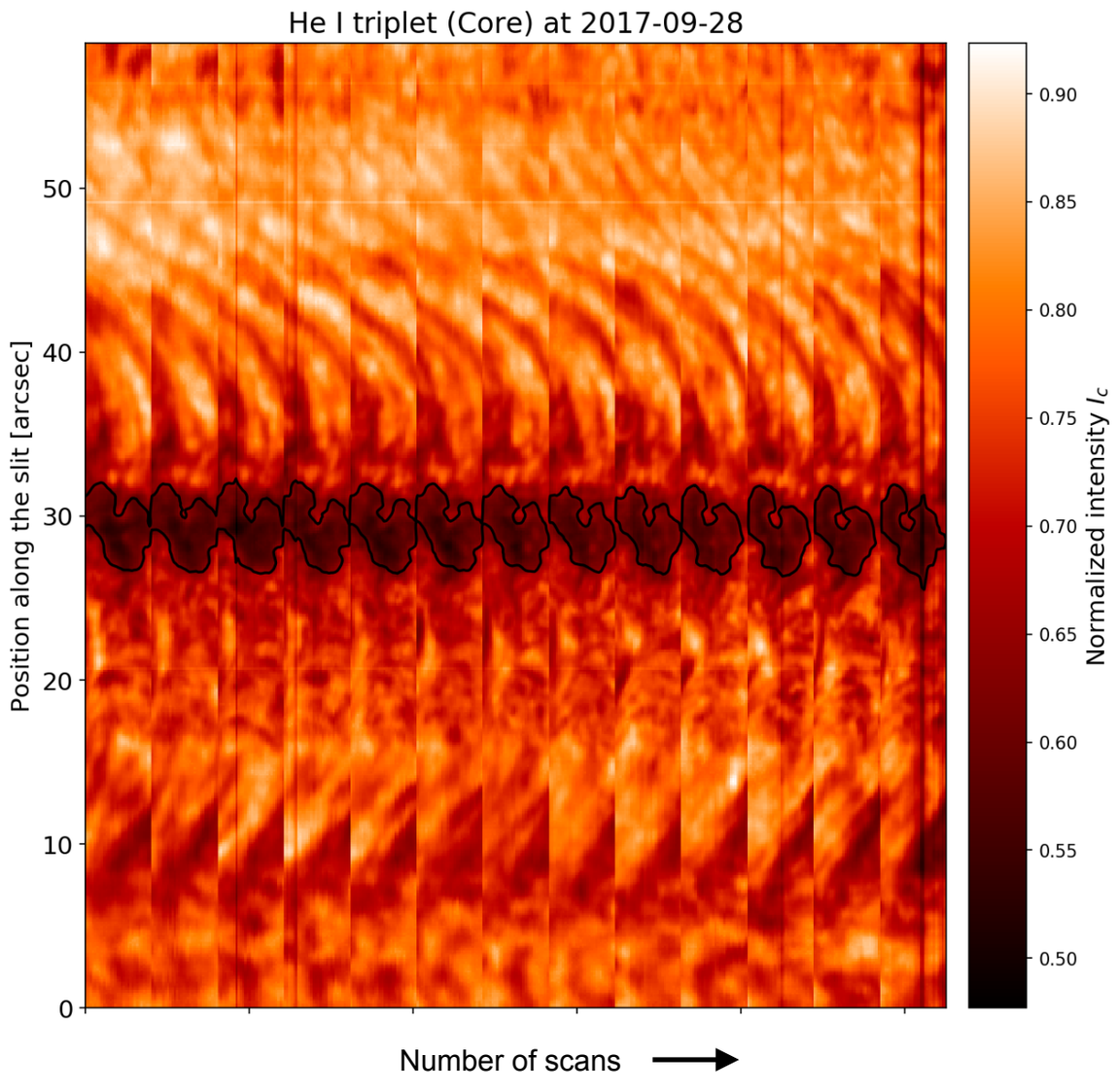
- Dominik Utz (P. I.)
- Peter Gömöry
- Christoph Kuckein
- Horst Balthasar
- Norbert Magyar
- Jose Ivan Campos Rozo
- Stefan Hofmeister
- Otmar Kühner
- Thomas Keller (technician)

Collaboration team:

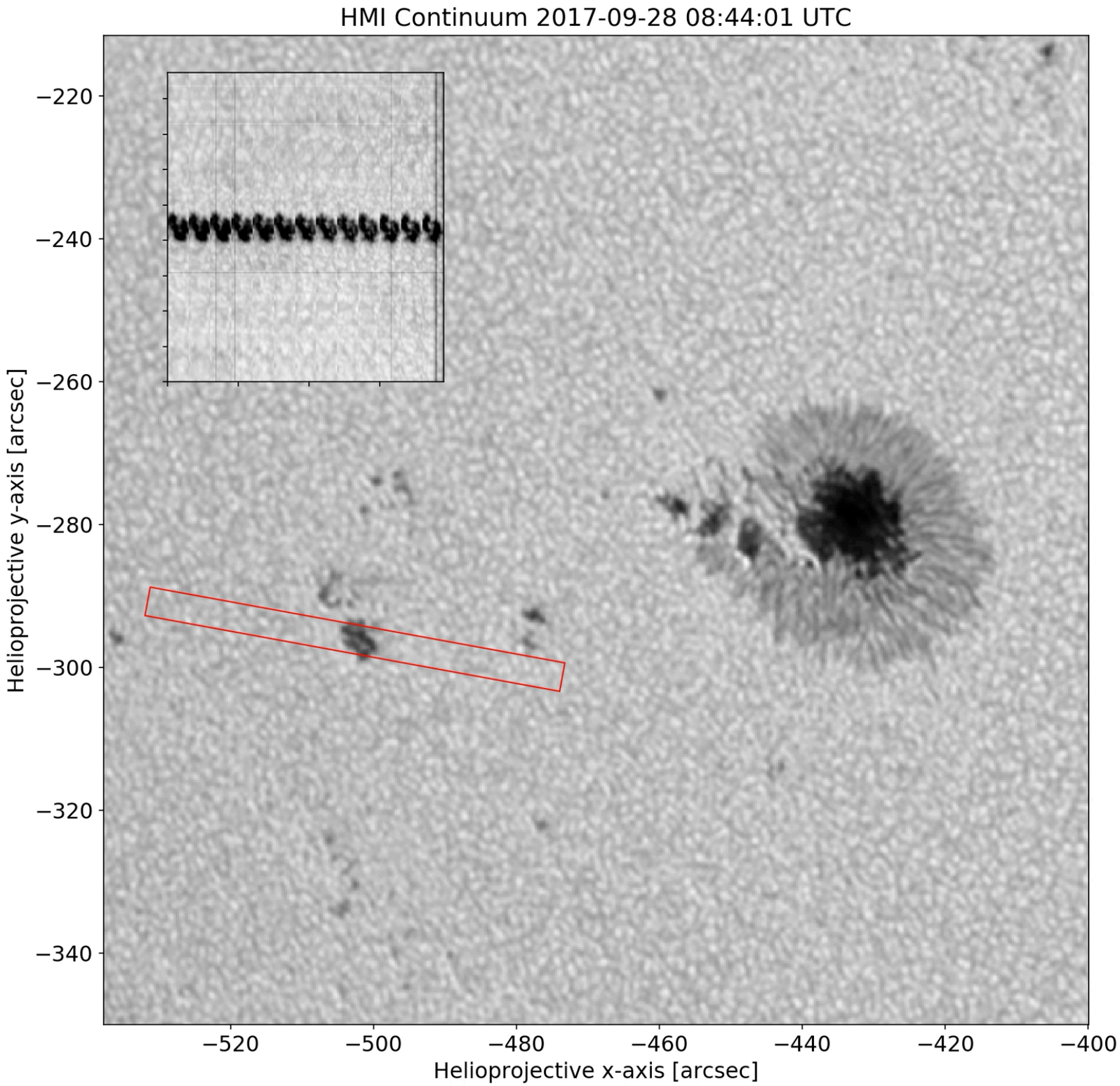
- Sergio Gonzalez Manrique
- Meetu Verma
- Carsten Denker
- Judith Palacios
- Julius Koza
- Kilian Krikova
- Luis Bellot Rubio
- Santiago Vargas Dominguez

GRIS: GREGOR Infrared Spectrograph

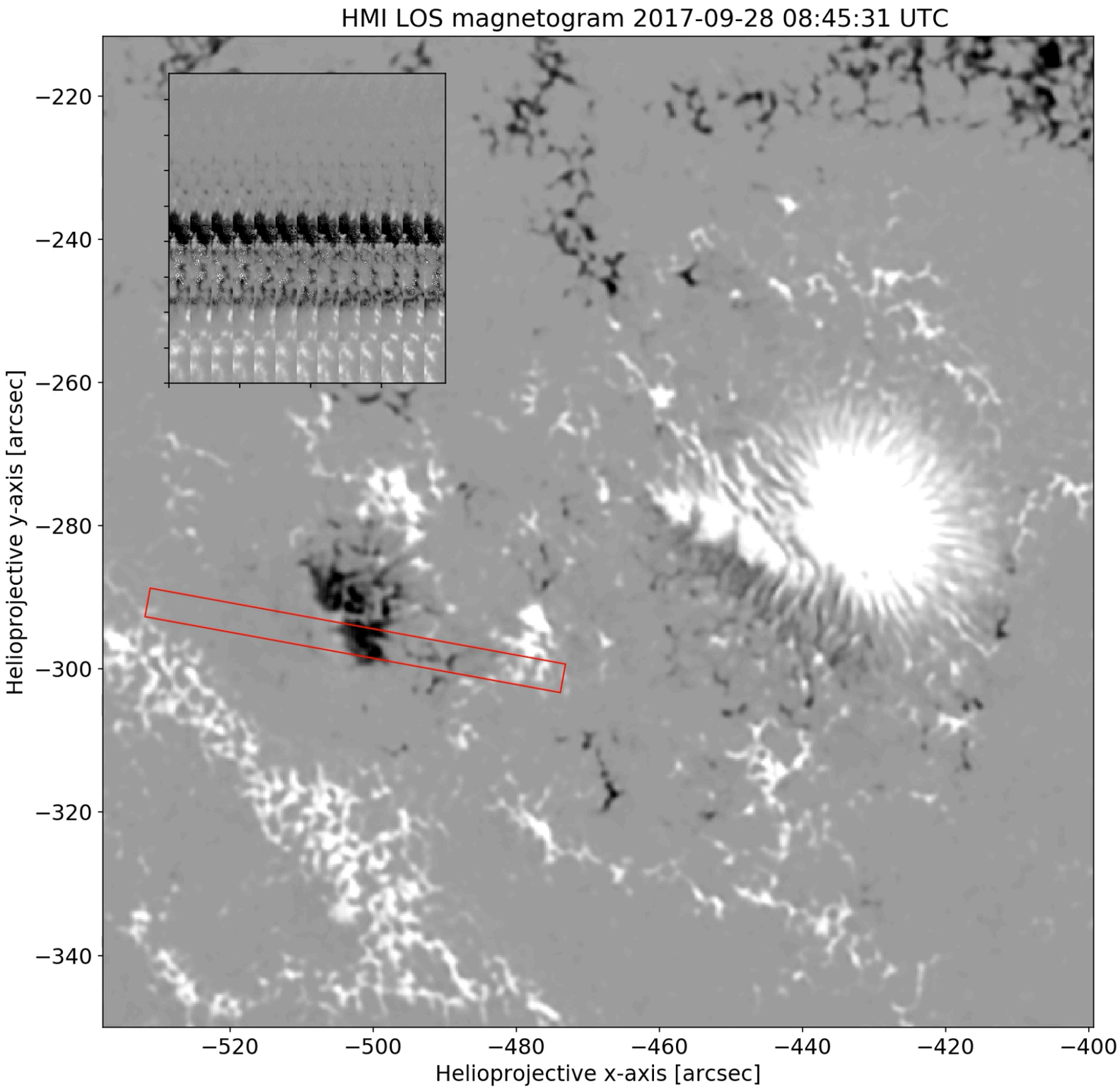




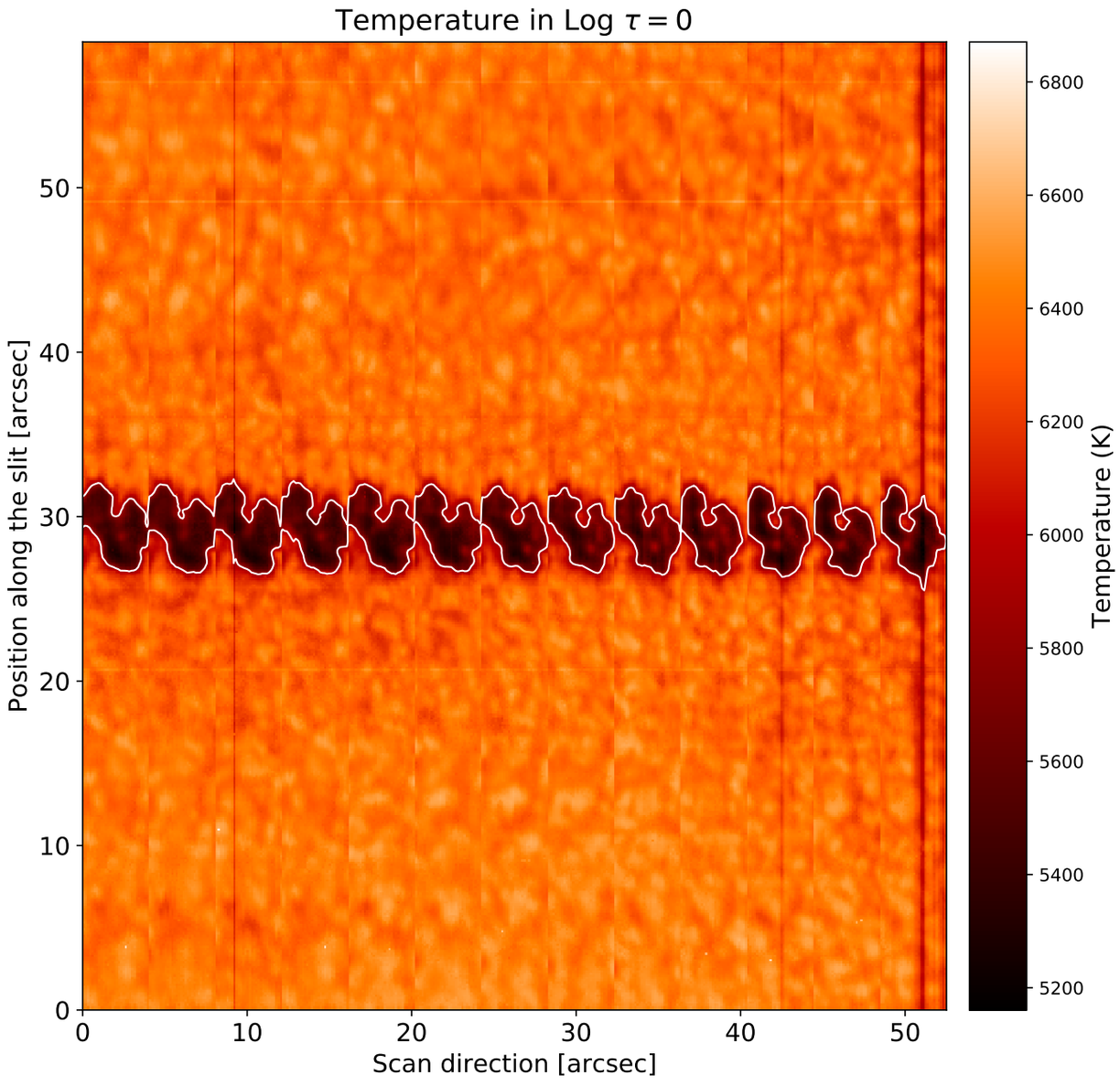
Coaligment of GRIS data and HMI/SDO data set

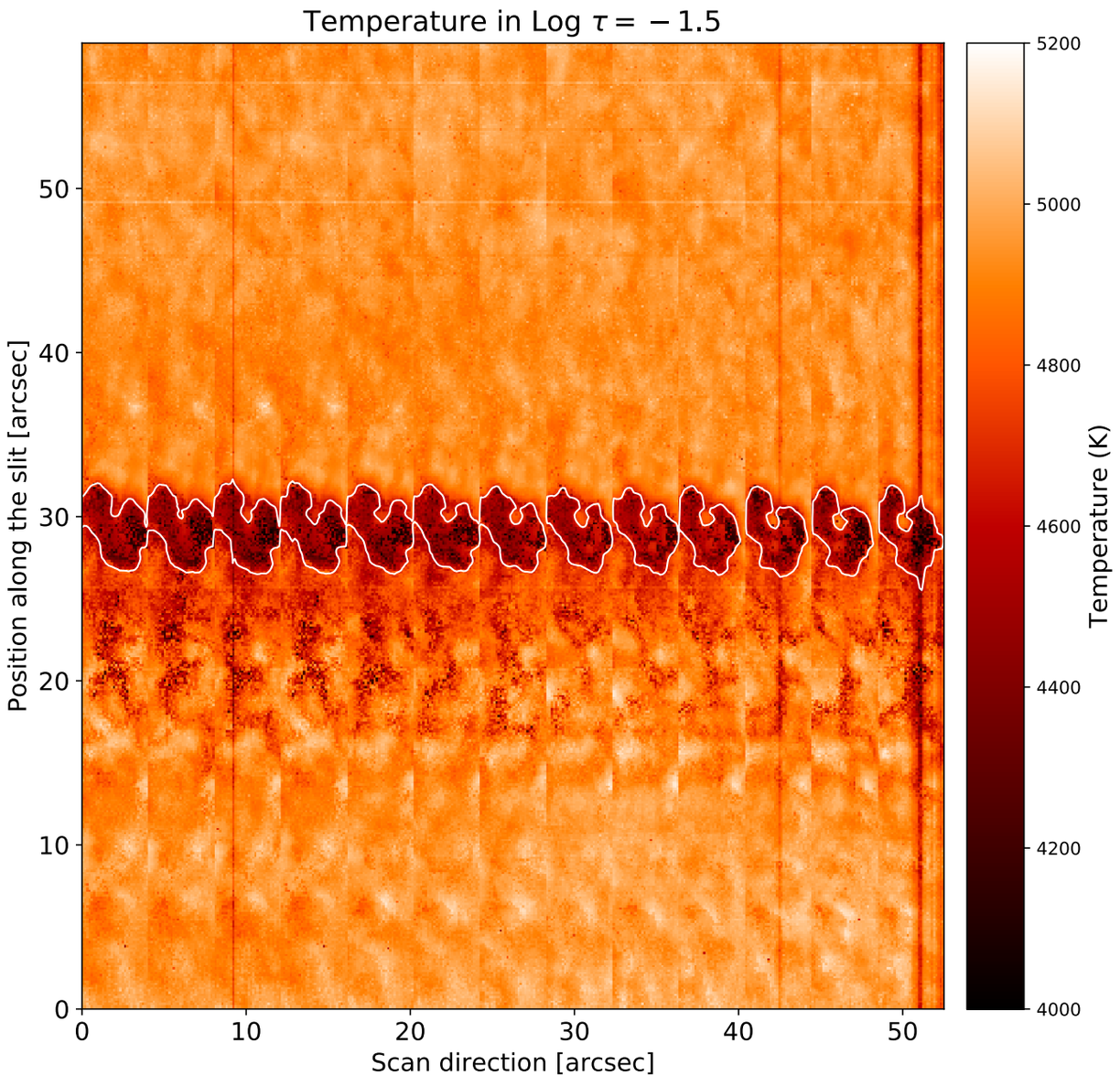


Coaligment of GRIS data and HMI/SDO data set



First results for the Stokes parameters inversions

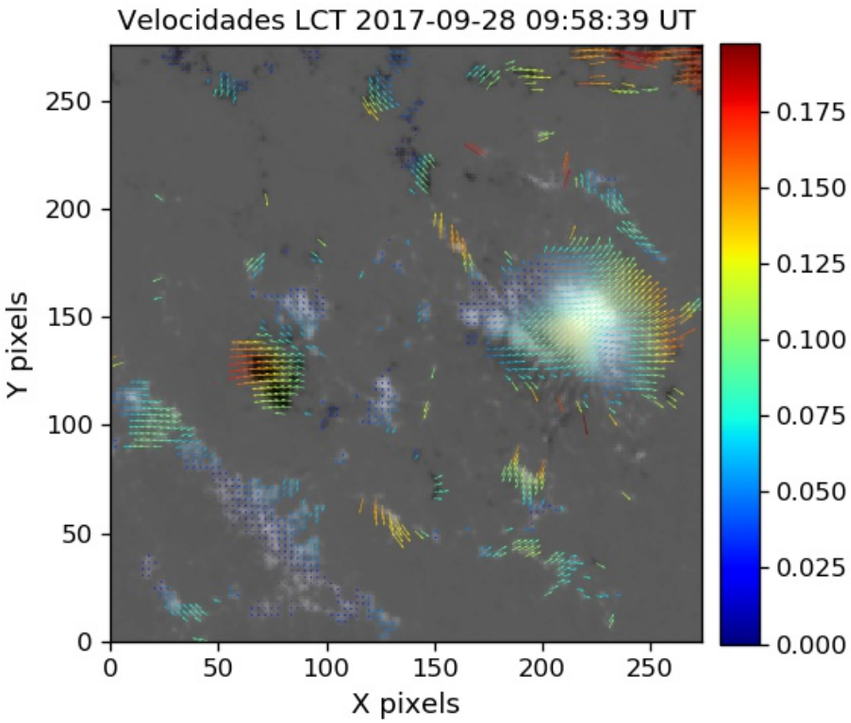


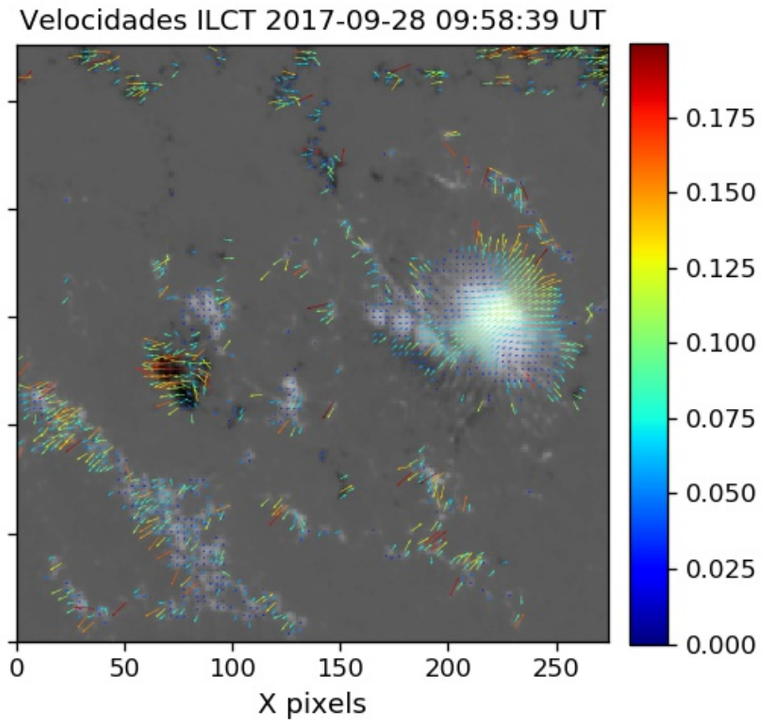


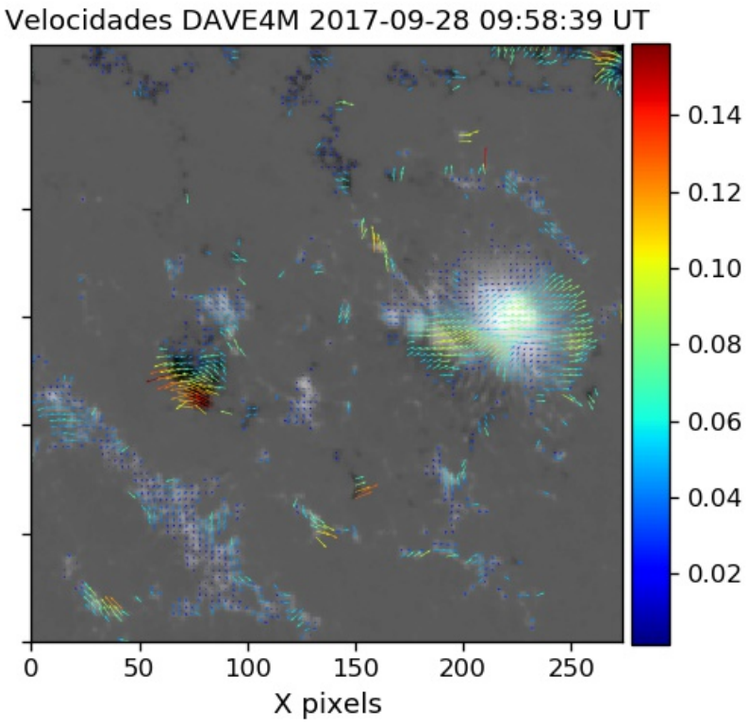
Future work

LCT can not solve very well magnetic field horizontal motions
Working now in one a Python's adaptation to the ILCT code
(Applying the Induction equation)
Stay tunned (It is al ready in the oven)

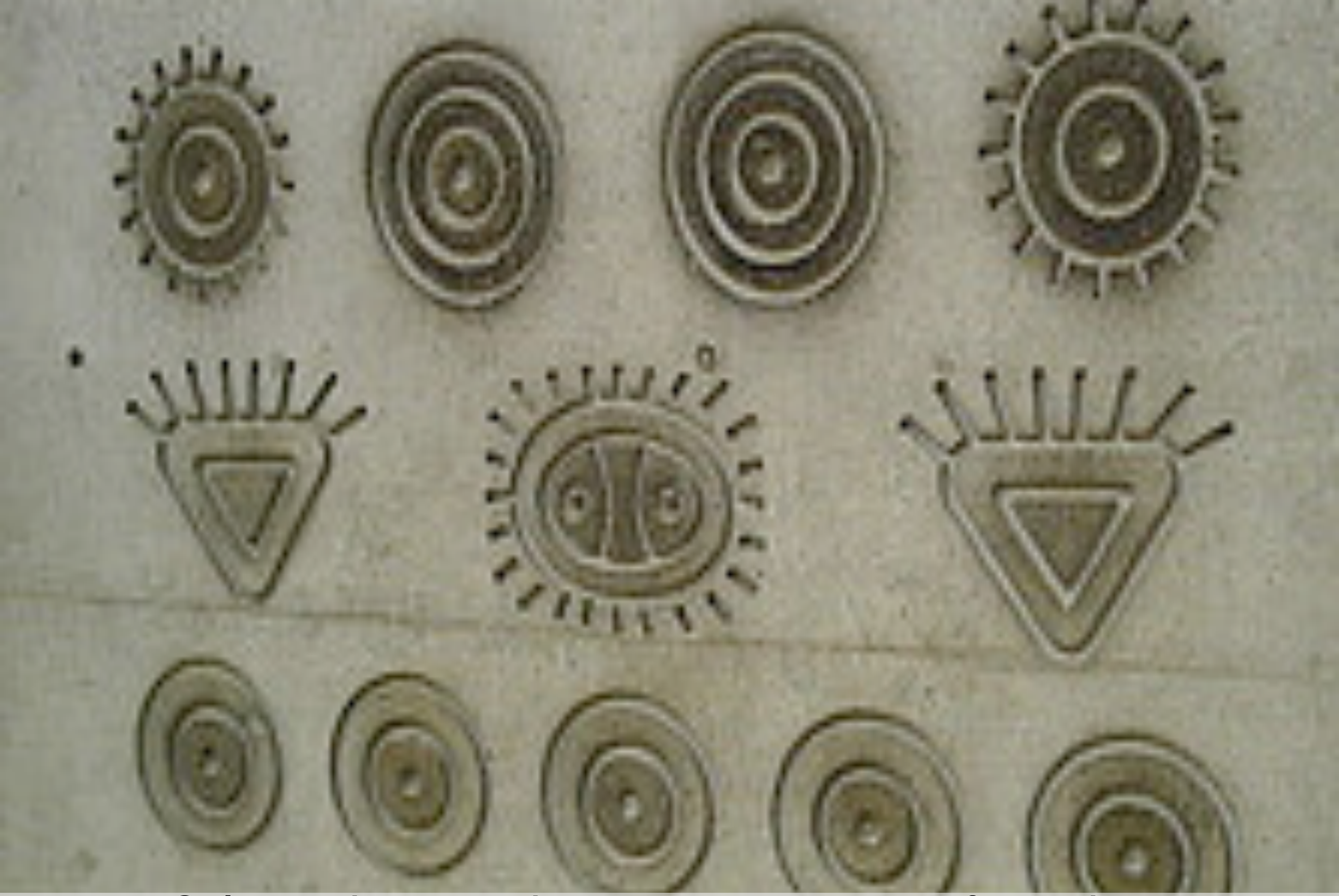
Comparison between LCT, ILCT, and DAVE4VM
(All of them working very well in Python)







Thank you for your attention



Solar and moon phases representation from the Colombian indigen cultures (Chibchas indigens)