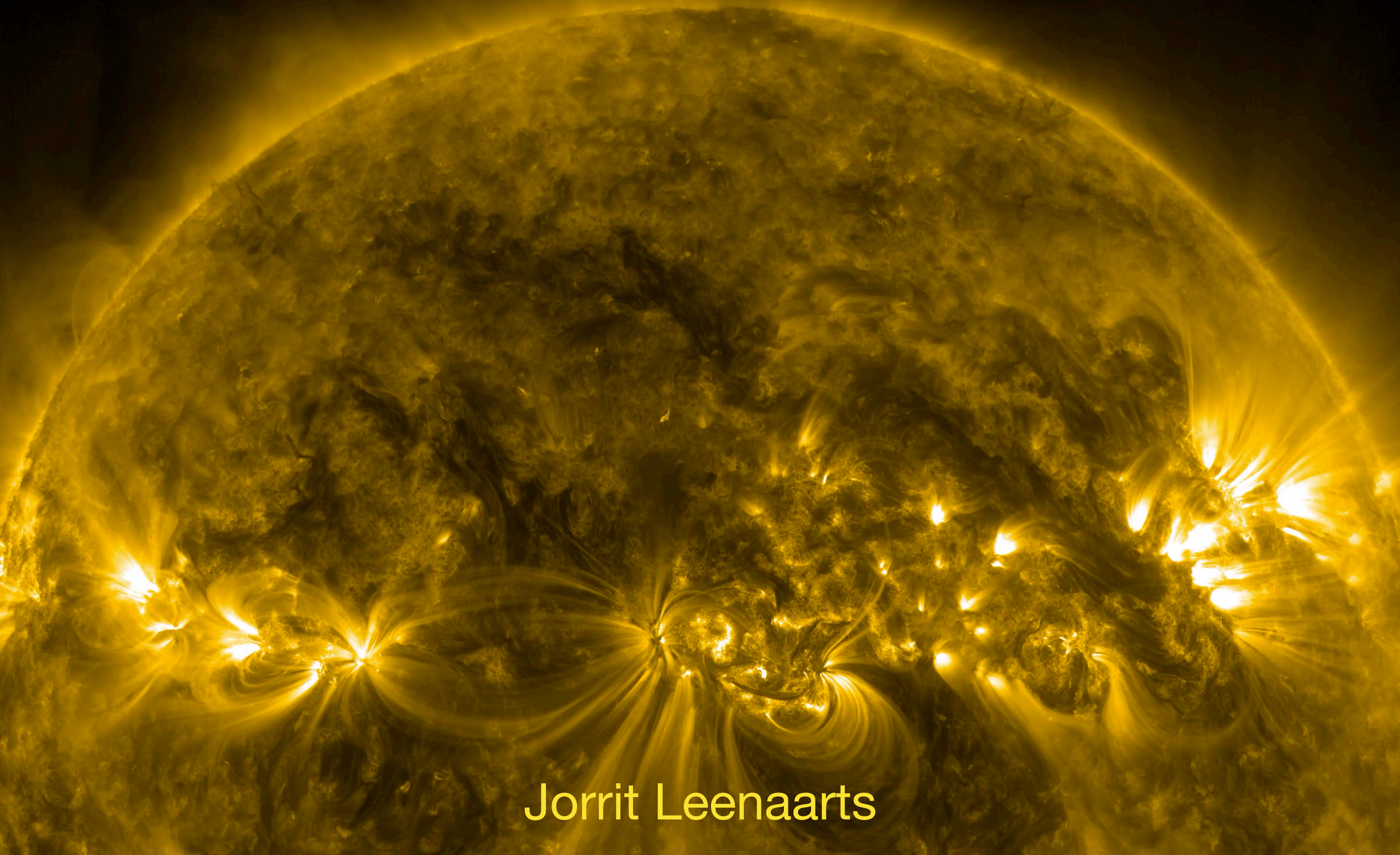
Solar physics proposals for Voyage 2050



Jorrit Leenaarts

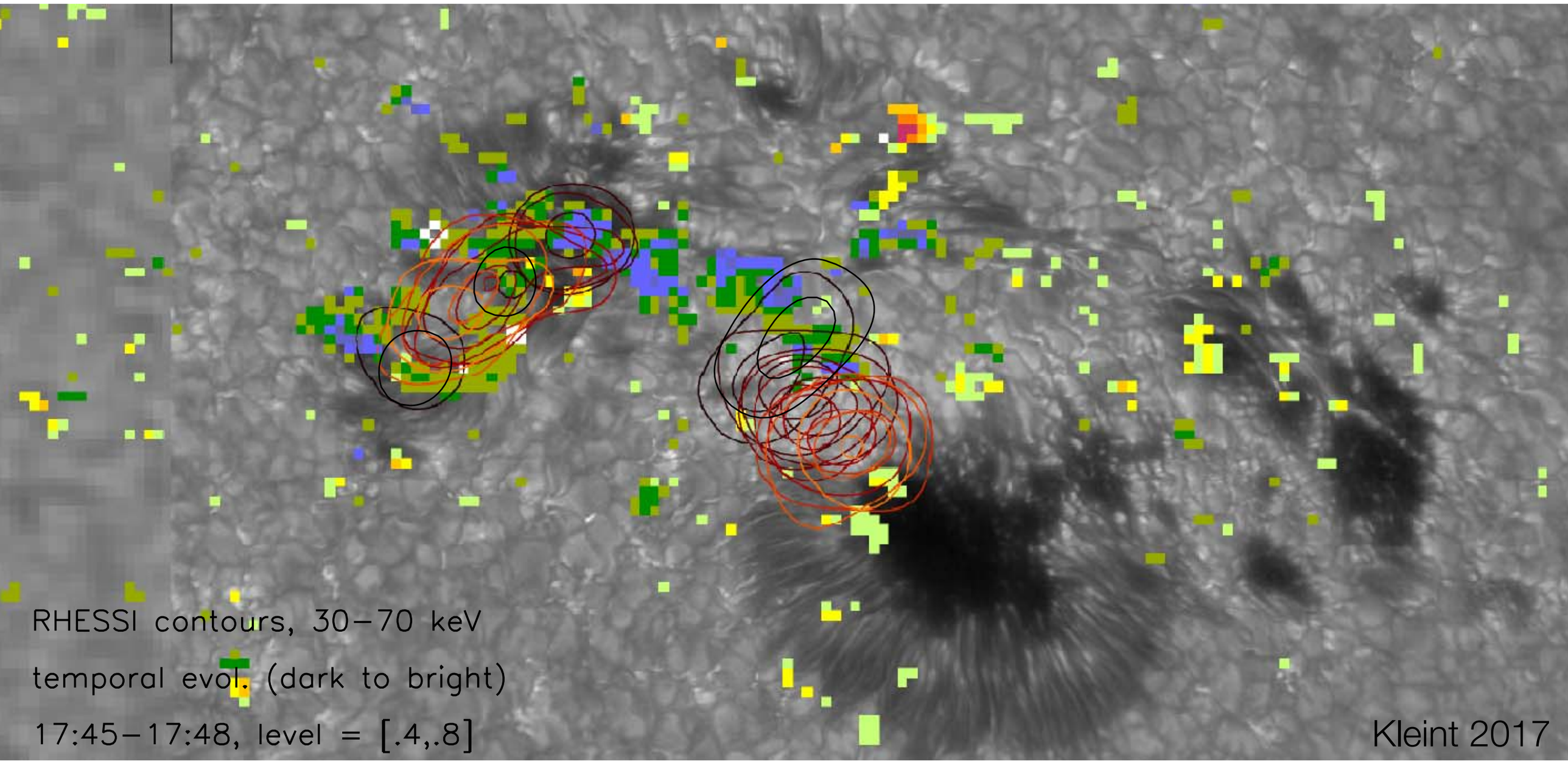
7,5 white papers

Title	Size	Proposers
Coronal Magnetism Explorer	S/M?	Scullion et al.
Exploring the solar poles	L/M	Harra et al.
High Resolution Imaging and Spectroscopy Explorer	L(/M)	Erdelyi et al.
In situ studies of the solar corona	L/M?	Krasnosselskikh et al.
Magnetism and structure of chromosphere and transition region	S(/M?)	Orozco Suárez et al.
Magnetic Imaging of the Outer Solar Atmosphere	L/M	Peter et al.
Solar Particle Acceleration, Radiation & Kinetics	L/M	Matthews et al.
The Grand European Heliospheric Observatory	N.A.	McCrea et al.

Magnetic field regulates activity

- How does the dynamo work?
- How is the outer atmosphere heated?
- How do flares and CMEs work?
- Can we reliably predict flares and CMEs?
- How is the solar wind accelerated and heated?
- How does particle acceleration work on the Sun, and by extension, in the universe.

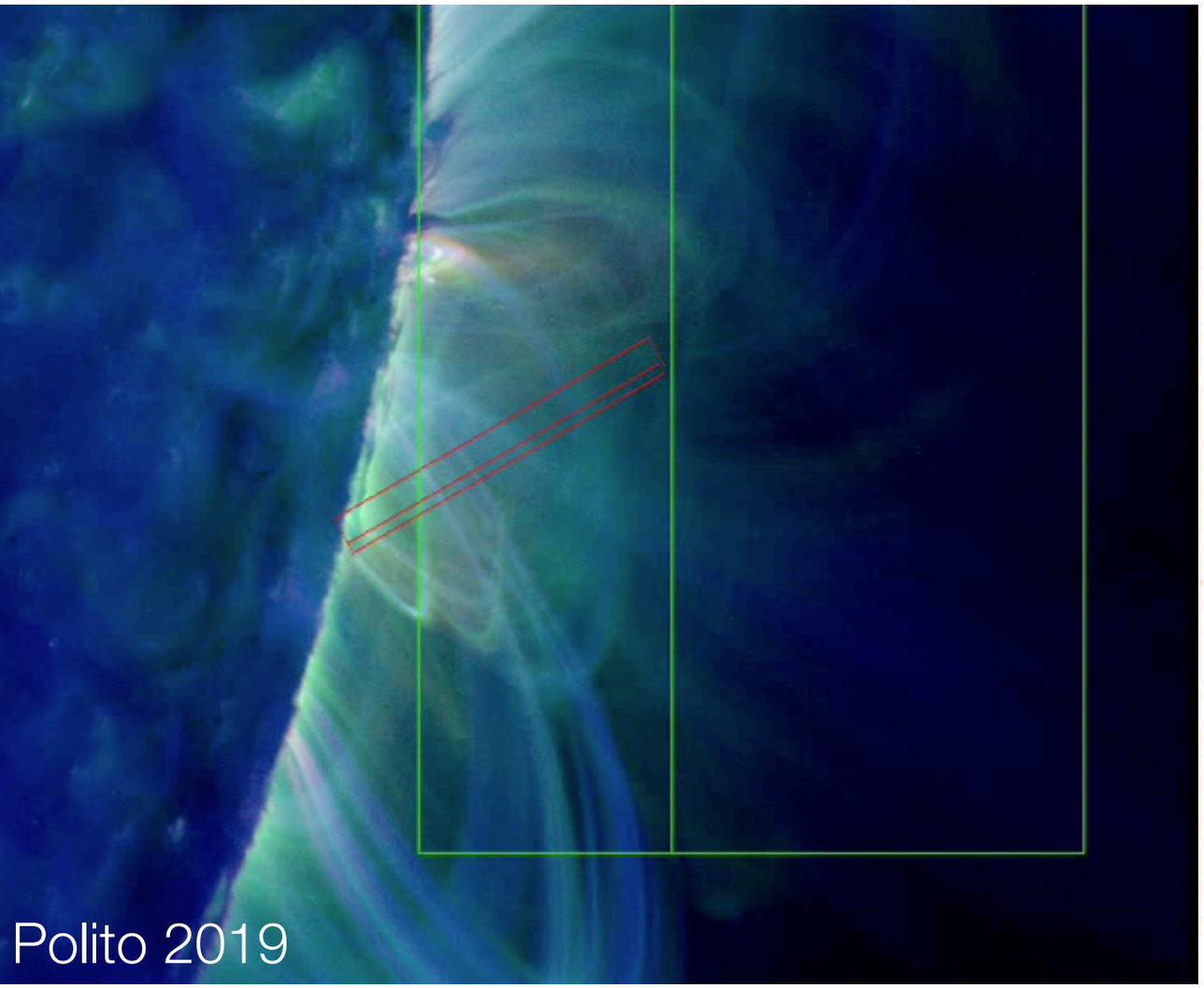
Why from space?

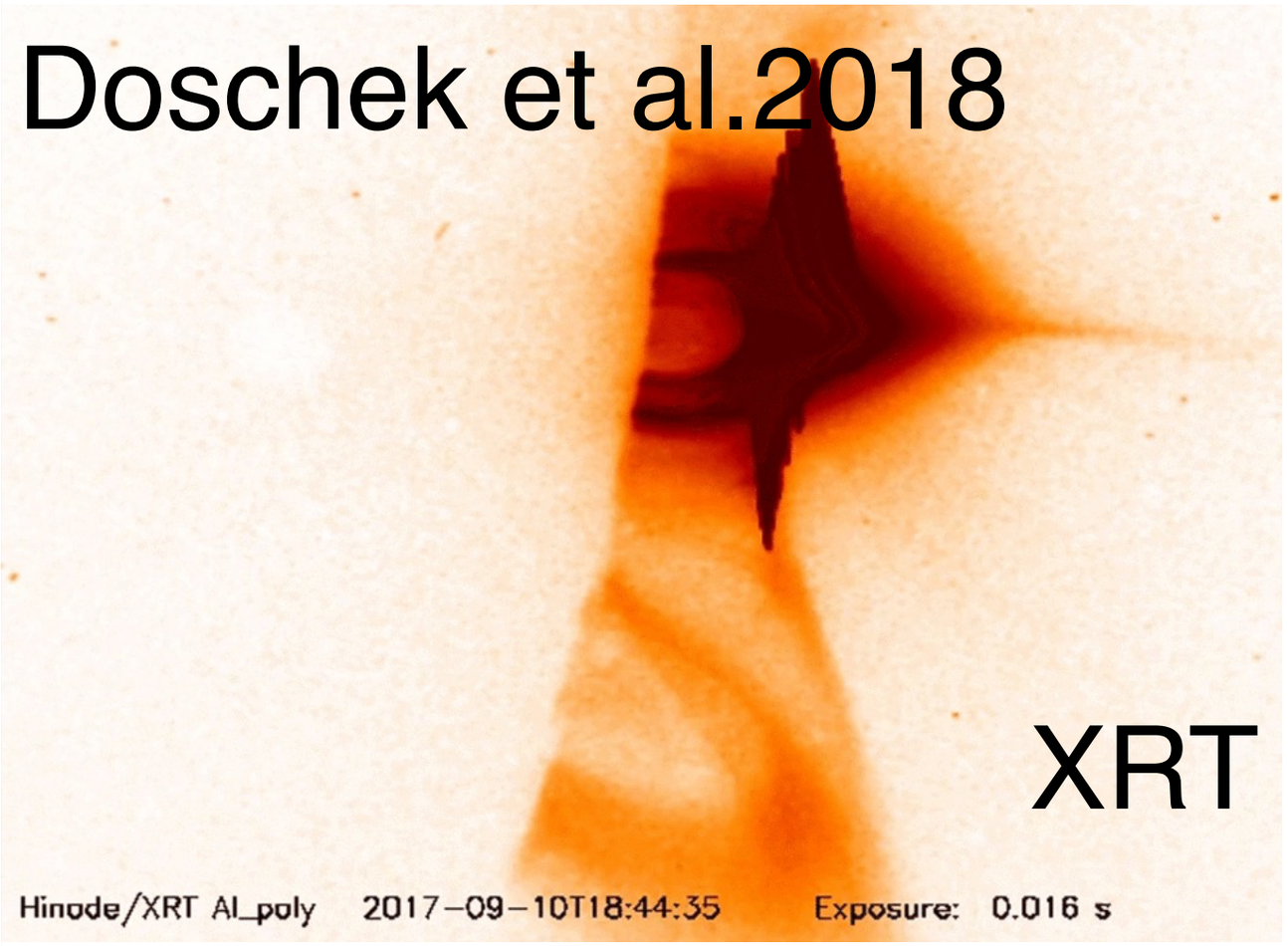


Earth's atmosphere limits us to $\lambda \geq 300$ nm.

➥ We cannot see the hot stuff, or miss diagnostics for cold stuff.

Why from space?



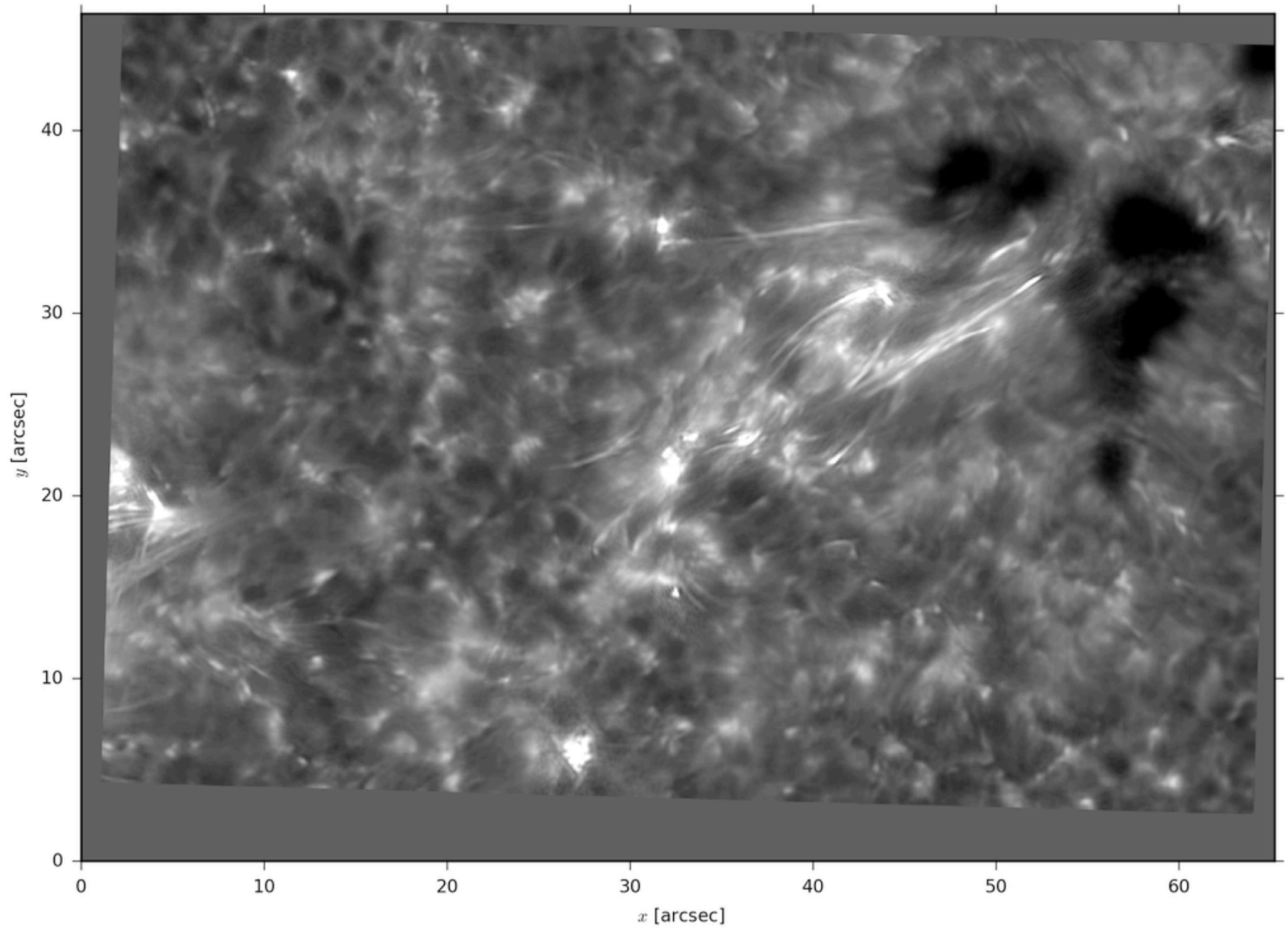


Earth provides only a single vantage point only.

➥We cannot see the poles.

➥We cannot do stereoscopy, events are too quick

Why from space?

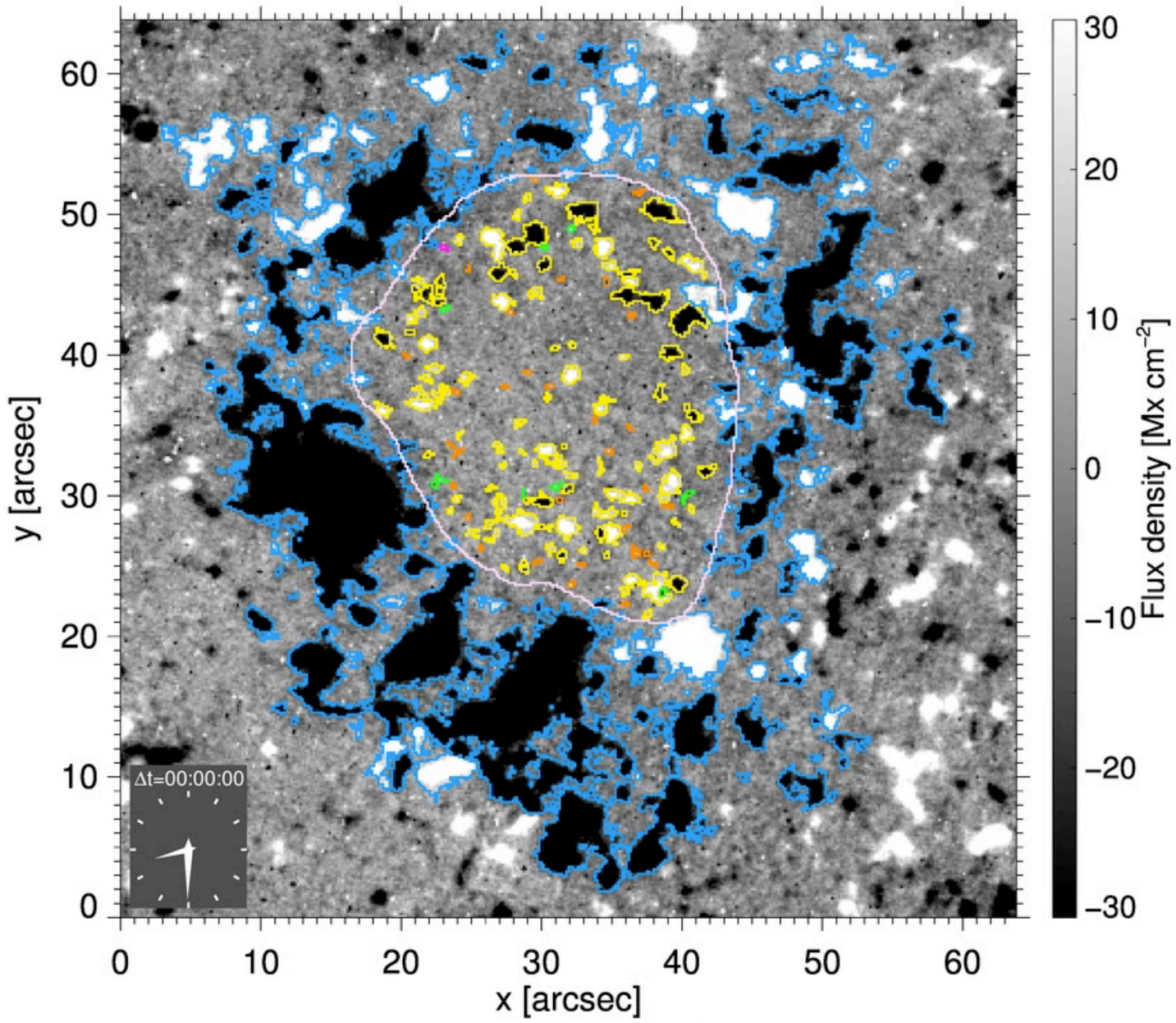


Earth’s atmosphere blurs and lowers SNR needed for polarimetry

➥We cannot get simultaneous large FOV and high resolution

➥We cannot get long stable time series

Why from space?



Gosic et al 2016

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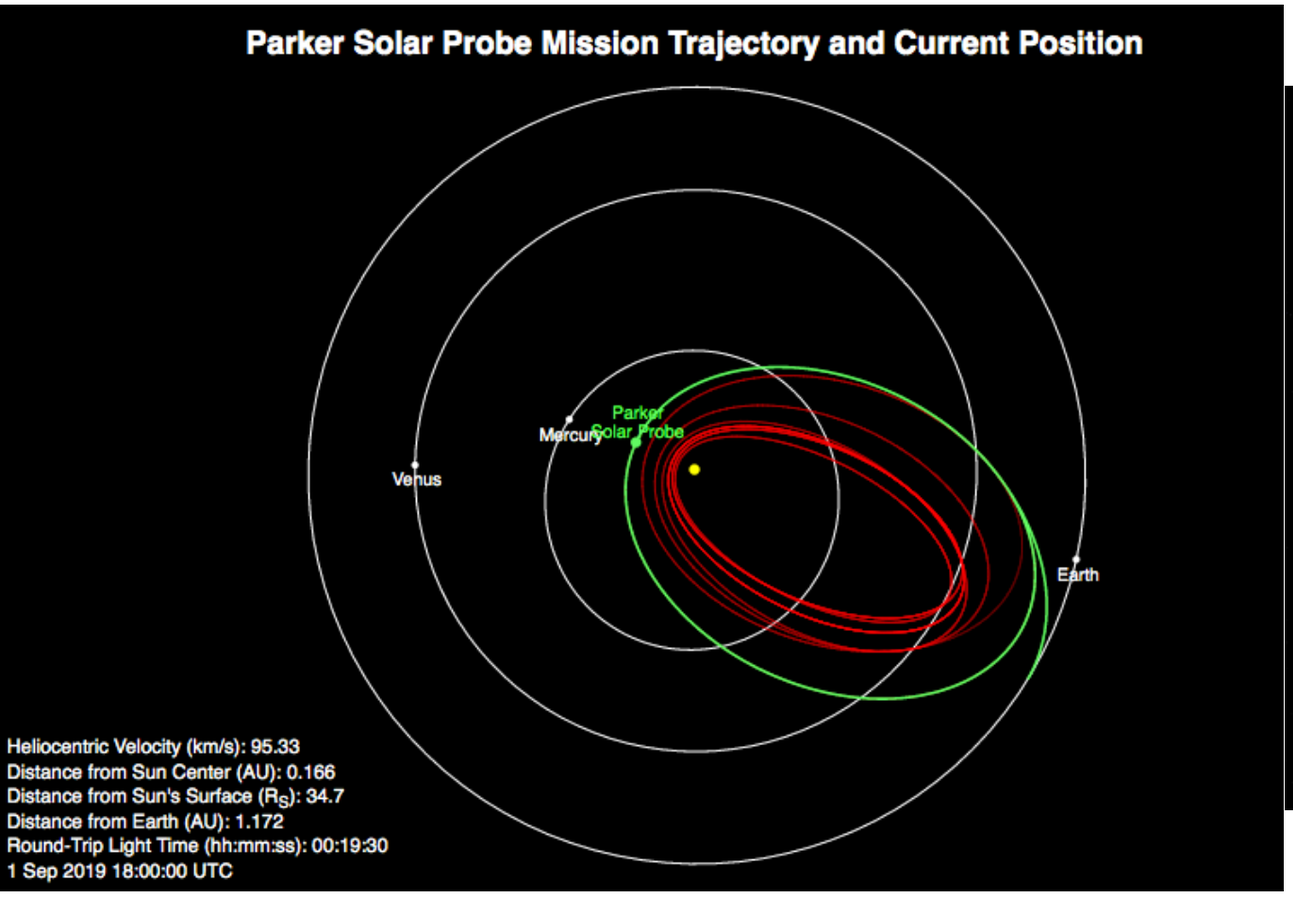
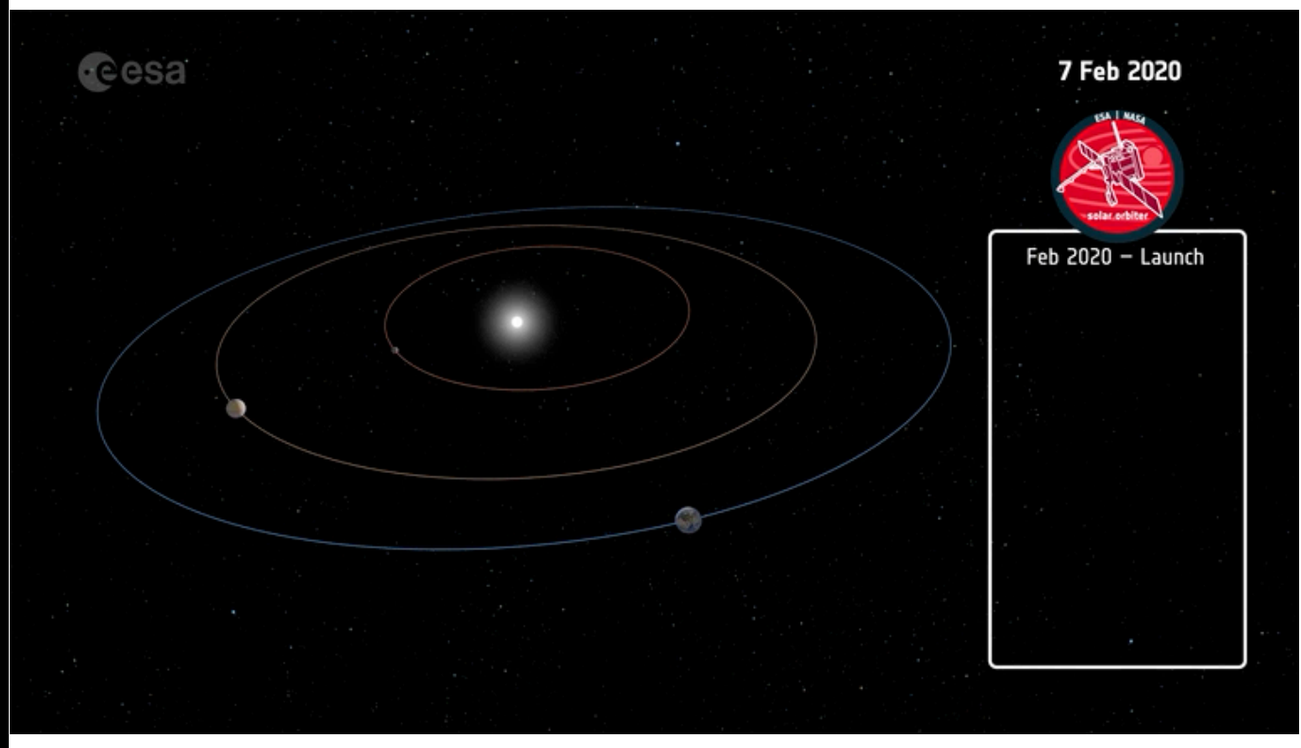




We can only do remote sensing from Earth

➥Going to the Sun allows in situ measurements

Solar Particle Acceleration, Radiation & Kinetics (SPARK)

Matthews et al.

- L or M mission concept to study particle acceleration
- Universal process but uniquely accessible on the Sun
    - Remote stereoscopic sensing and in situ measurements

SPARK

- What is the transition between plasma heating and particle acceleration?
- What are the processes responsible for ion acceleration, and what is their relationship to electron acceleration processes
- How and where are the most energetic particles accelerated on the Sun?
- What is the role of the magnetic field in determining the onset and evolution of particle acceleration, and what is the role of energy transport effects?

SPARK

- Spectra 4 keV-150 MeV
- Imaging 2 keV - 30 MeV
- Measure X-ray and γ-ray polarisation
- Stereoscopy through multiple spacecraft at L4 & L5.

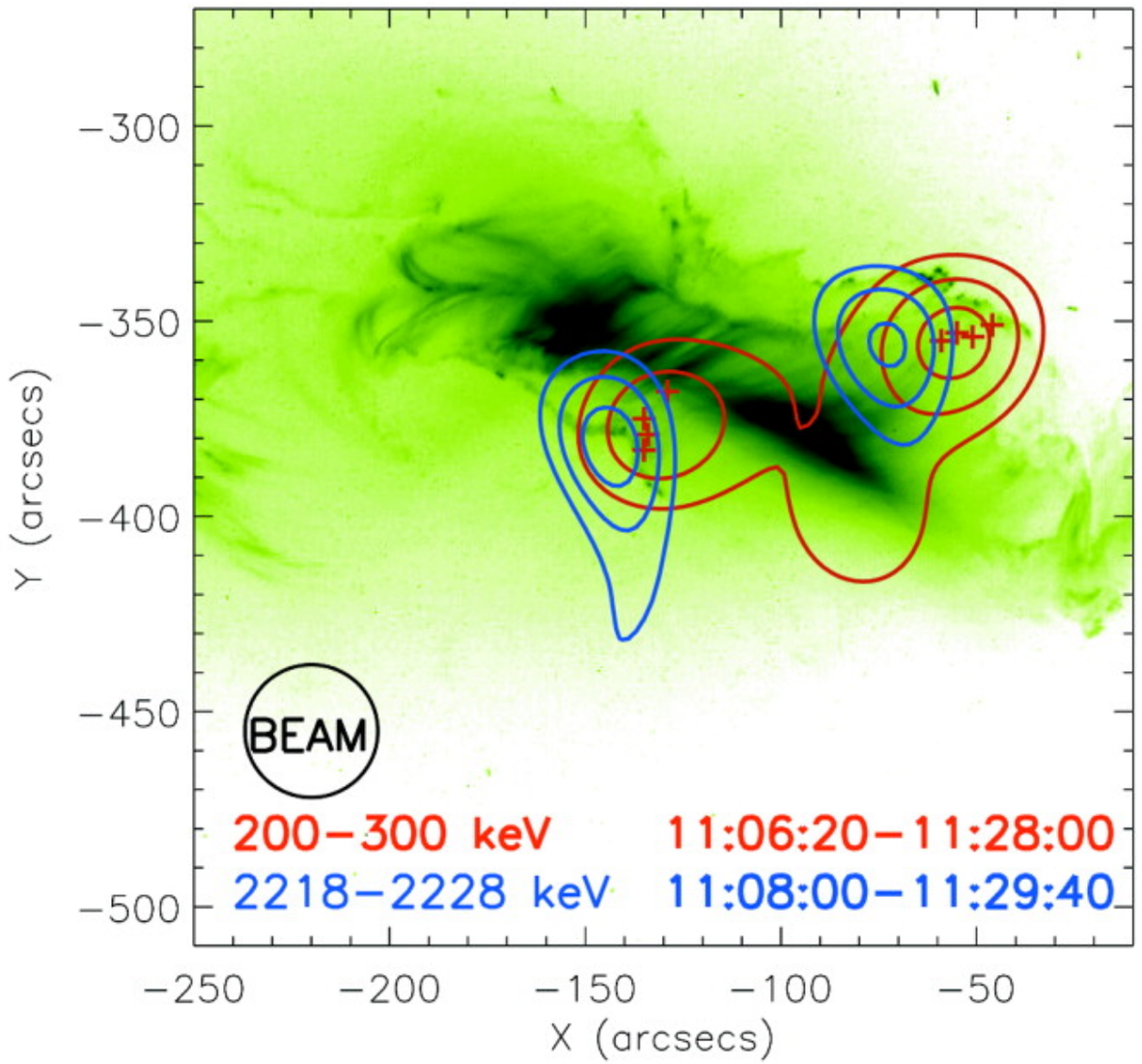
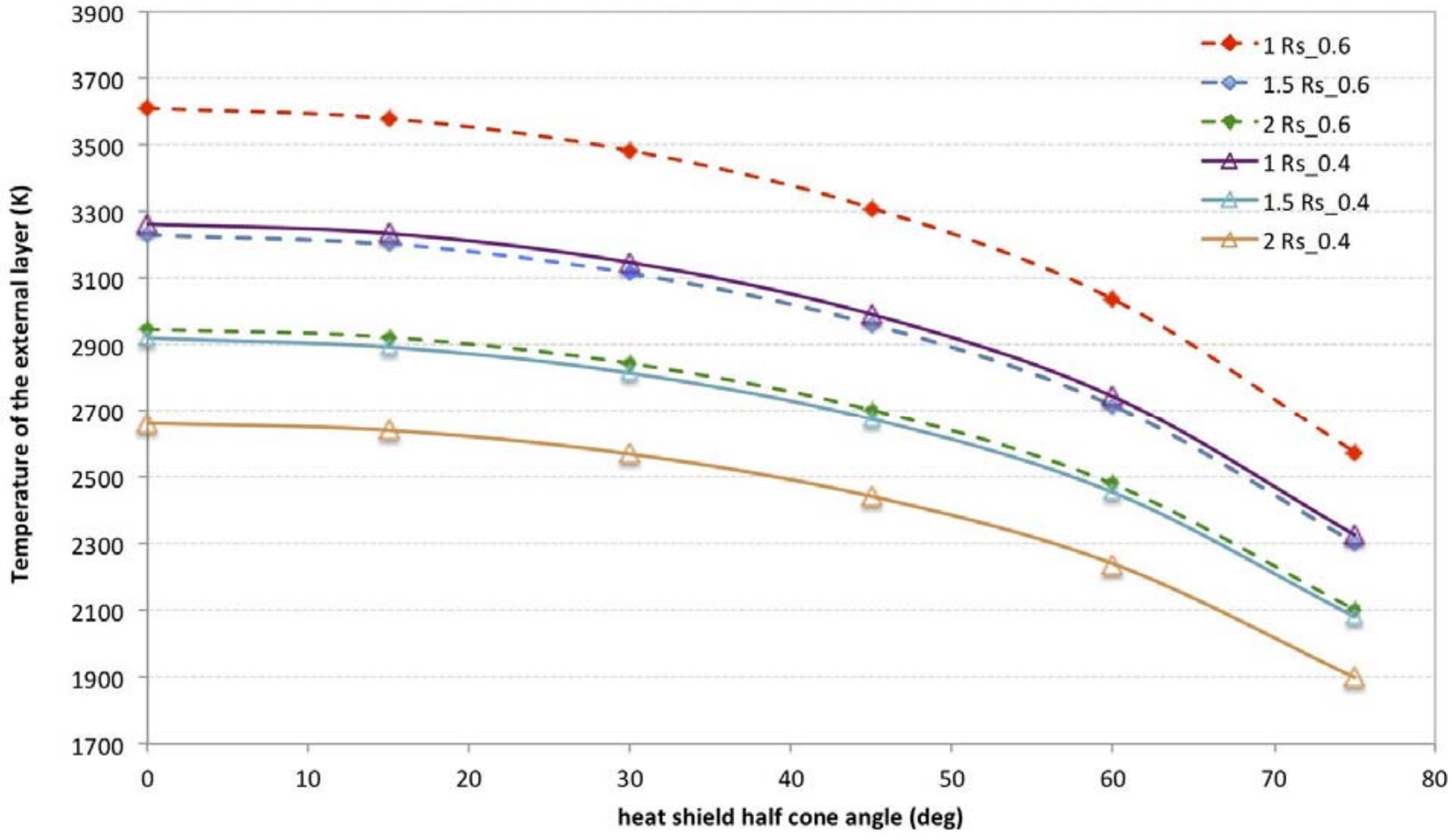


Figure 2: Overlay of the 50%, 70%, and 90% contours of gamma-ray images made with RMCs 6+9 on a TRACE 195 Å image of the October 28 flare (Hurford et al., 2006).

In situ studies of solar wind heating and acceleration

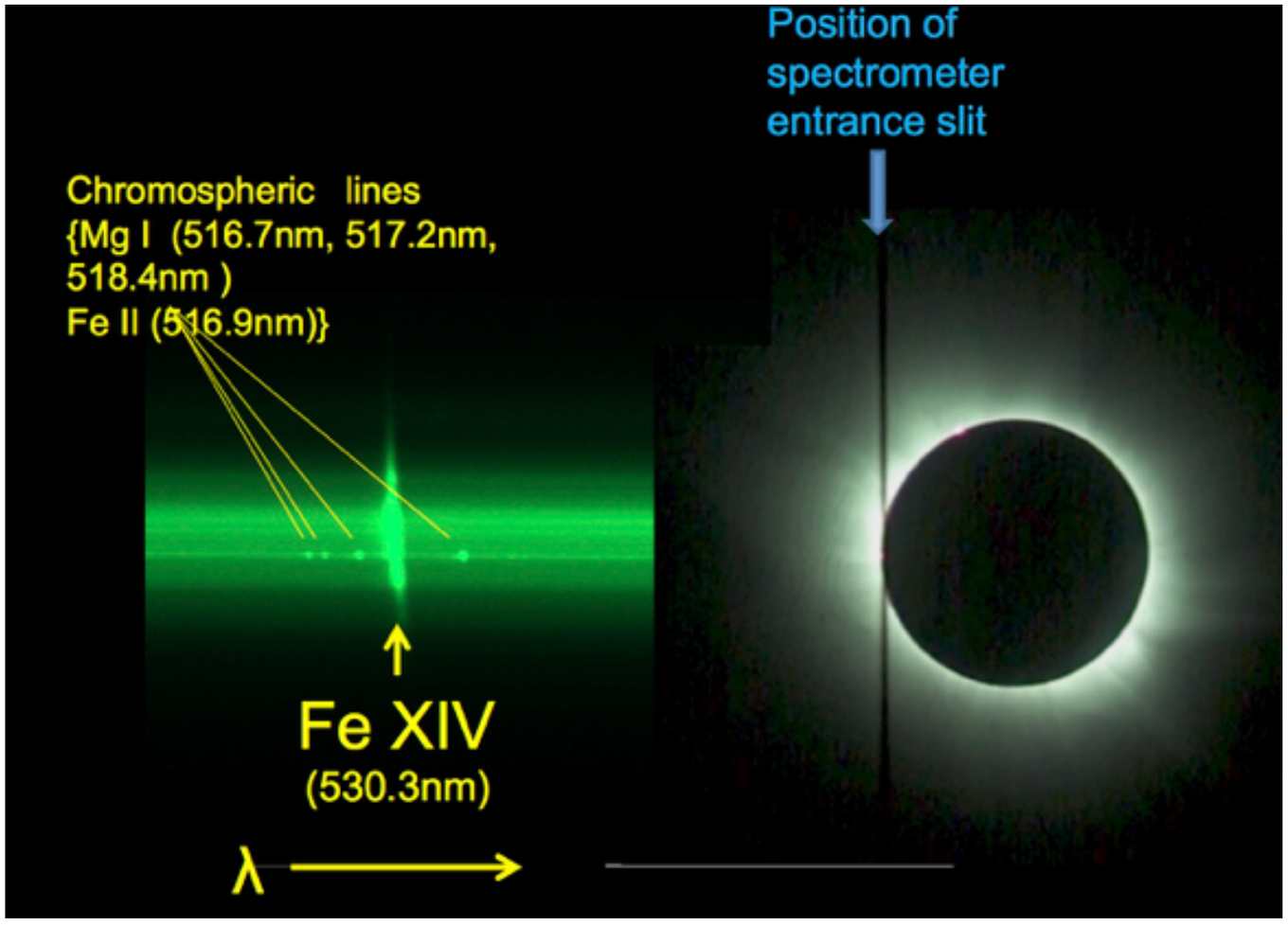
Krasnoselskikh et al.



- In situ measurements down to 1 solar radius from the surface
- How is the solar wind accelerated ?
- How is the solar wind heated ?
- What are in situ properties of the solar atmosphere ?

Coronal Magnetism Explorer

Scullion et al.

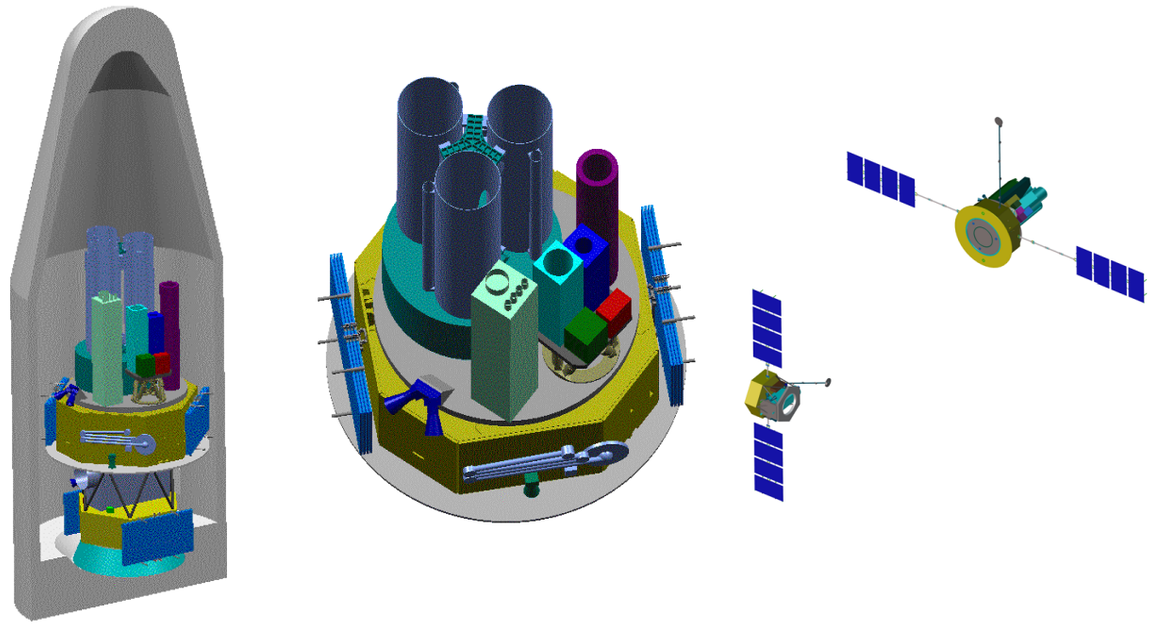


Wave power, magnetic fields, and CME formation and properties in the solar corona

- 3 pairs of satellites, 1 satellite per pair external occulter
- Earth, trailing and leading earth orbit for stereoscopy
- Coronagraph, and imaging spectropolarimetry in optical/IR.

High Resolution Imaging and Spectroscopy Explorer

Erdelyi et al.

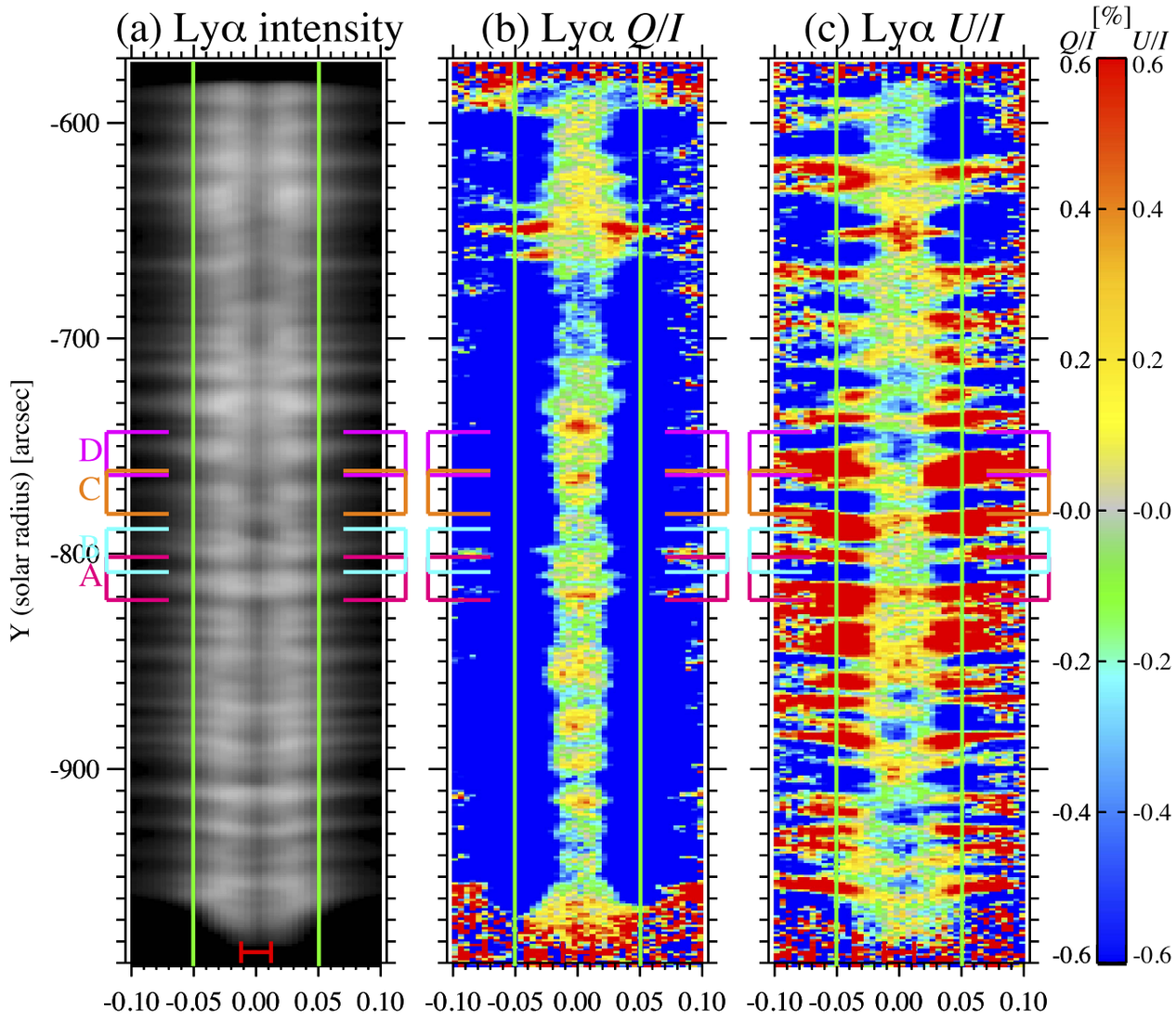


Comprehensive observatory tackling many major open questions in solar physics

- 2 satellites at L1, 1 satellite as external occulter
- Coronagraph in vis., UV, NIR
- Imaging spectropolarimetry in UV
- 3 50-cm UV telescopes act as interferometer
- Host of other instruments

Magnetism and structure of chromosphere and transition region

Orozco Suárez et al.



- Make 3D time-dependent models of chromosphere and TR
- Use atomic level polarisation, Hanle, and Zeeman effects in Lyα and Mg II h&k