The Chromospheric Lyman-Alpha Spectropolarimeter (CLASP)

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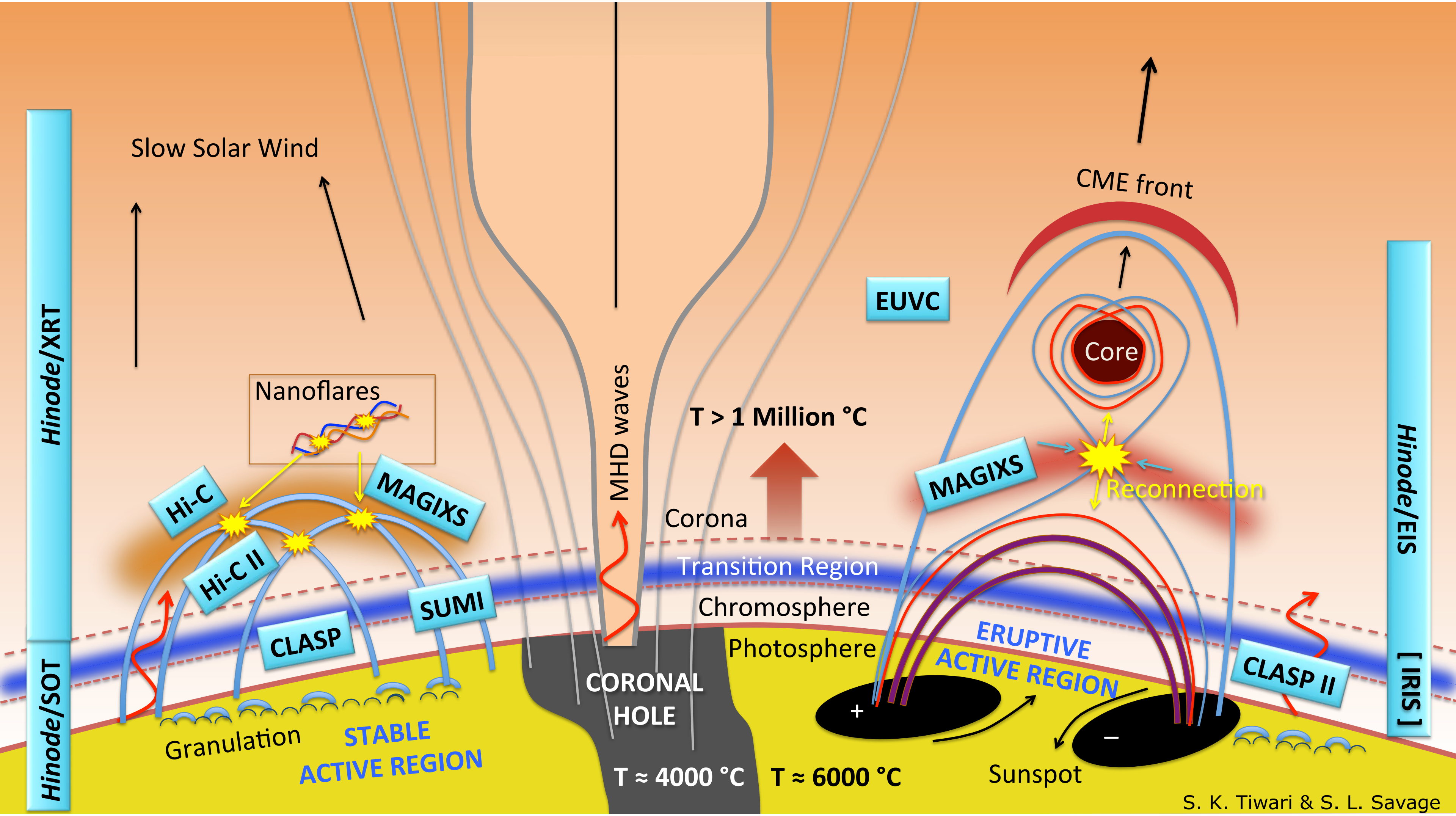
Sounding Rocket Instruments at MSFC



Why measure the magnetic field in the chromosphere?

BOX 10.1 SOLAR AND HELIOSPHERIC PHYSICS PANEL'S MAJOR SCIENCE GOALS AND ASSOCIATED ACTIONS

SHP1. Determine how the Sun generates the quasi-cyclical variable magnetic field that extends throughout the heliosphere.

a. Measure and model the near-surface polar mass flows and magnetic fields that seed variations in the solar cycle.
b. Measure and model the deep mass flows in the convection zone and tachocline that are believed to drive the solar dynamo.
c. Determine the role of small-scale magnetic fields in driving global-scale irradiance variability and activity in the solar atmosphere.

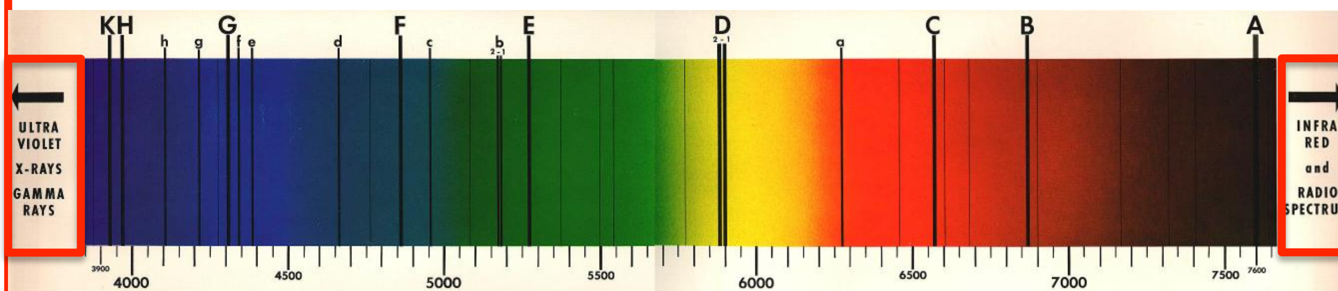
SHP2. Determine how the Sun's magnetism creates its dynamic atmosphere.

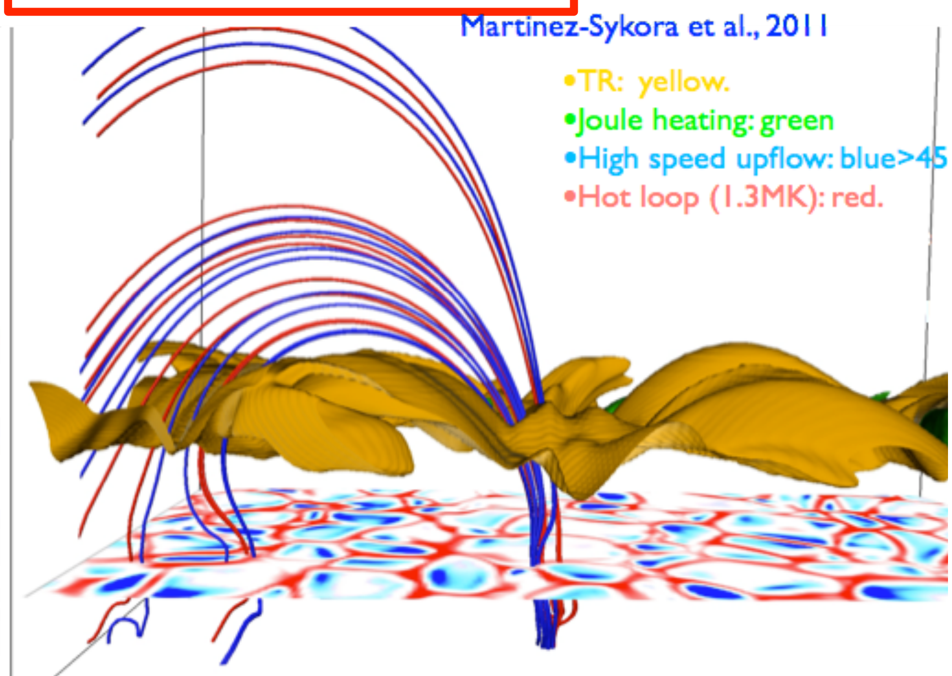
a. Determine whether chromospheric dynamics is the origin of heat and mass fluxes into the corona and solar wind.
b. Determine how magnetic free energy is transmitted from the photosphere to the corona.
c. Discover how the thermal structure of the closed-field corona is determined.
d. Discover the origin of the solar wind's dynamics and structure.

Solar and Space Physics: A Science for a Technological Society, 2013

Why has it not been measured before?

Magnetically sensitive spectral lines formed in chromosphere are not in the visible wavelength range, so measurements have to go above atmosphere.





Advances in theoretical modeling of the chromosphere and transition region allow for prediction and interpretation of the results.

Chromospheric Lyman-Alpha Spectropolarimeter (CLASP)

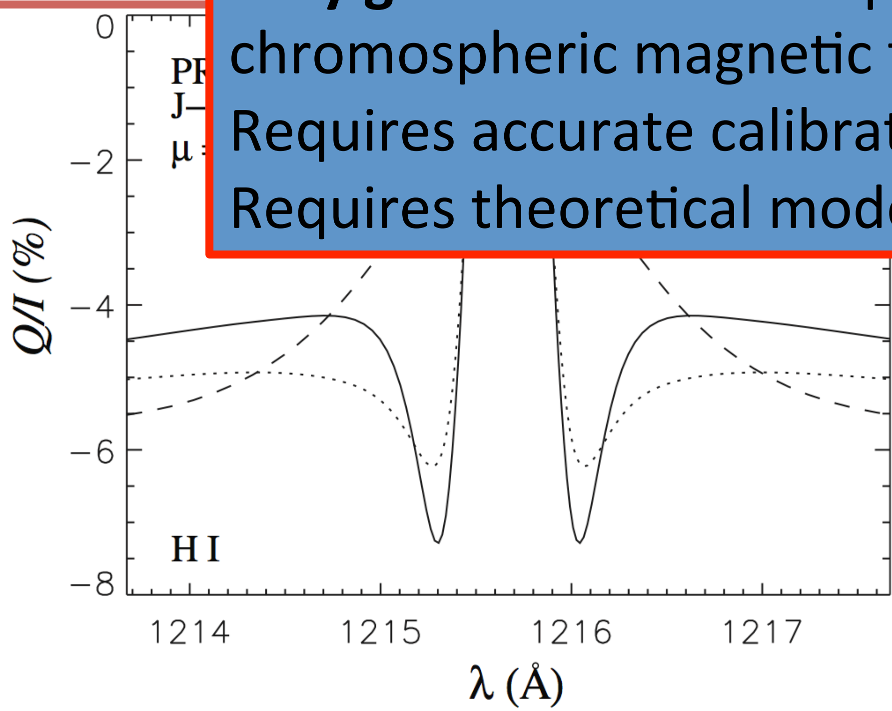
Science Goal 1: Detect scattering polarization in the wings of Lyman-alpha.

- Sensitive to the thermal structure of the chromosphere.
- Not sensitive to magnetic field
- Magnitu

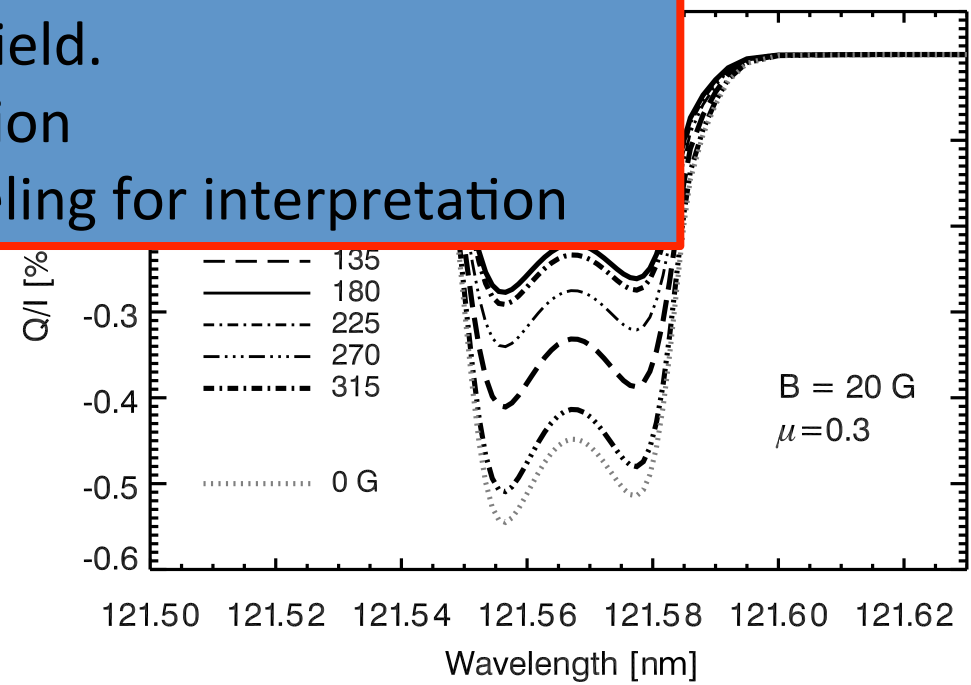
Science Goal 2: Detect polarization in the line core.

- Modified by the magnetic field
- Magnitude of the polarization is ~ 0.1%
- Accuracy required technological advances in mirror coatings and low-noise detector systems

Holy grail: Use line core polarization to infer the chromospheric magnetic field.
Requires accurate calibration
Requires theoretical modeling for interpretation



Belluzzi et al. 2012



Trujillo Bueno et al. 2011

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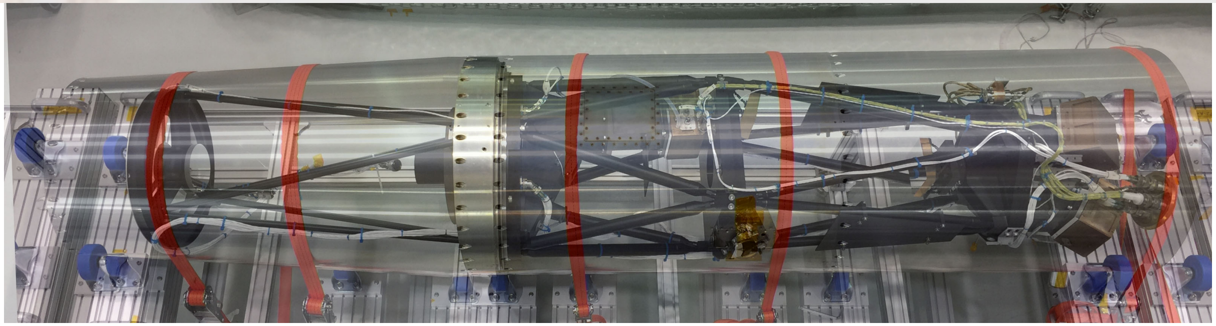
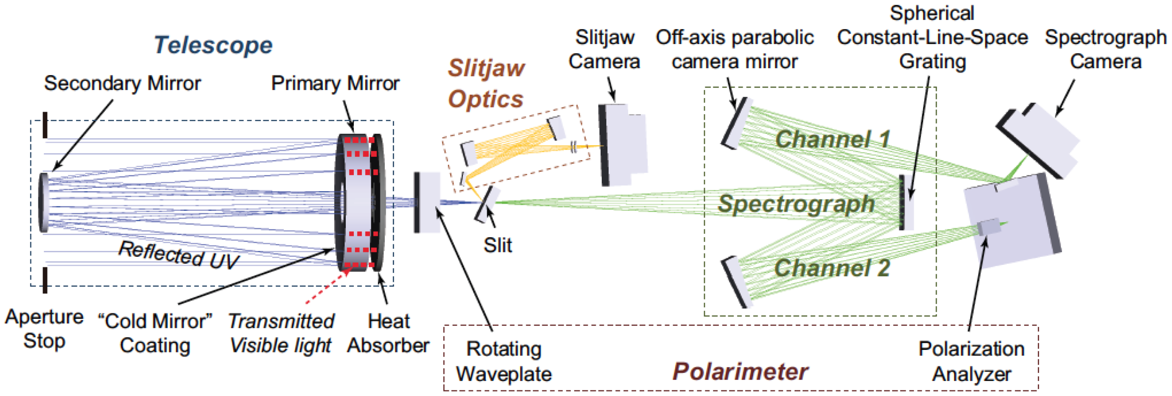




CLASP is a dual channel spectropolarimeter to measure the polarization of Lyman-alpha.

CLASP was designed and built through an international partnership. Scientists from 11 organizations and 6 countries form the CLASP team. Primary teams and responsibilities are listed below.

MSFC/USA (PI: A. Winebarger) – Cameras, avionics, project management, coordination w/ NASA launch team

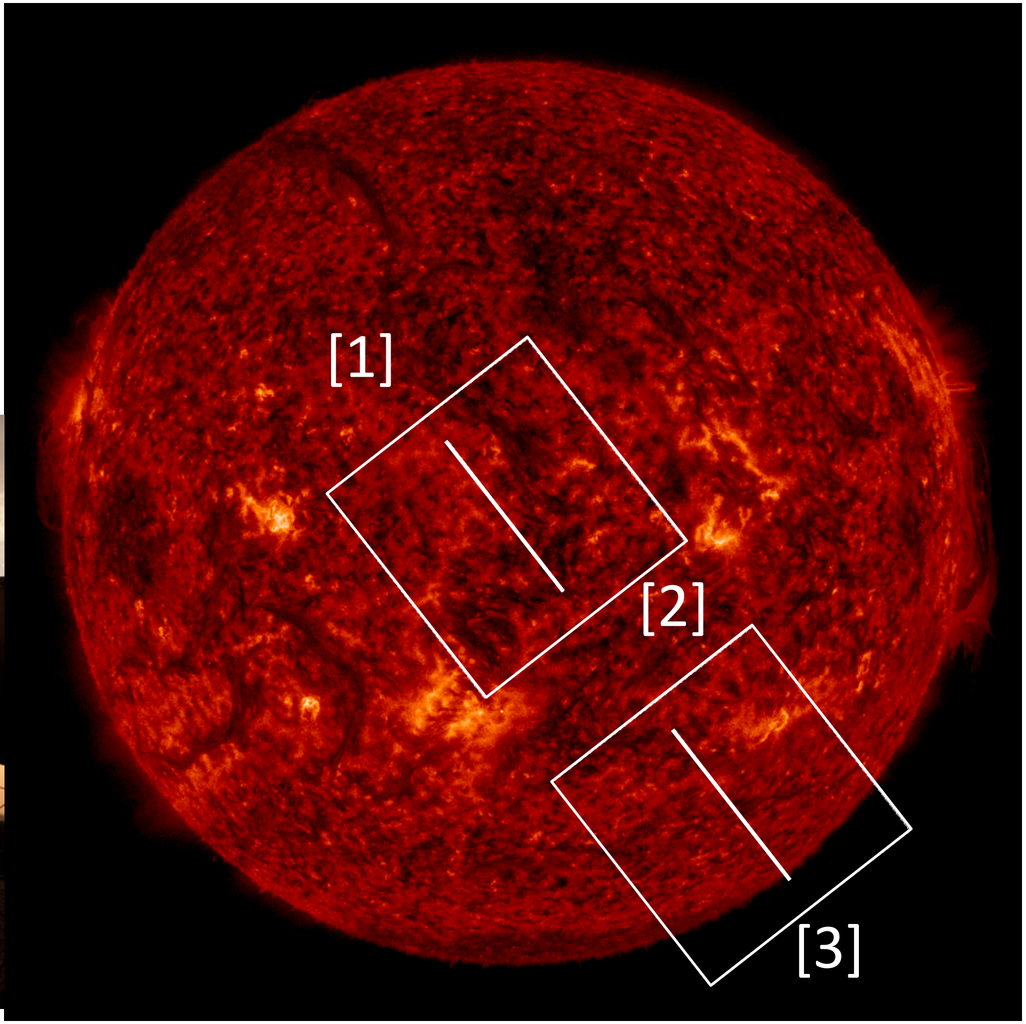
NAOJ & JAXA/Japan (Co-PI: R. Kano) – Optics & opto-mechanics, instrument structure

IAS/France (Co-PI: F. Auchère) – Diffraction Grating

IAC/Spain (Co-PI: J. Trujillo Bueno) – Theoretical predictions and modeling of the Hanle effect

Chromospheric Lyman-Alpha Spectropolarimeter (CLASP)

CLASP was launched on September 3, 2015 from White Sand Missile Range



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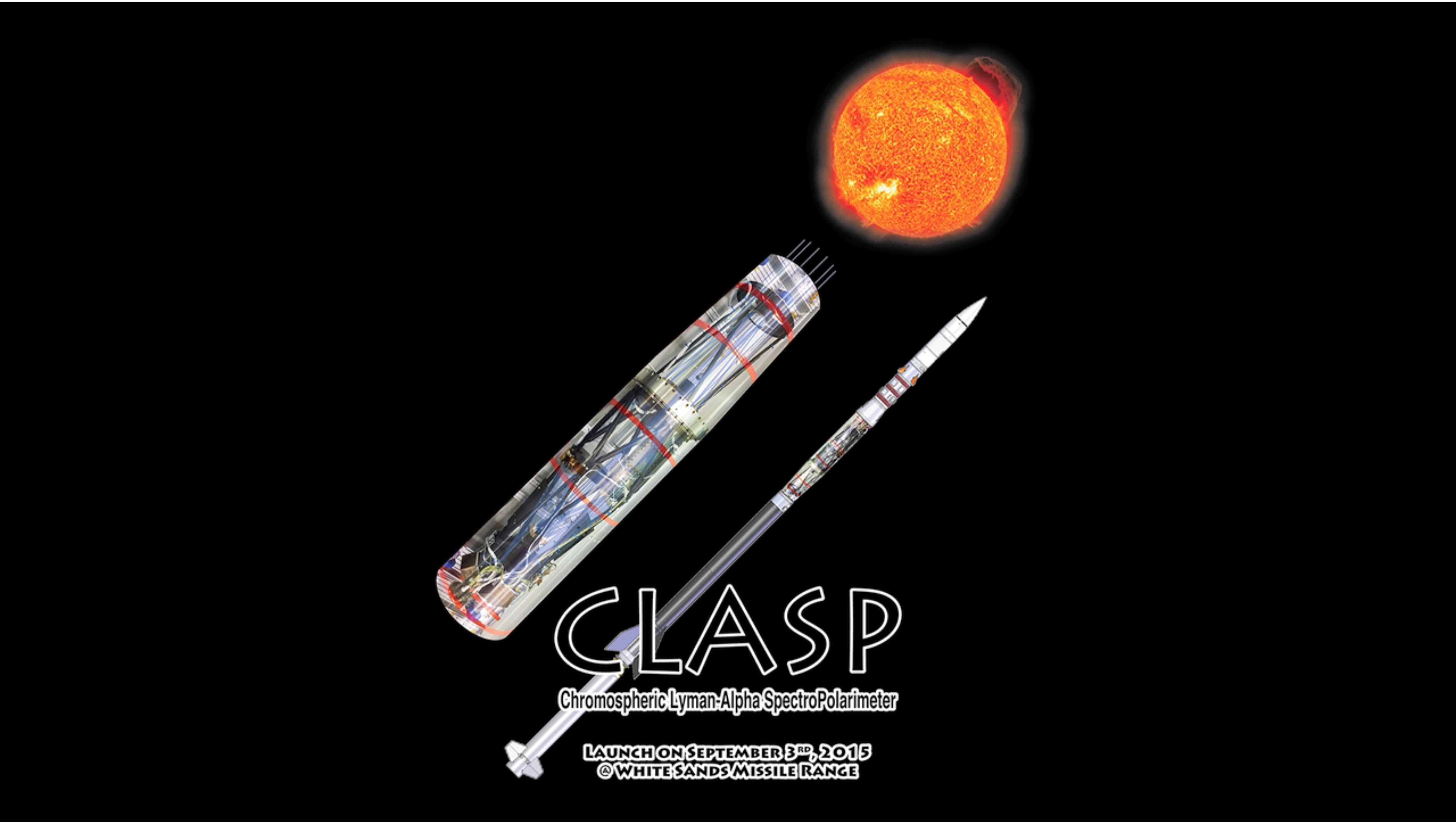
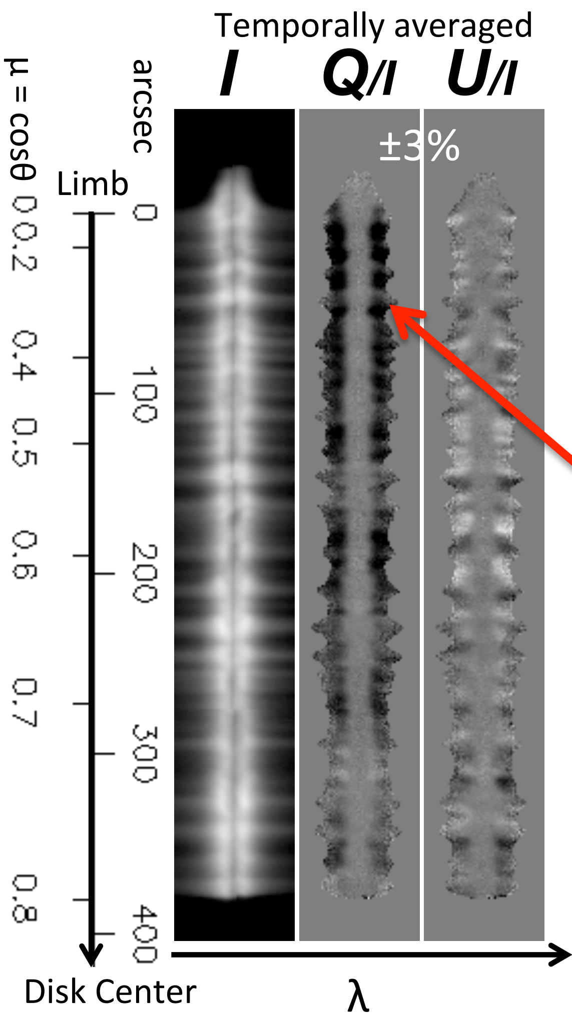
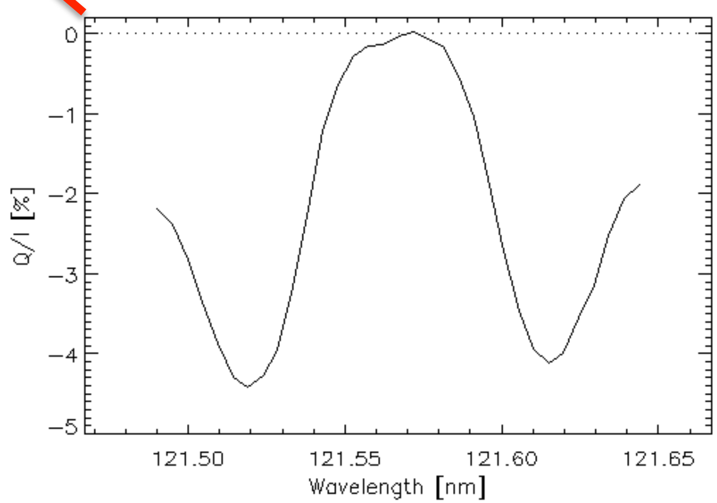


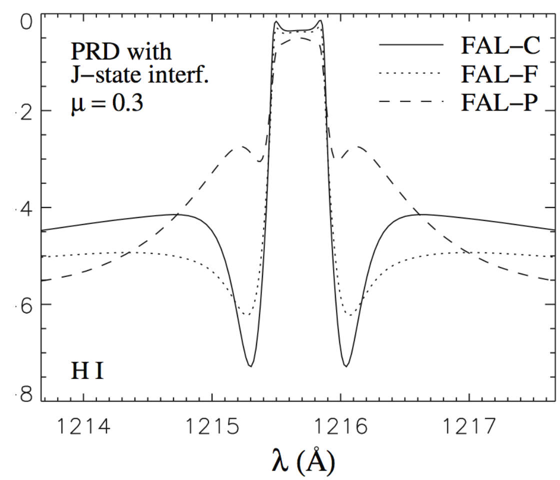
CLASP Initial Results



Further calibrations/investigations are required, but …

- **A few %** of polarization in the wing, and **a few of 0.1 %** in the core.
- A clear **C-to-L variation** in the wing of Q/I.
- Small-scale structures along the slit.
- Q/I profile is essentially **consistent with the model prediction**.



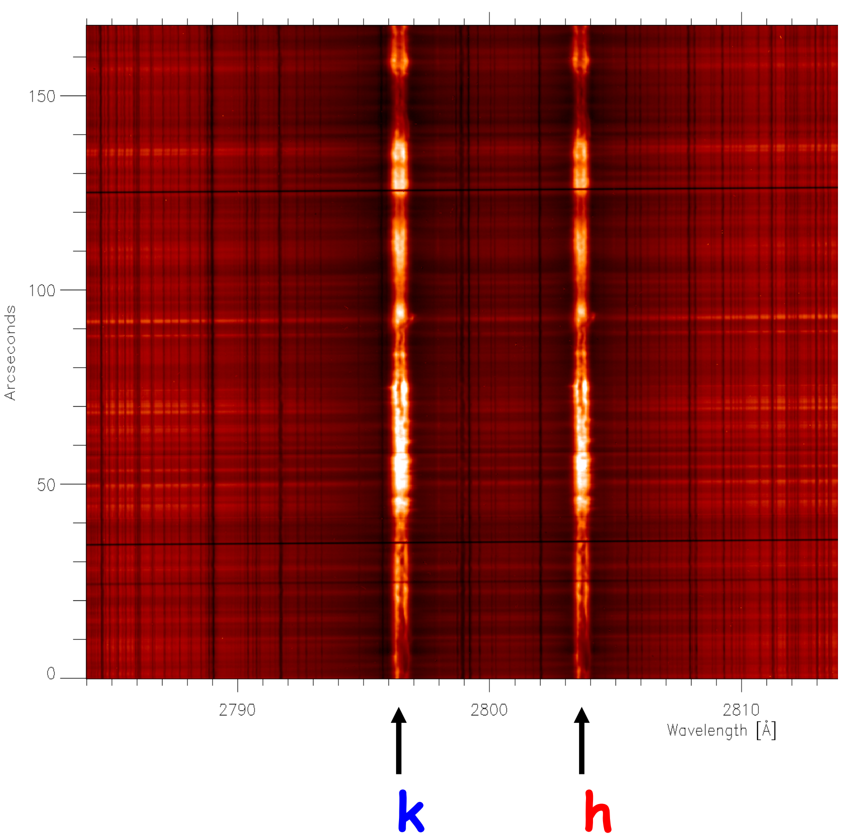


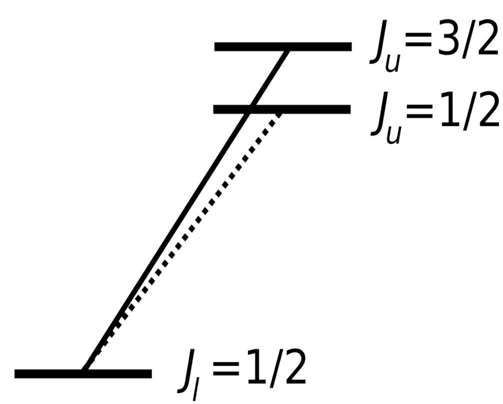
Belluzzi et al. 2012

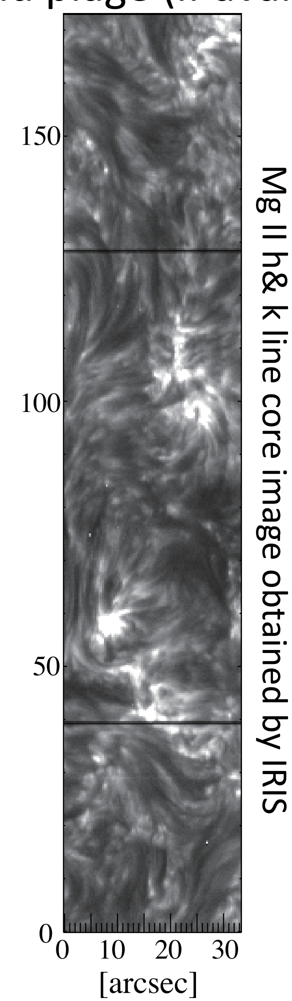
2 What is next for CLASP?

CLASP 2 proposes to change the wavelength to Mg II h&k, another set of magnetically sensitive spectral lines in the UV at ~ 280 nm.

Observing target: QS and plage (if available)



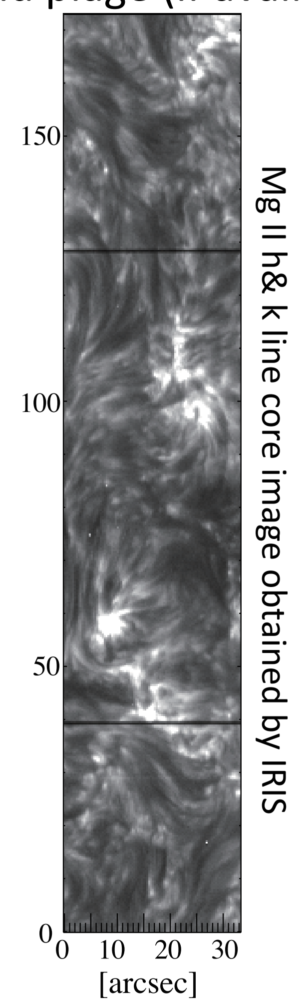




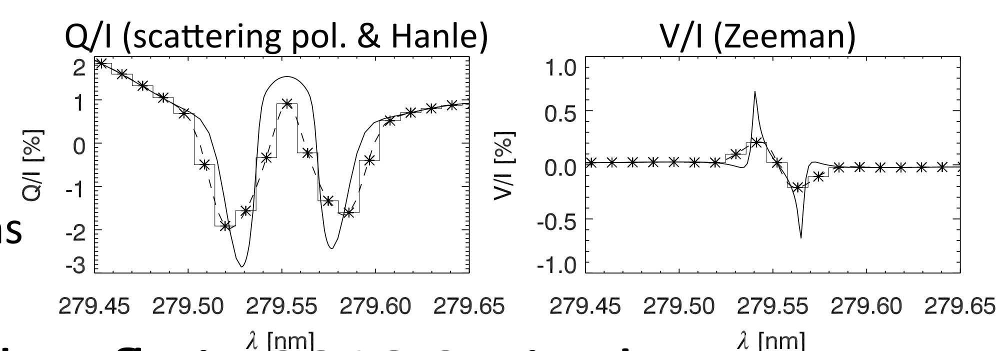
What is next for CLASP?

Without significant modification of CLASP1 optical design and structures, we propose to change the wavelength to Mg II h&k

Observing target: QS and plage (if available)



Measurement of ***circular*** as well as linear polarizations

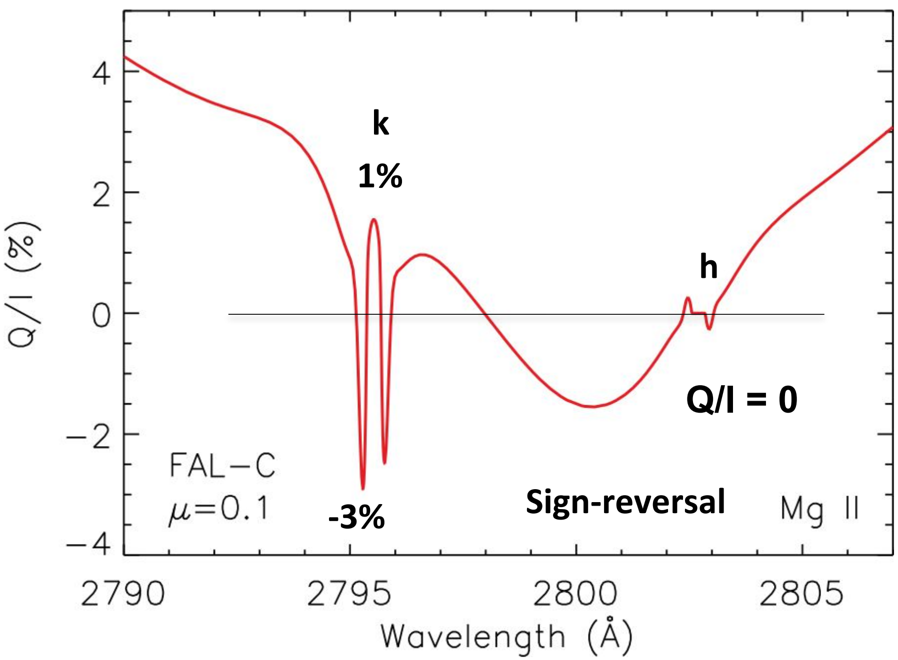


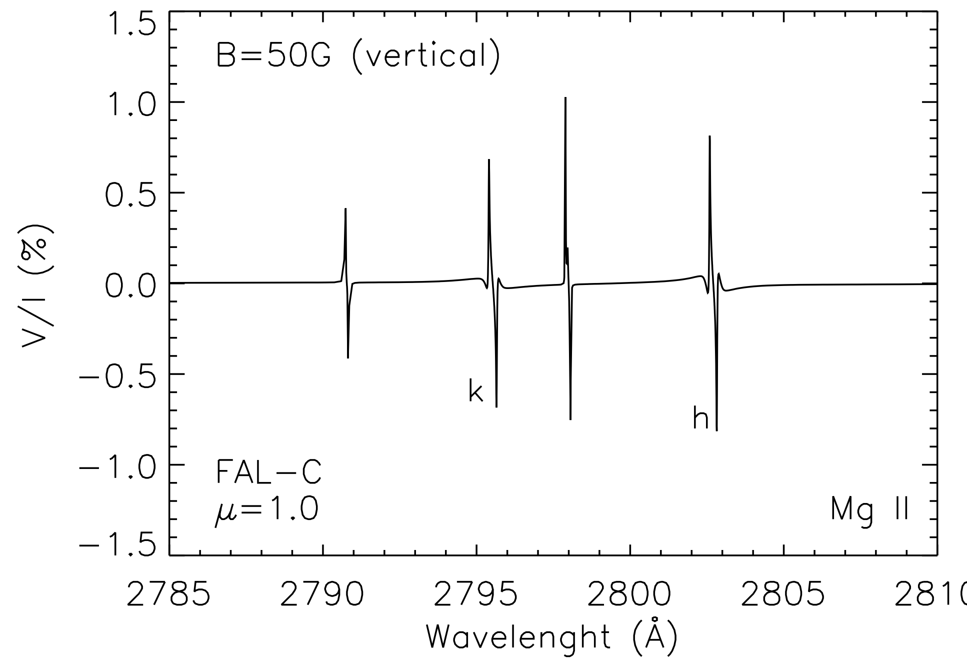
- Proposed to fly in 2018 Spring!

What is next for CLASP?

Linear polarization sensitive to scattering polarization and Hanle effect from 5-50 G.

Circular polarization sensitive to Zeeman effect for B > 50 G.





Proposed to fly in Spring 2018.

Belluzzi & Trujillo Bueno (2012; ApJ Letters)

Successful Mission was due to the CLASP Team