

The CoMP-S instrument at the Lomnický Peak Observatory

Synergy with the space-born observatories

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S. Tomczyk, S. Sewell, P. Aumiller, R. Summers, L. Sutherland, A. Watt

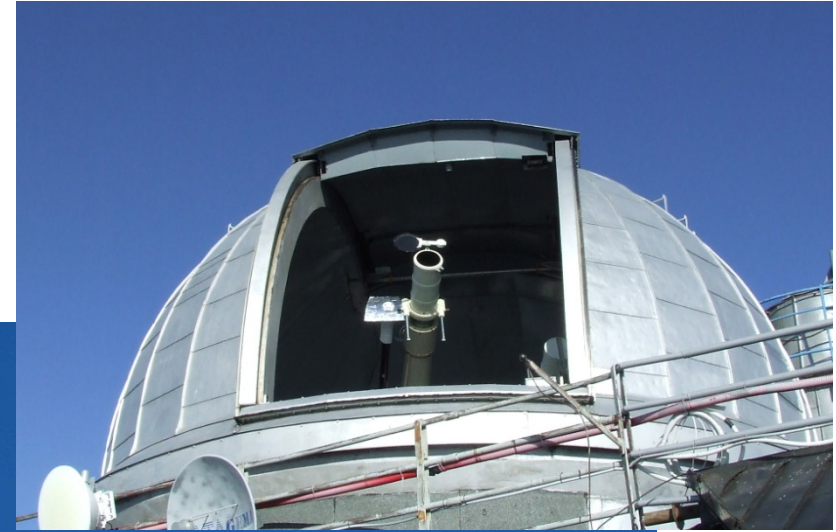
Astronomical Institute, Slovak Academy of Sciences, Tatranská Lomnica, Slovakia
High Altitude Observatory, The National Center for Atmospheric Research, Boulder, USA



SLOVAK RESEARCH
AND DEVELOPMENT
AGENCY



Lomnický Peak Observatory

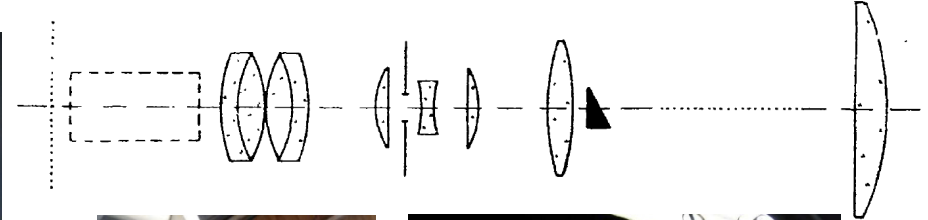


- 2633 m above sea level on the 2nd highest peak of the High Tatras mountain in the North Slovakia
- one of a few sites still performing routine ground-based coronal observations
- astroclimate from 1963 to 2009:
 - ~ 120 days/year – sunshine
 - observations of prominences
 - ~ 70 days/year – observations of emission corona

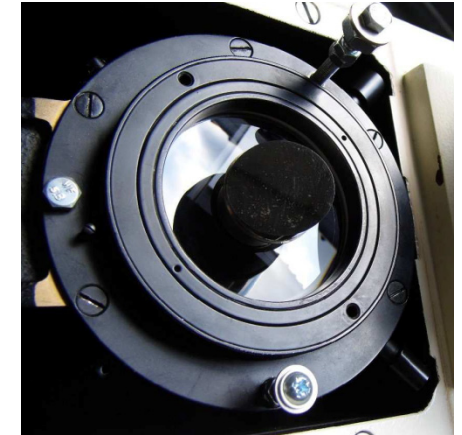


Zeiss coronagraphs

200-mm single-lens
objective, $f = 3000$ mm



imaging 100-mm
objective



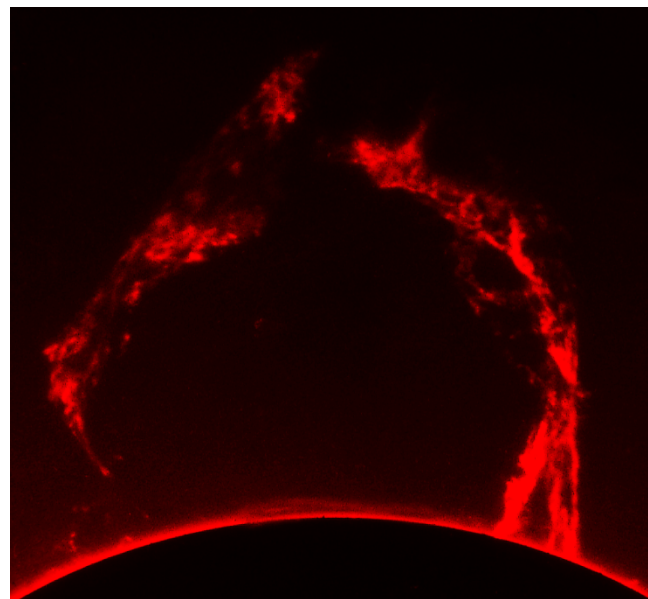
artificial moon (Lyot diaphragm)
in the field lens

- two Zeiss 200/3000 coronagraphs on the common mount installed in 1961 and 1970
- optical twins, co-pointing precision of 2 arcsec should be reached this year
- diameter of the solar image in the focal plane: 4 cm
- field-of-view: 1.02 - 1.84 of the solar radius
- diffraction limited from 530 nm to 1100 nm
- focusing by moving the objective lens along the optical axis

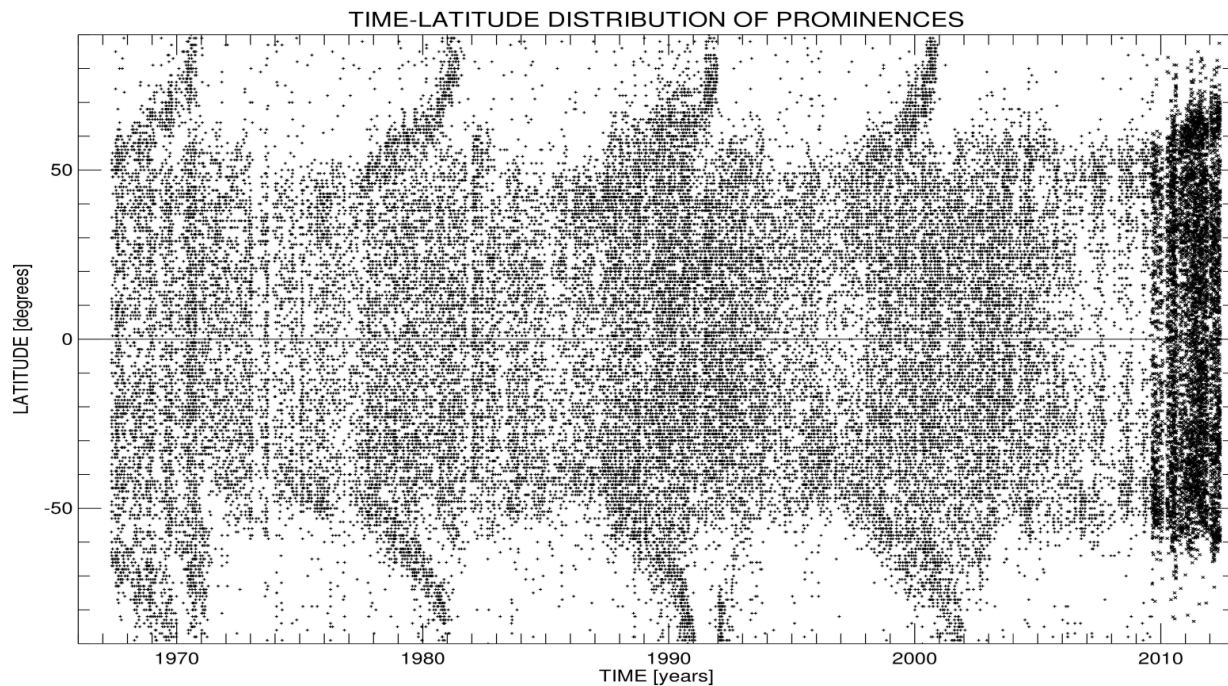
Achievements

Long-term data sets of observations and catalogues of:

- prominences in $H\alpha$



3 May 1971

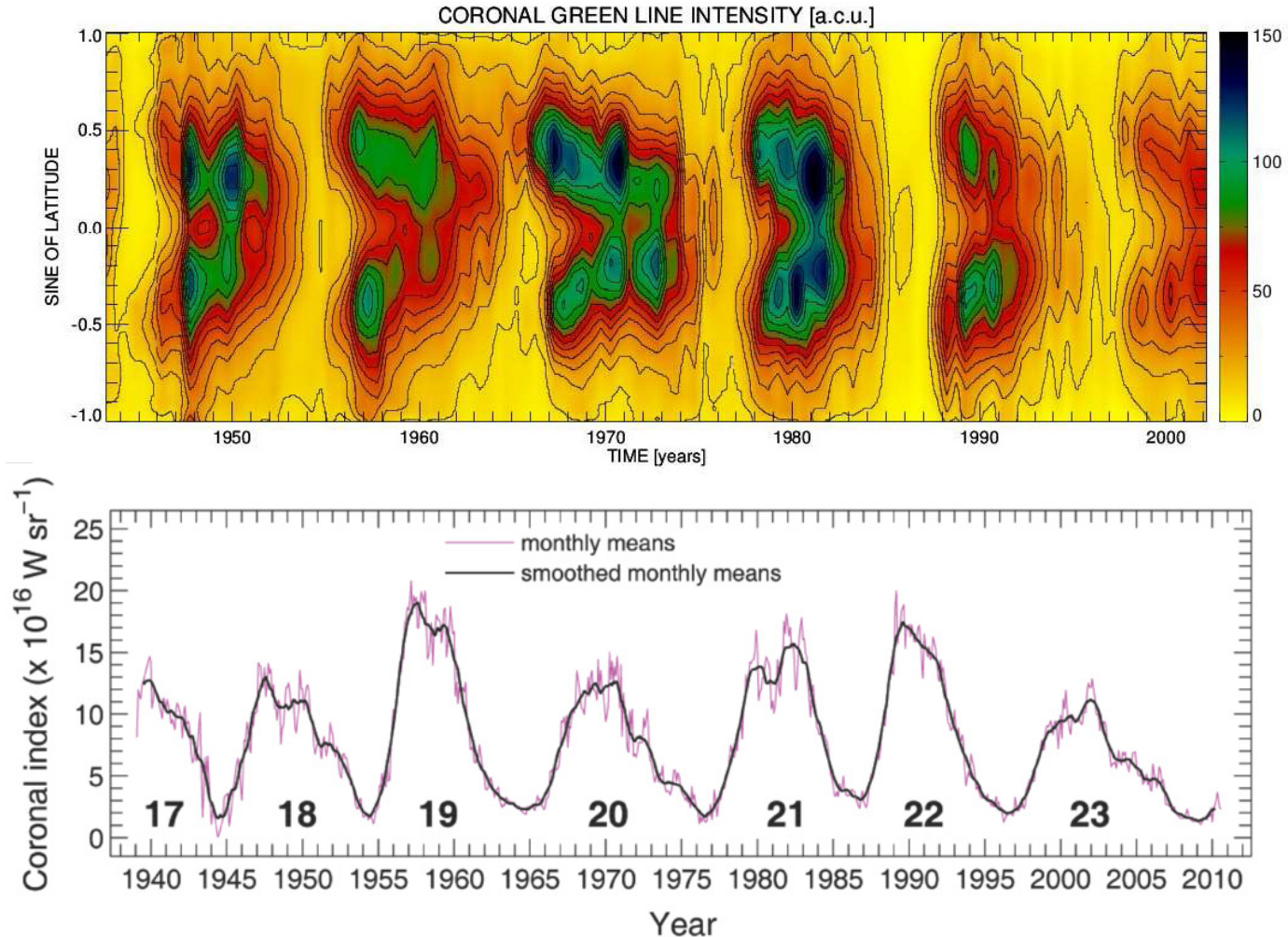


since 2010 the data set continues using observations from the Kanzelhöhe Observatory (Austria)

Achievements

Long-term data sets of observations and catalogues of:

- prominences in $H\alpha$
- coronal green line (Fe XIV 530.3 nm) intensities and coronal index



<http://www.ngdc.noaa.gov/stp/solar/corona.html>

What's next ?

Spectropolarimetry by CoMP-S

- CoMP-S: The Coronal Multi-channel Polarimeter for Slovakia
- NOT a twin of CoMP at Mauna Loa, a main difference in operating spectral range:
CoMP 1070 – 1090 nm
CoMP-S 500 – 1100 nm
- 2D wide-field polarimeter for VIS and near-IR emission lines of prominences and corona
- design and production: a team led by Dr. S. Tomczyk, HAO, NCAR, Boulder
- deployment of the instrument at the Lomnický Peak Observatory supported through EU structural funds

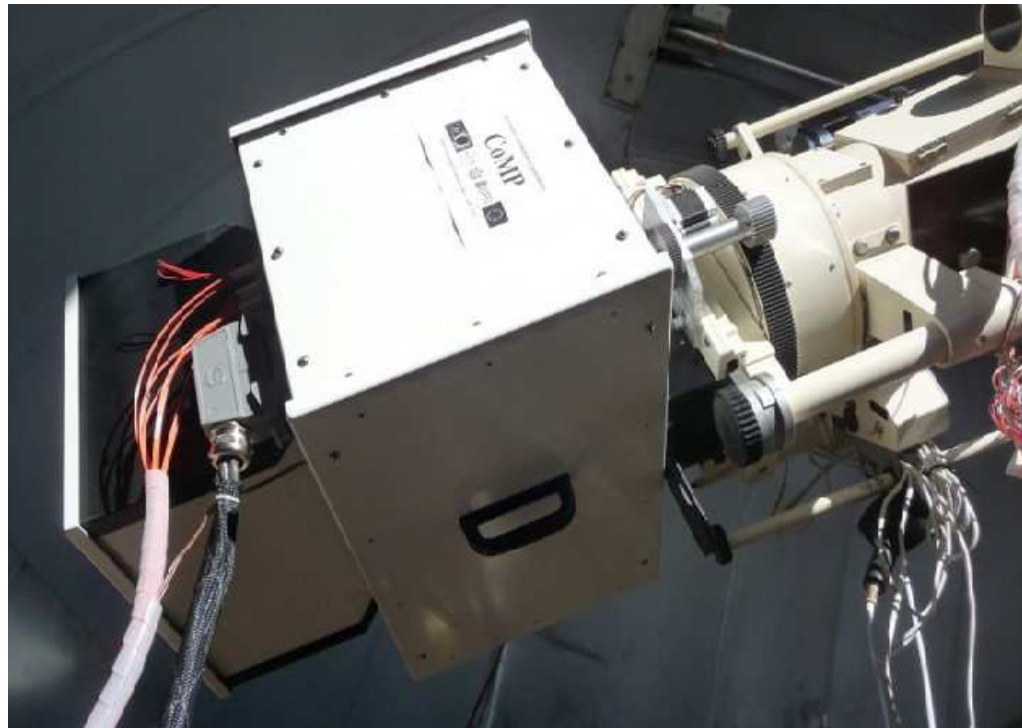


- March 2011: CoMP-S installed
- April 2011 – April 2013: the commissioning phase of the instrument
- May 2013: start of regular observations of prominences using VIS PCO cameras
- January 2014 installation of additional near-IR Goodrich GA1280J cameras

<http://www.astro.sk/LSO/COMP-S/>

Main features of CoMP-S

- operating spectral range: 500 – 1100 nm
- field of view: 14 arcmin \times 11 arcmin
- 4-stage tunable Lyot filter with polarimeter (two ferro-liquid crystal polarizers)
- sequential measurement of several VIS and near-IR lines
- expected deliverables: 2D full Stokes I, Q, U, V
- actual observational output: the linear combinations of $I \pm Q$ $I \pm U$ $I \pm V$
- then, e.g., Stokes I reconstructed from the sums



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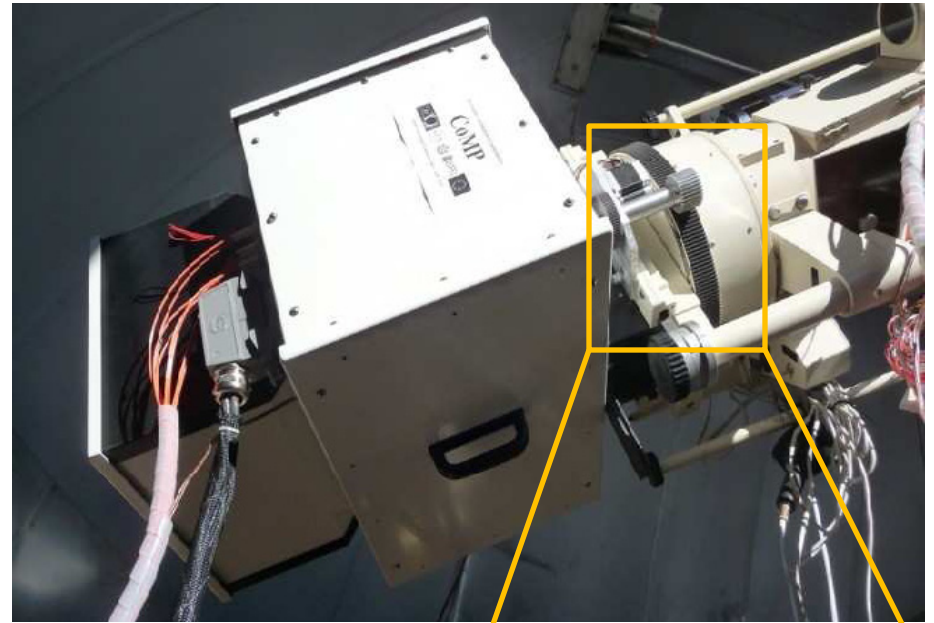
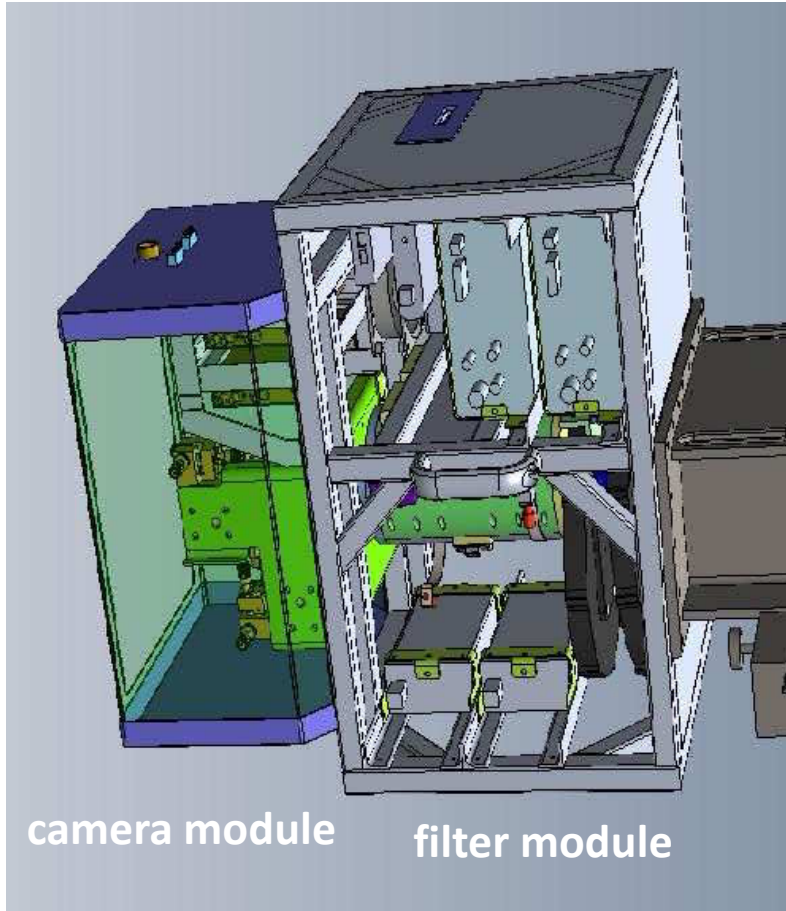
Selected emission lines

given by prefilters available in the prefilter carrousel

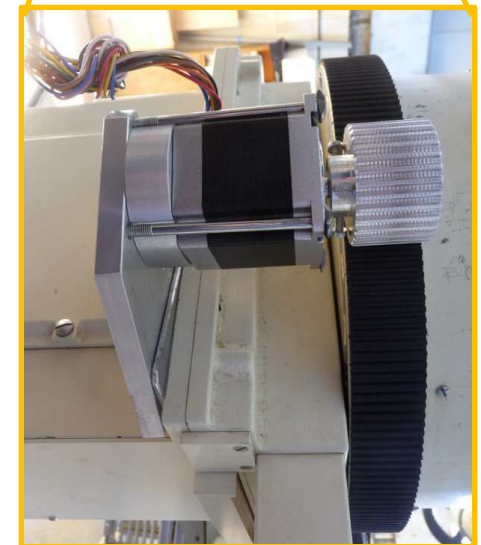
prominences	He I 587.6 nm D ₃
	H α 656.3 nm
	Ca II 854.2 nm
	He I 1083.0 nm

corona	Fe XIV 530.3 nm
	Ca XV 569.5 nm
	Fe X 637.5 nm
	Fe XI 789.2 nm
	Fe XIII 1074.7 nm
	Fe XIII 1079.8 nm

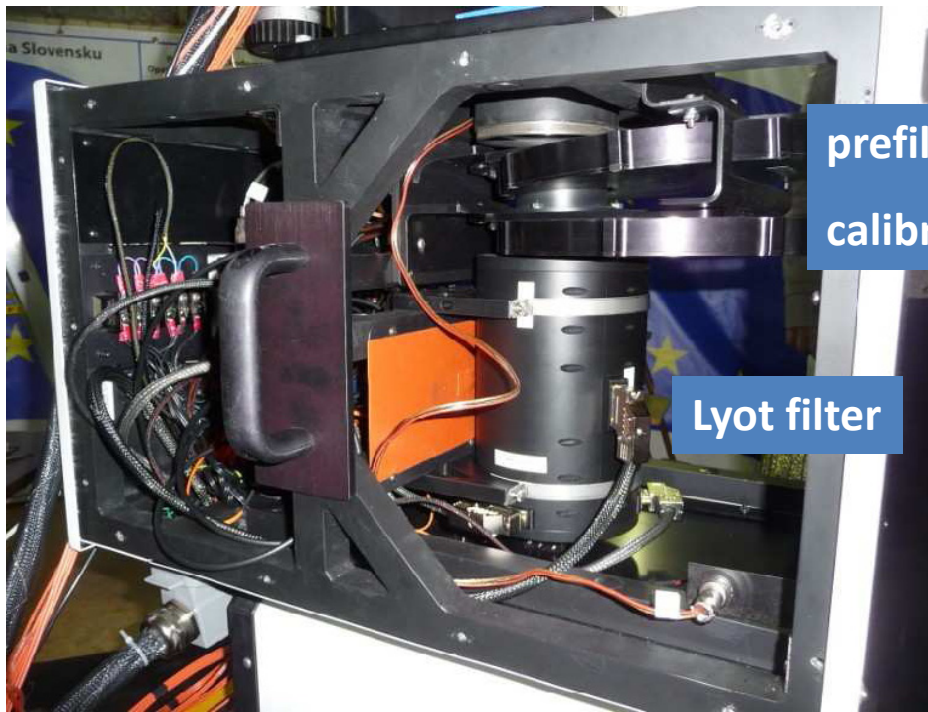
Building blocks of CoMP-S



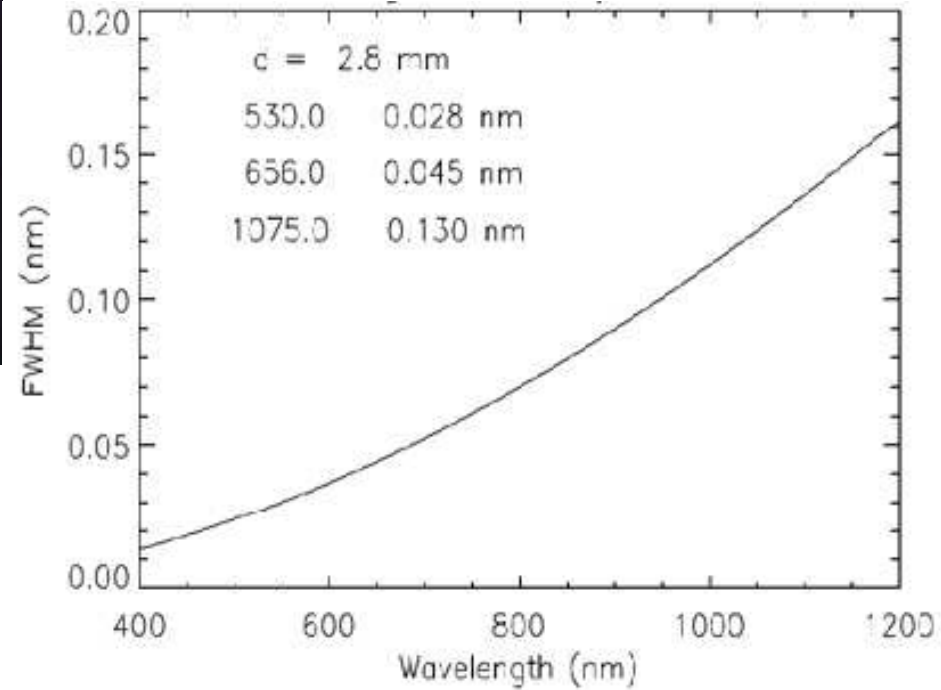
instrument rotator



- + a cabinet with electronics on the pier of mount
- + control computer and storage array

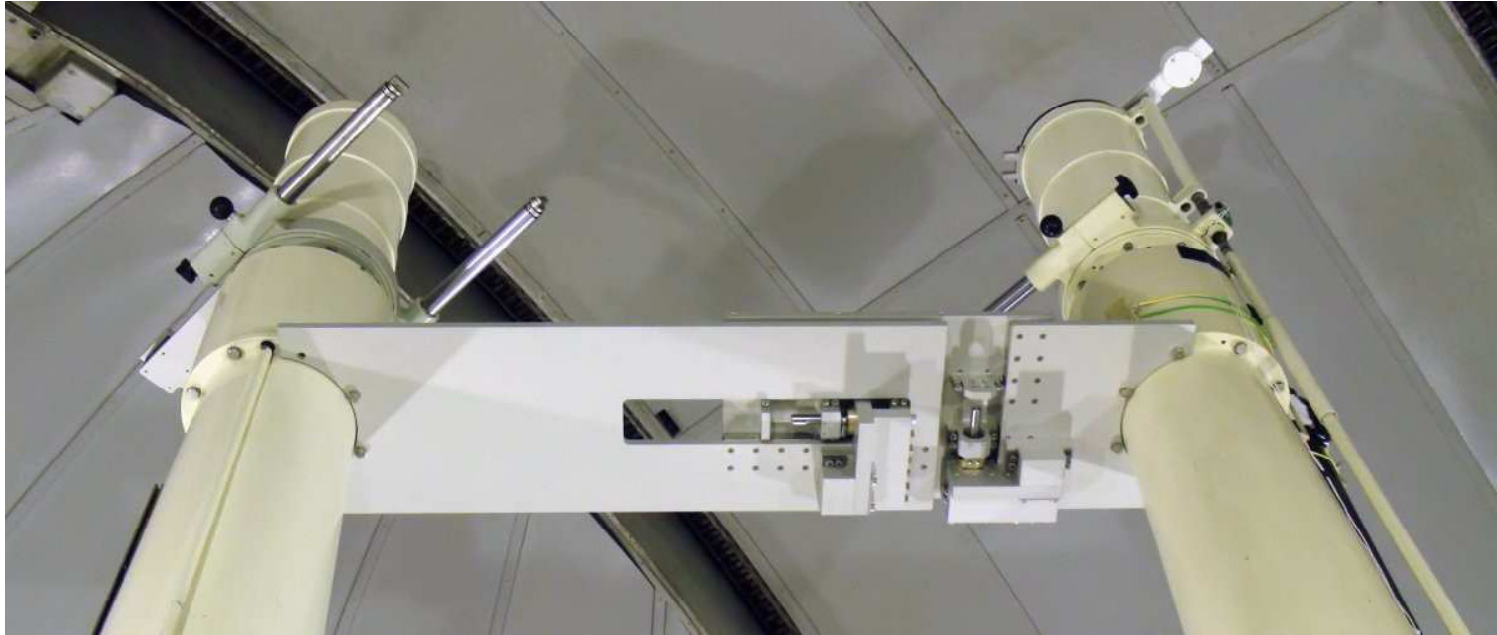


FWHM of the Lyot filter



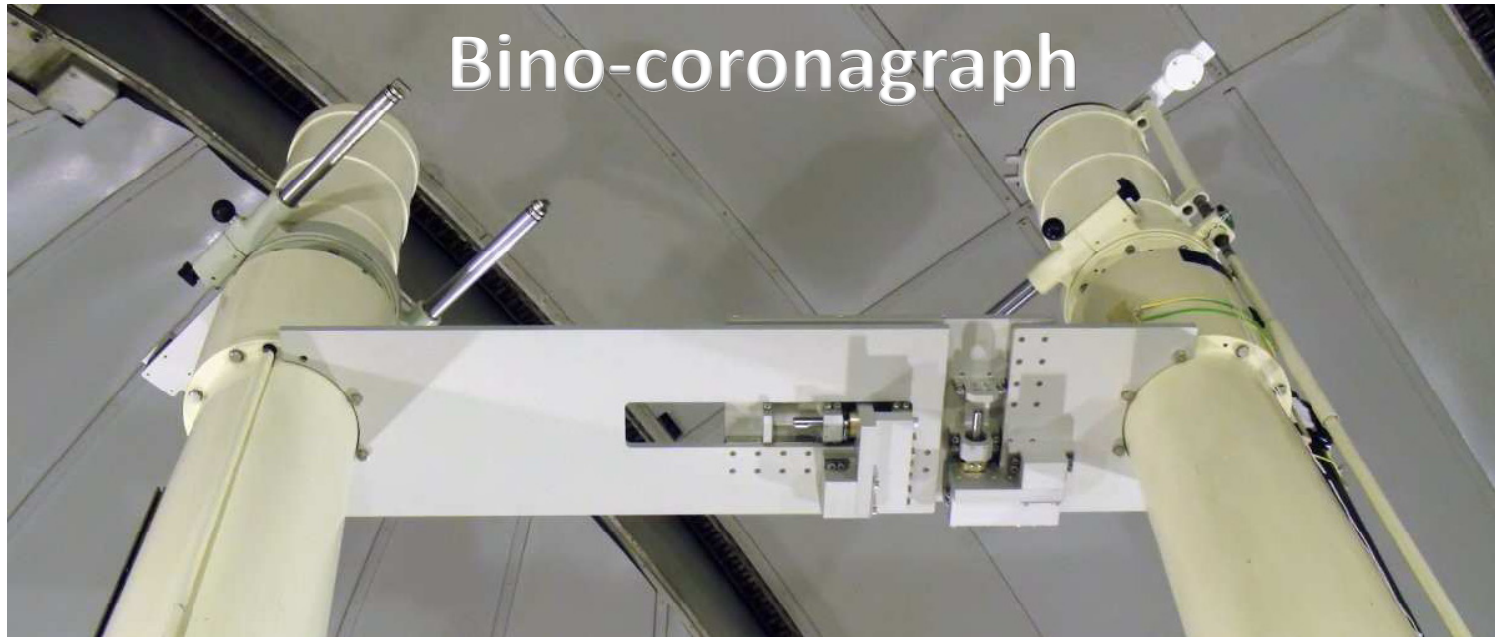
FWHM at:	530 nm	0.28 Å
	H α	0.45 Å
	1075 nm	1.3 Å

Prospects and possibilities



- to exploit joint potential of twin coronagraphs on the common mount
- on-going work on co-pointing of the coronagraphs, an aim: 2-arcsec co-pointing precision (Rob Hammerschlag, Hankom Engineering Rotterdam)
- possibility of parallel observations in the future
- right coronagraph: CoMP-S, left coronagraph:
 - small diffraction grating spectrograph
 - tests of new instruments, please contact: J. Rybak - rybak@astro.sk
 - at disposal for hosting instruments for temporary joint observations (since October 2013: CorMag spectropolarimeter for the green coronal line developed in Osservatorio Astronomico di Torino, INAF, by prof. G. Fineschi)

Prospects and possibilities

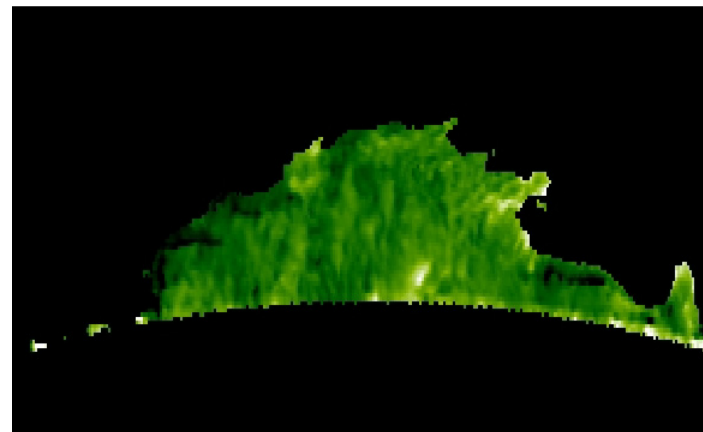
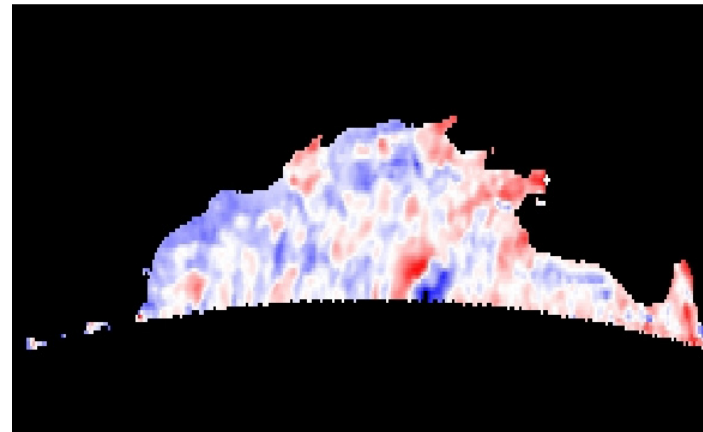
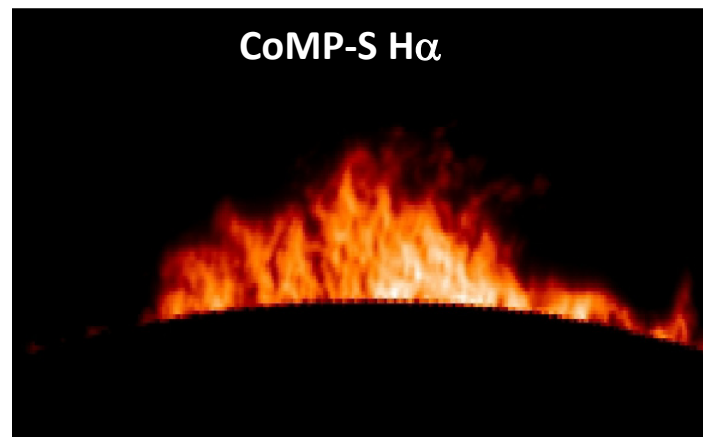


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- taken during HOP 186
„Mass loading of quiescent prominences from multi-wavelength observations“
PI: P. Schwartz
- a quiescent prominence on 20 October 2012 at 07:09 UT
- H α profile scanned in 11 wavelength settings, only Stokes I
- total scan time: 20.75 s
- wavelength steps
core: $\pm 0.1 \text{ \AA}$, wings: $\pm 0.2 \text{ \AA}$
- FWHM of filter: 0.45 \AA
- post-facto 4×4 pixel binning, final sampling: 1.3 arcsec/px
- Gaussian fitting of 11 samples of H α profiles through formula:

$$f(\lambda) = A \exp\left\{-\frac{(\lambda - \lambda_c)^2}{2w^2}\right\}$$

- derived parameters:
 - Gaussian amplitude A
 - Dopplershift of λ_c
 - Gaussian halfwidth w



Example of observation and results

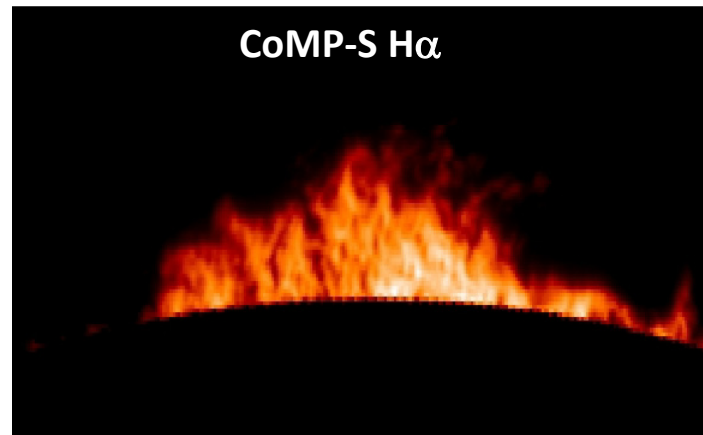
Gaussian amplitude

Dopplershifts: $\pm 12 \text{ km s}^{-1}$

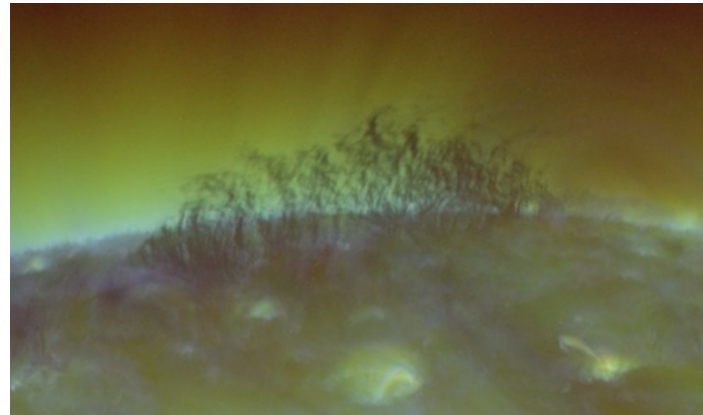
Gaussian halfwidths: $0.2 - 0.45 \text{ \AA}$

Example of observation and synergy

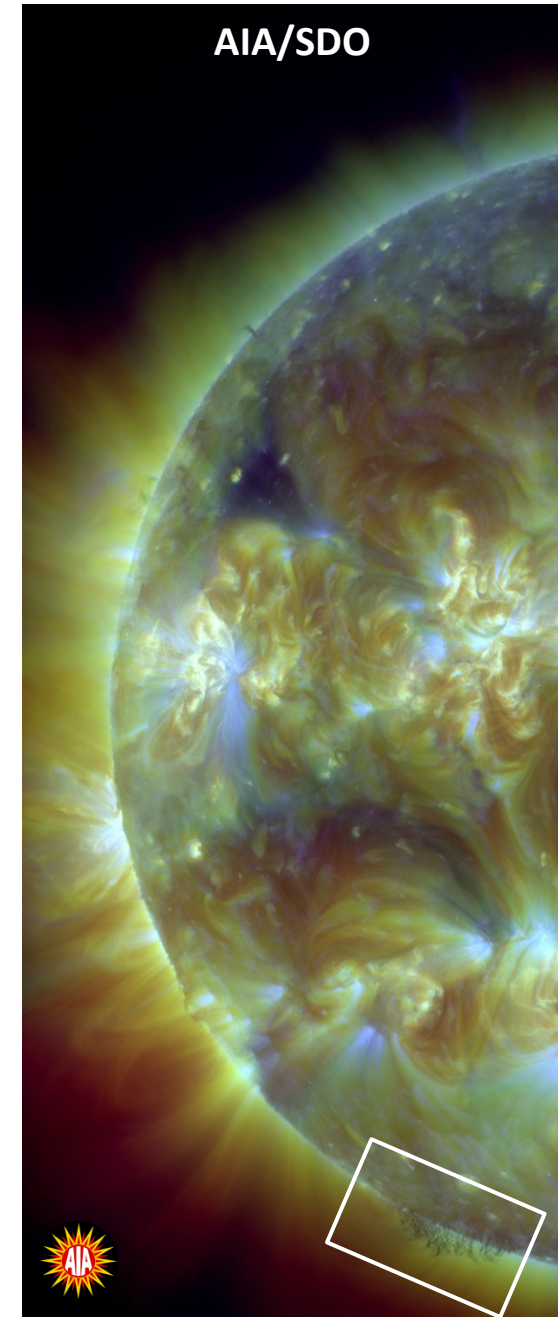
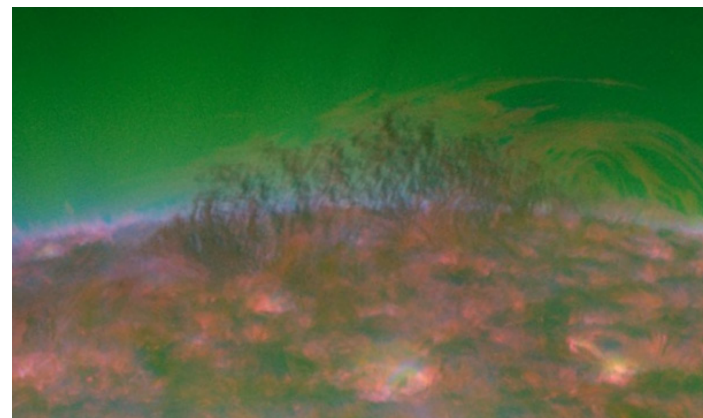
- a quiescent prominence on 20 October 2012 at 07:09 UT
- at position angle: 170°



AIA/SDO 07:11 UT
211 Å + 193 Å + 171 Å

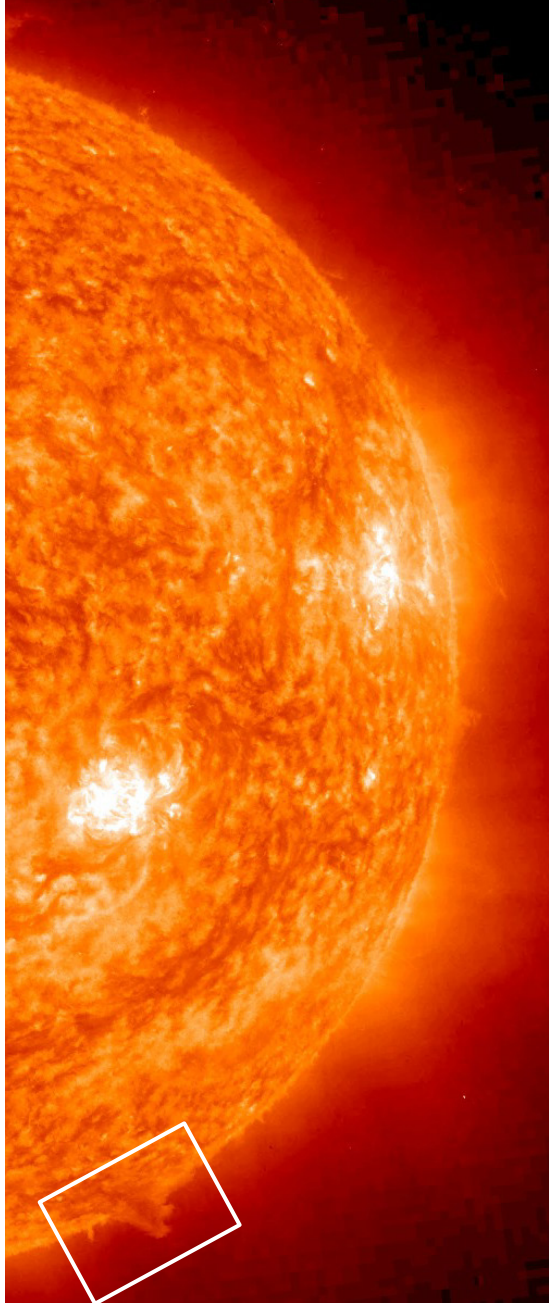


AIA/SDO 07:11 UT
304 Å + 211 Å + 171 Å



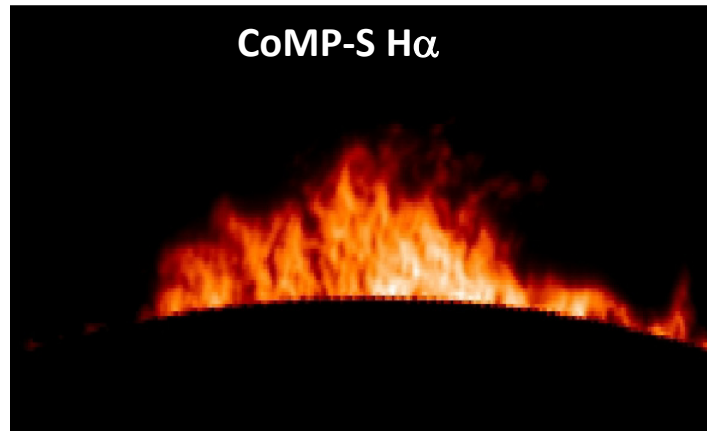
07:11 UT, 211 Å + 193 Å + 171 Å

STEREO Behind EUVI 304 Å



07:07 UT

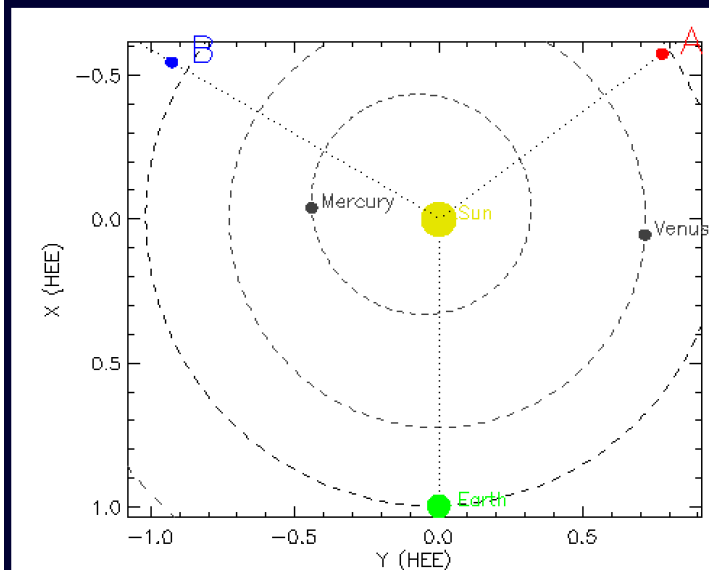
CoMP-S H α



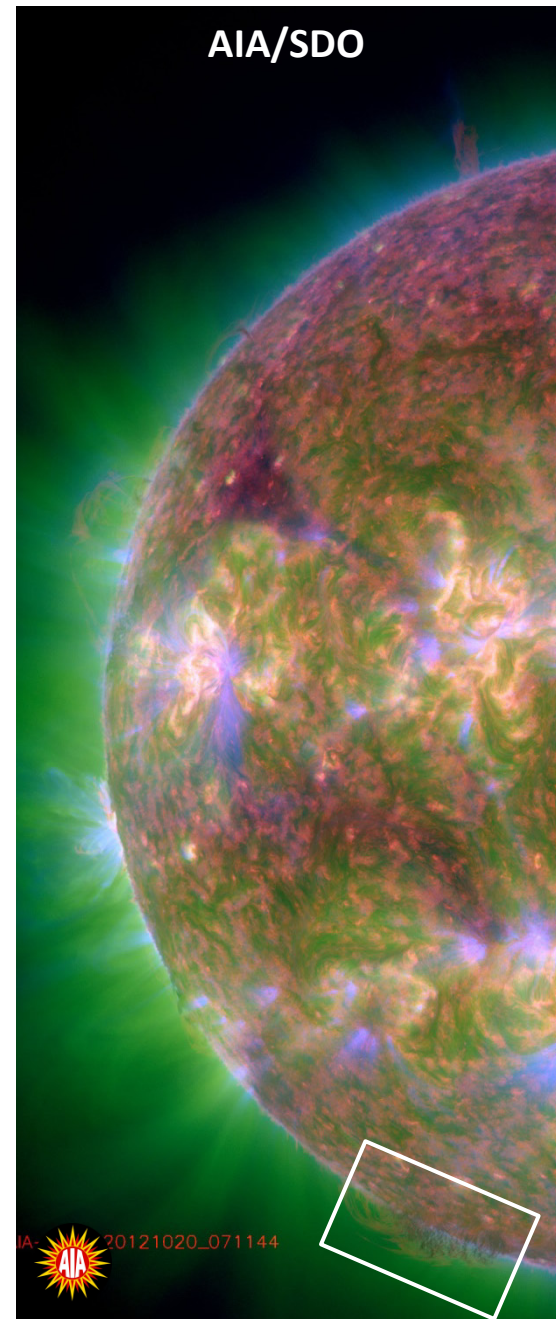
07:09 UT

Example of observation and synergy

Positions of STEREO A and B for 2012-10-20 08:00 UT



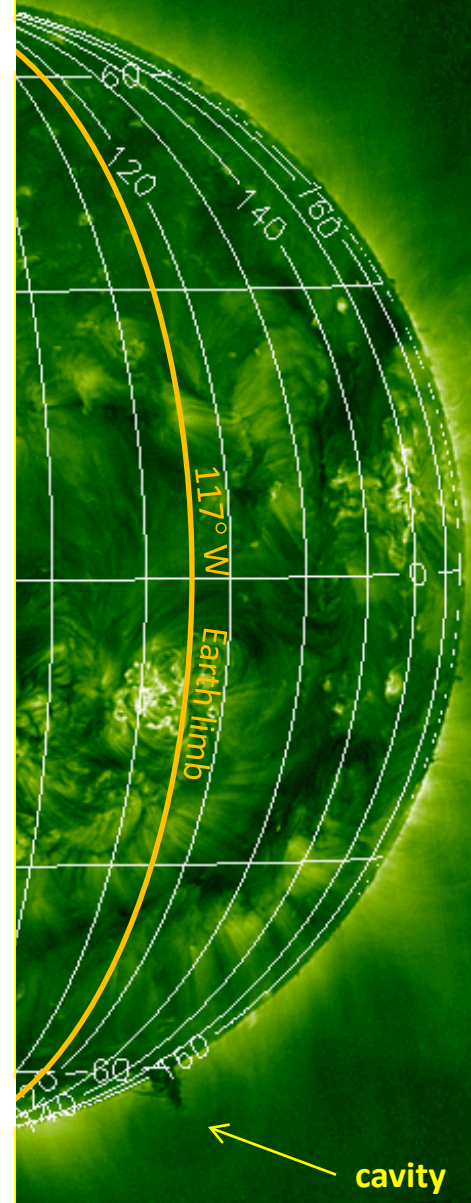
AIA/SDO



AIA 20121020_071144

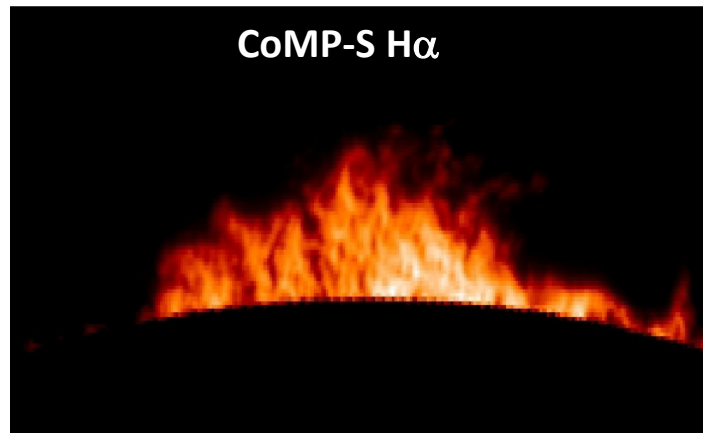
07:11 UT, 304 Å + 211 Å + 171 Å

STEREO Behind EUVI 195 Å



10:00:30 UT

CoMP-S H α



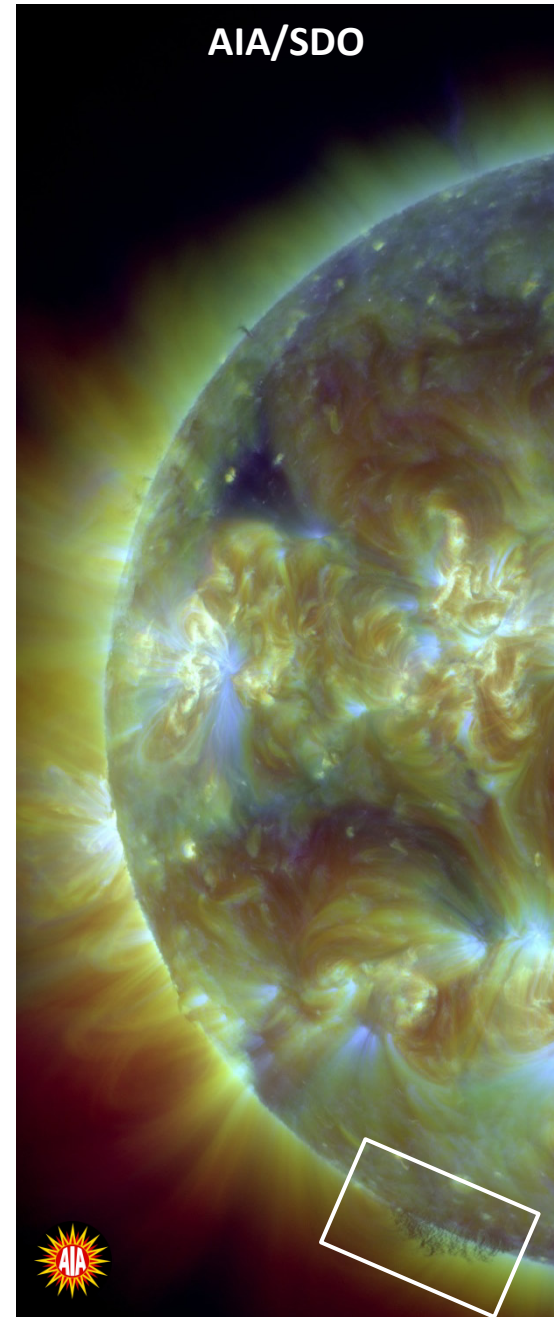
07:09 UT

Example of observation and synergy

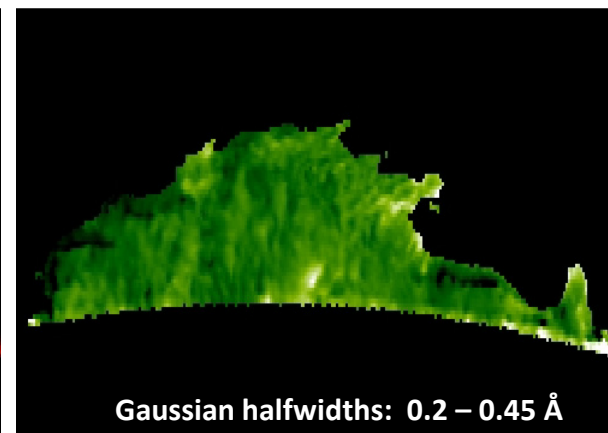
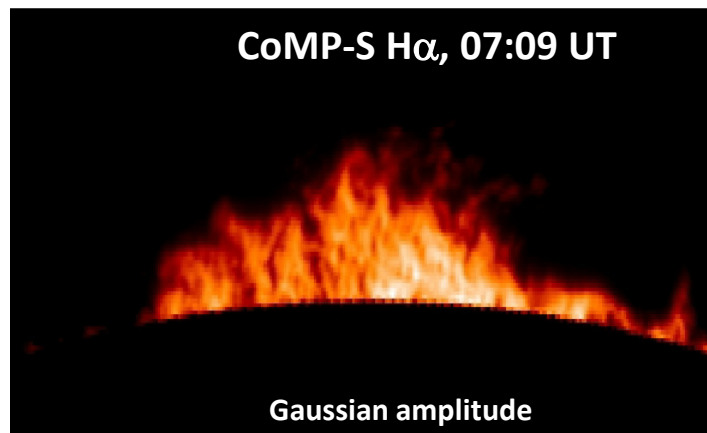
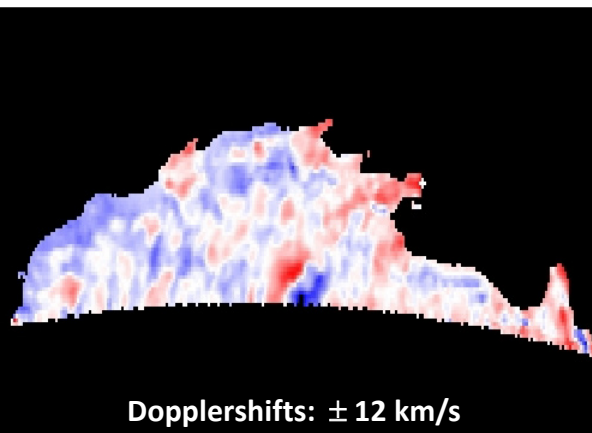
- Carrington grid superimposed
- the Earth-facing limb at 117° West
- the prominence is well towards the Earth
- EUVI-B sees probably the line of sight integration of the hedge-row structures seen in CoMP-S and AIA

courtesy: Angelos Vourlidas, Naval Research Laboratory

AIA/SDO

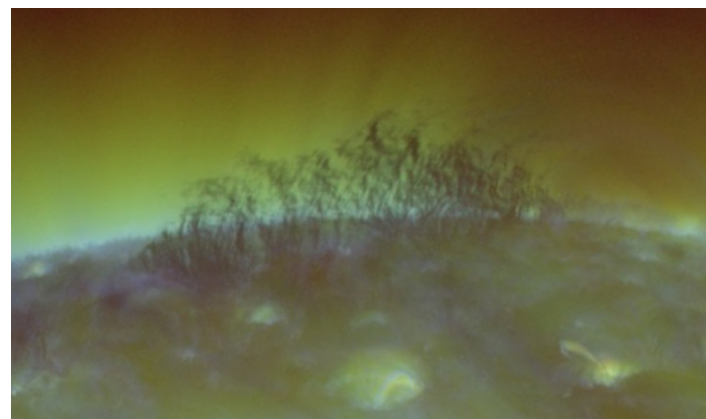
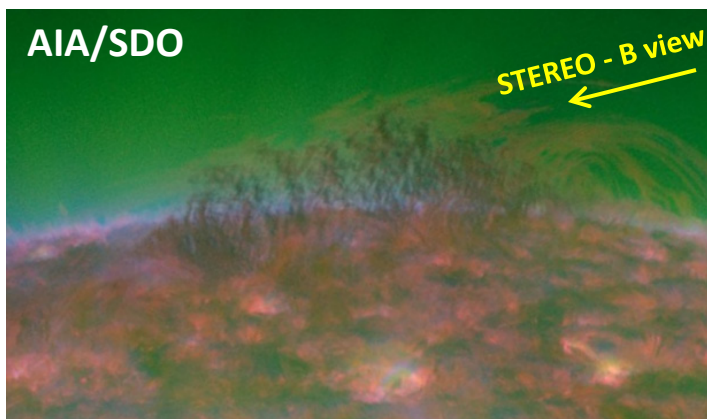


07:11 UT, 211 Å + 193 Å + 171 Å



07:11 UT

304 Å
+
211 Å
+
171 Å



07:11 UT

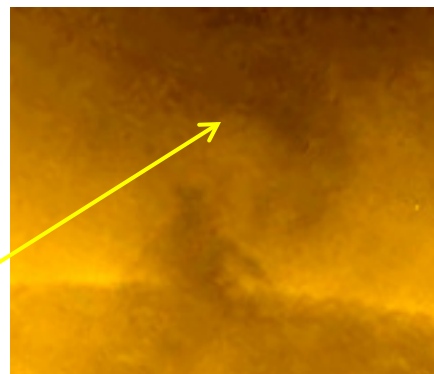
211 Å
+
193 Å
+
171 Å

STEREO Behind EUVI

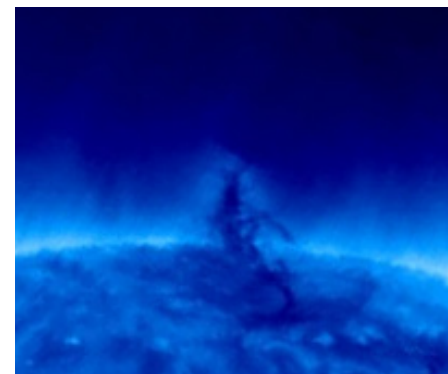
304 Å, 07:07 UT



195 Å, 07:06 UT



284 Å, 06:17 UT



171 Å, 06:14 UT

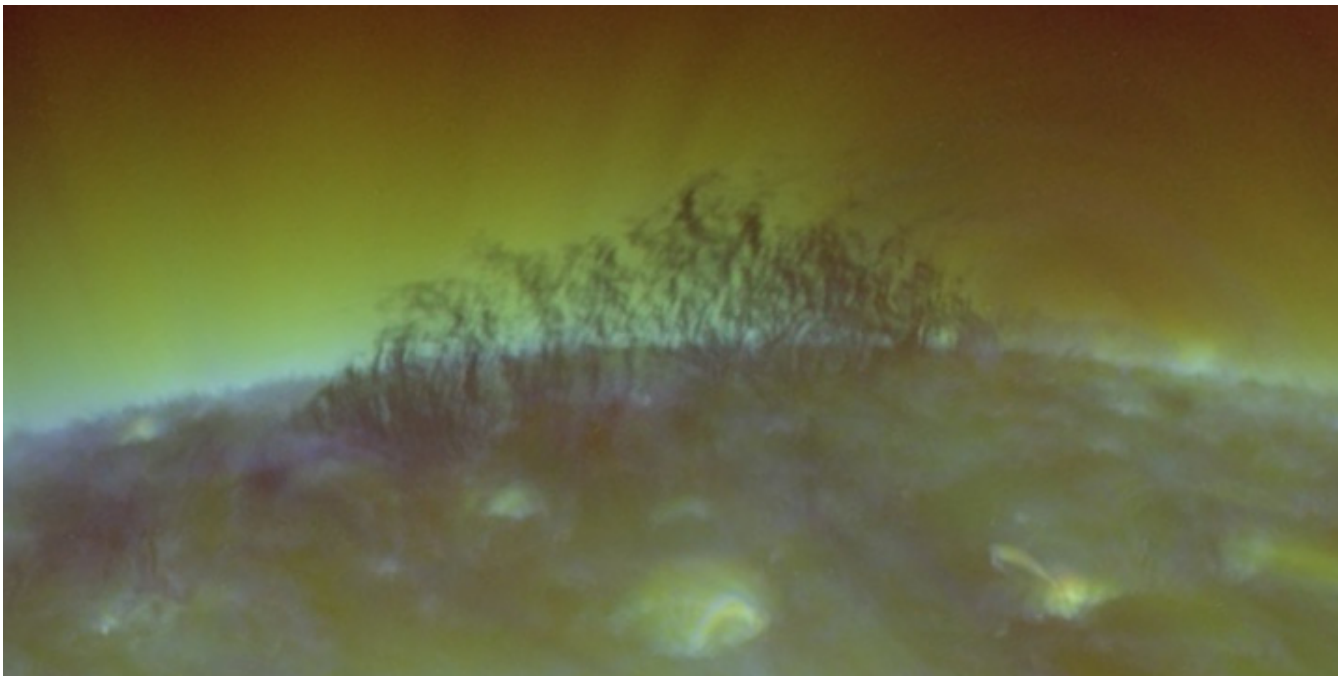
Summary

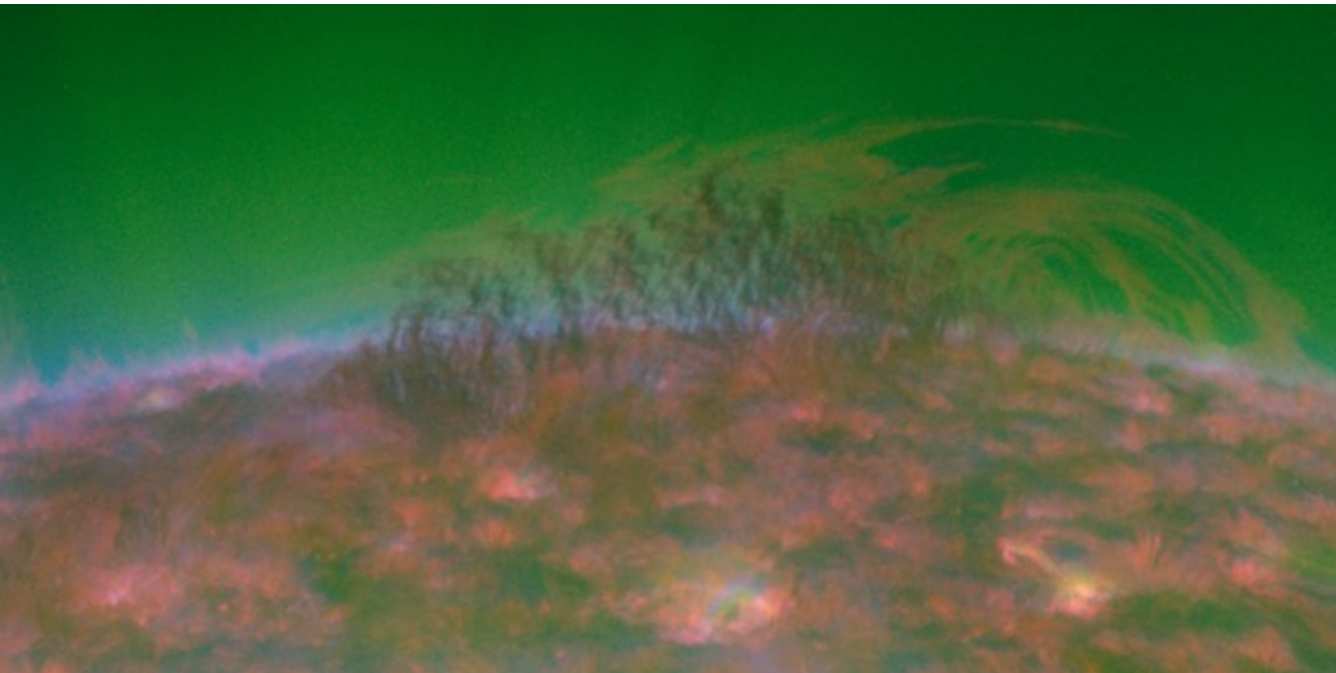
- 2D wide-field polarimeter CoMP-S at 200-mm Zeiss coronagraph became operational
- sequential measurements of several VIS and near-IR emission lines in prominences and corona in the spectral range from 530 nm to 1100 nm (since spring 2014)
- strictly simultaneous acquisition of data and the scattered light in the Earth atmosphere
- expected synergy with the space-born observatories SDO and STEREO by providing behind imagery also Dopplershifts , spectral widths, and full Stokes vector
- reduction of plarimetric data still in progress, therefore not presented here
- ready to join coordinated campaigns, please contact: J. Rybak - rybak@astro.sk

<http://www.astro.sk/LSO/COMP-S/>

CoMP-S publications: [Kučera et al. 2010: Contrib. Astron. Obs. Skalnaté Pleso, 40, 135](#)
[Schwartz et al. 2012: Contrib. Astron. Obs. Skalnaté Pleso, 42, 135](#)







Future shape of the camera modul

