



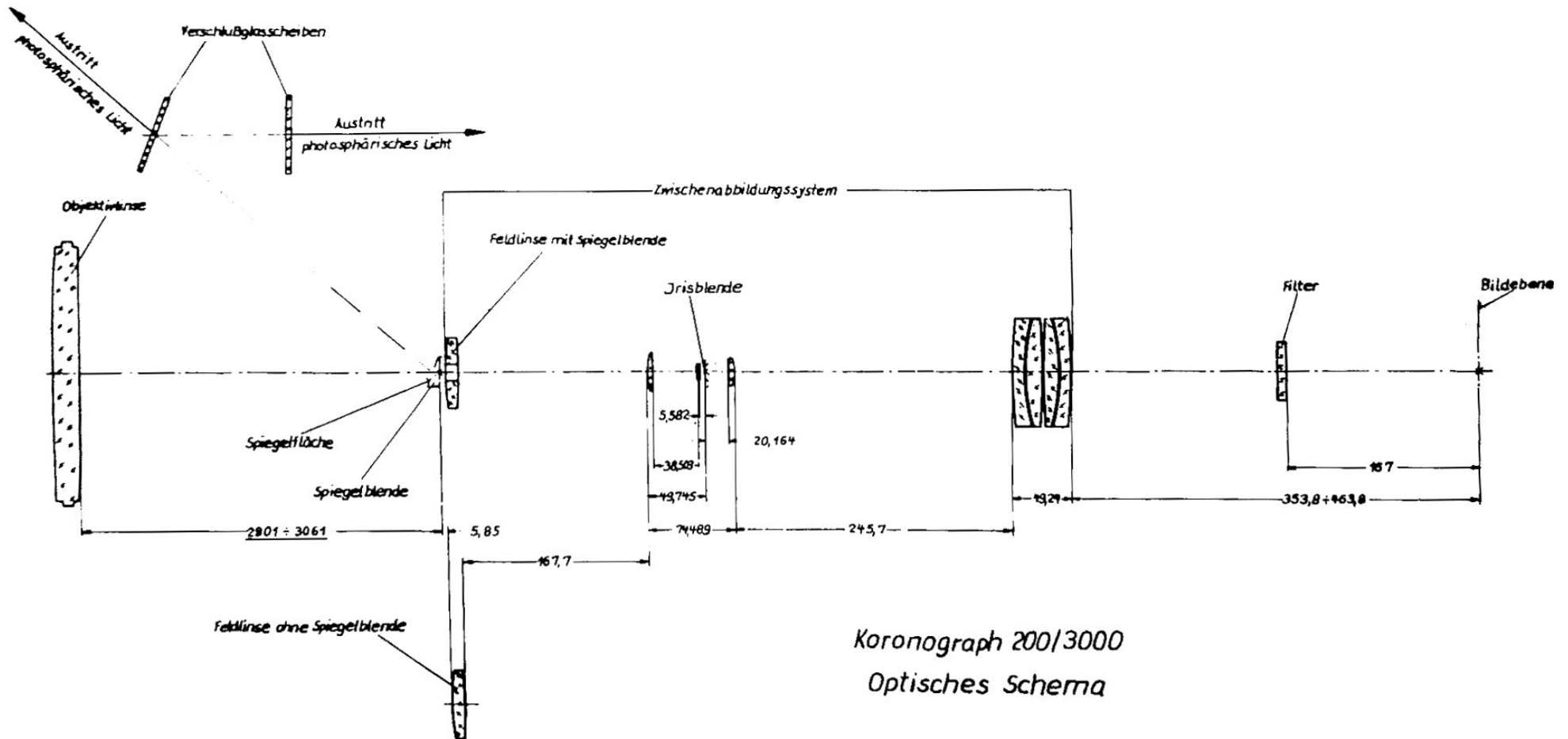
The LSO for our friend Manolo Collados Vera

the LSO group

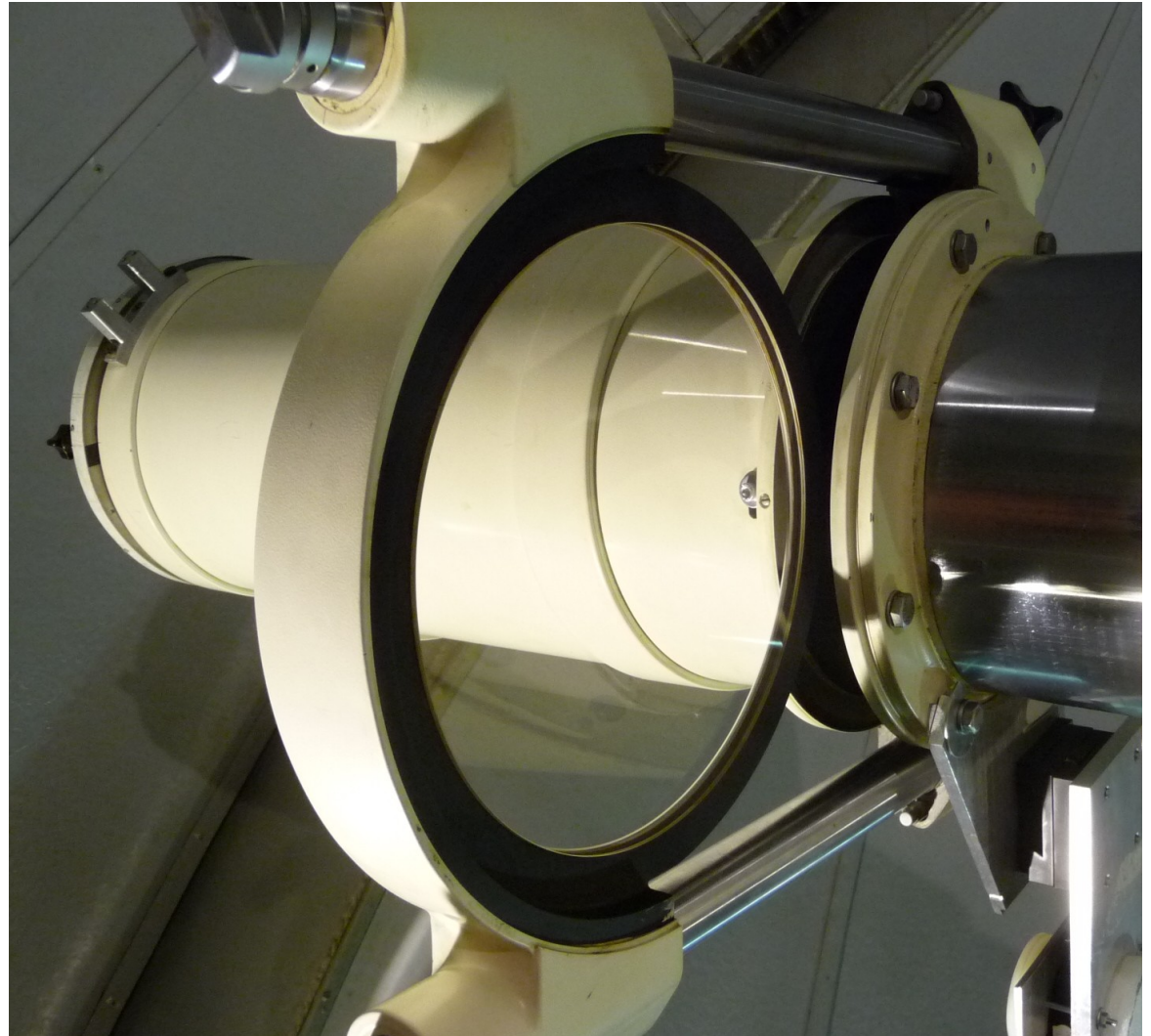
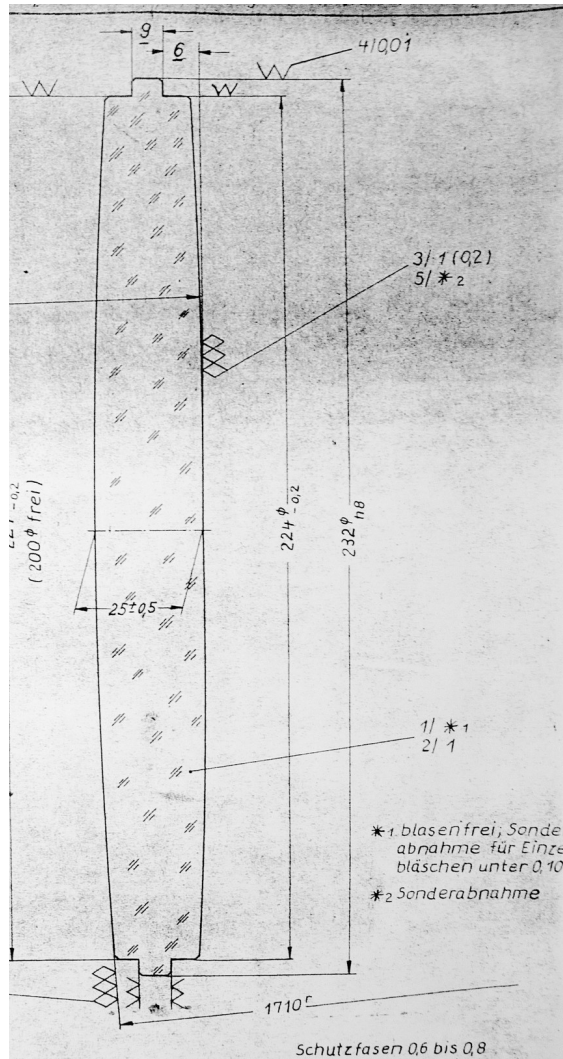


LSO ZEISS (Lyot) coronagraph

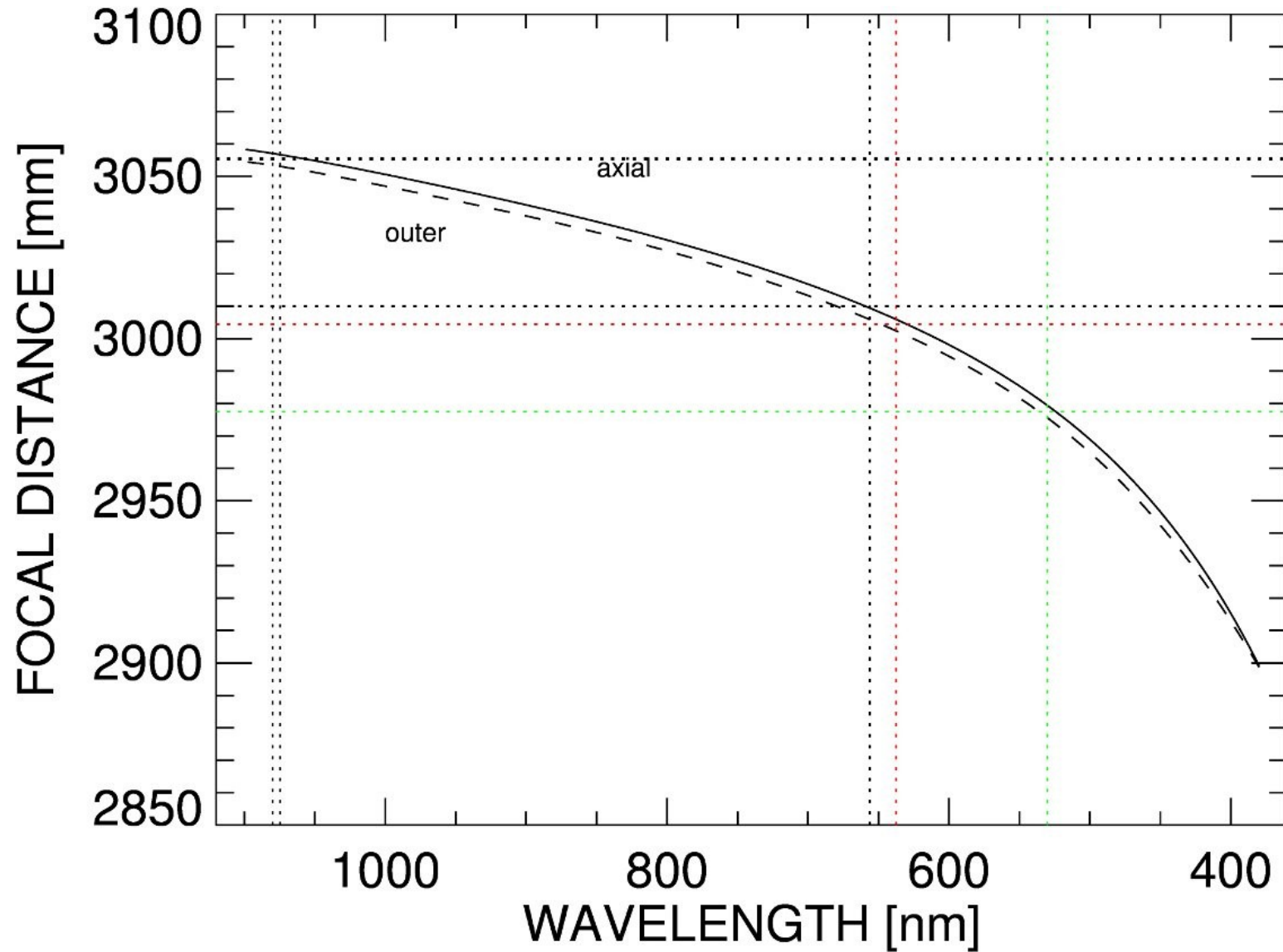
ZEISS coronagraph 200/3000/4000



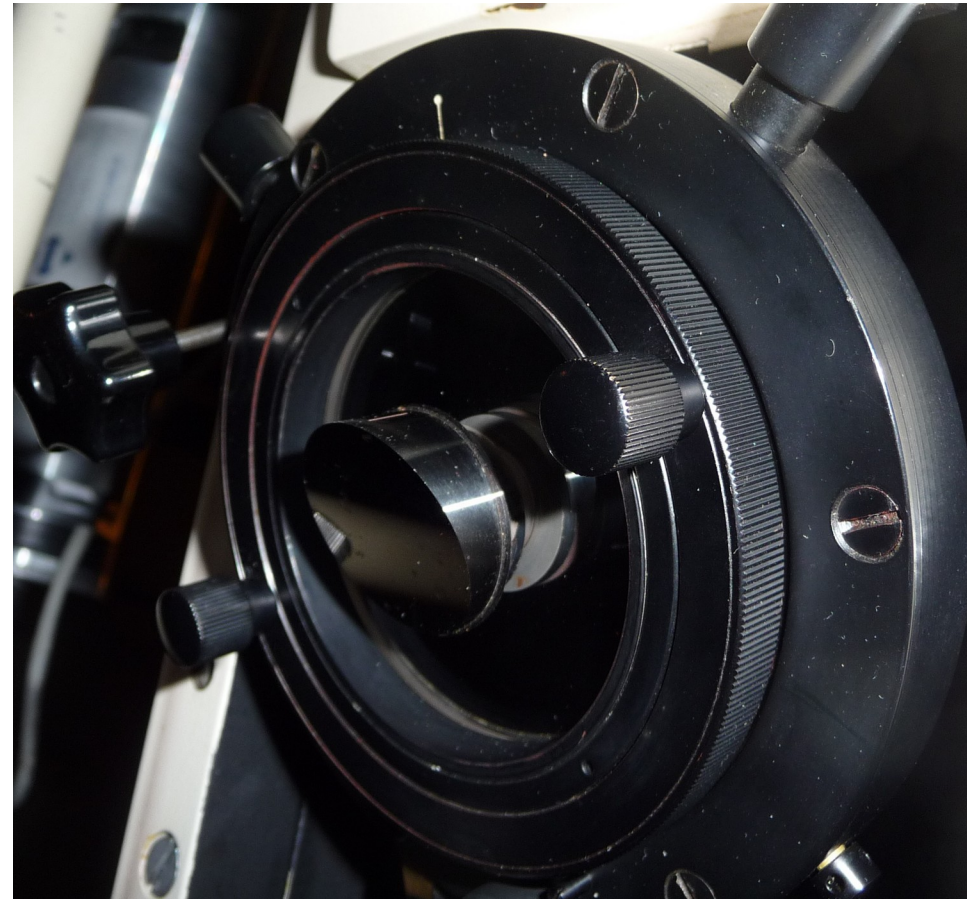
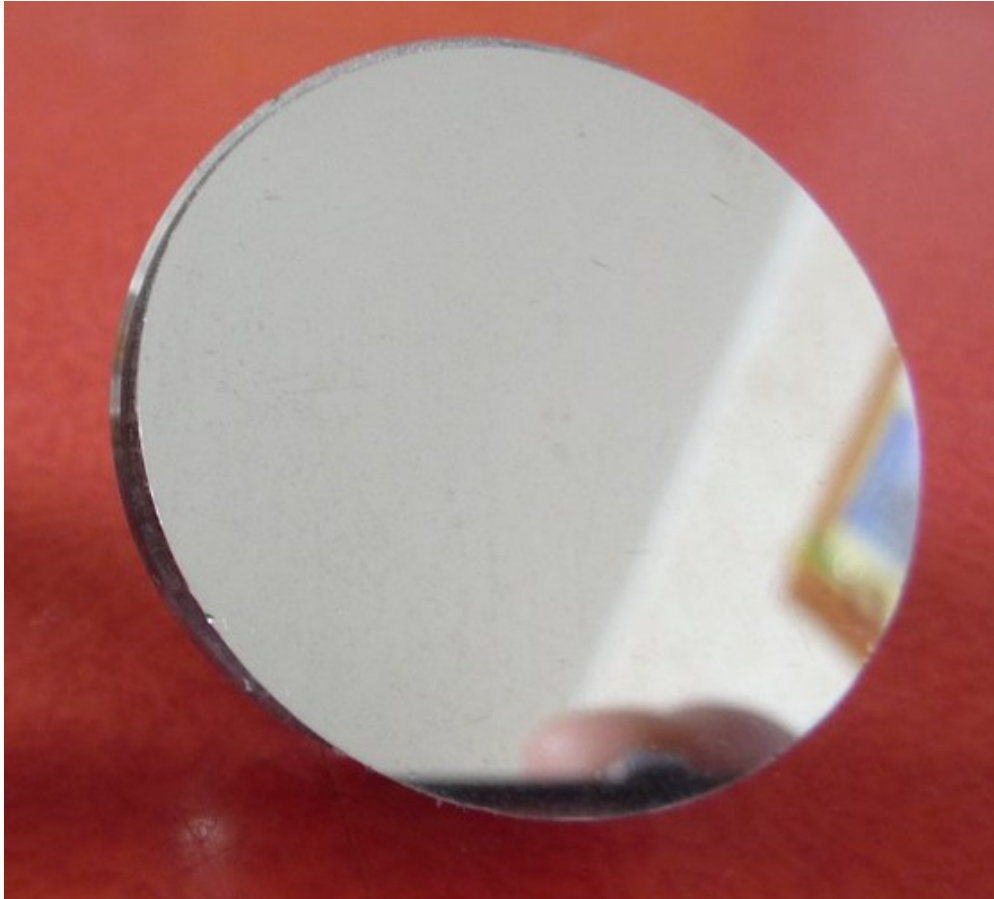
ZEISS coronagraph 200/3000/4000



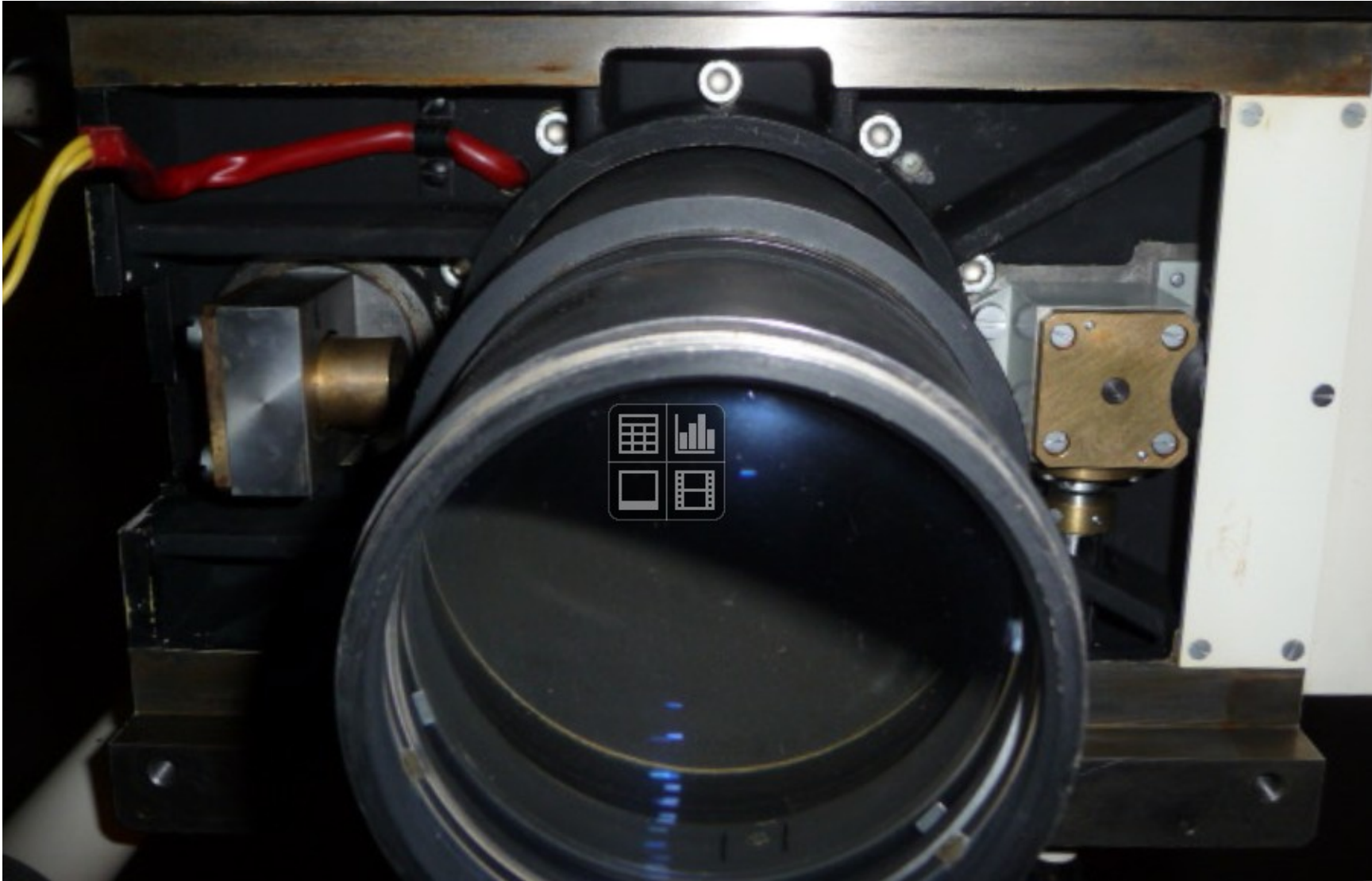
ZEISS coronagraph 200/3000/4000



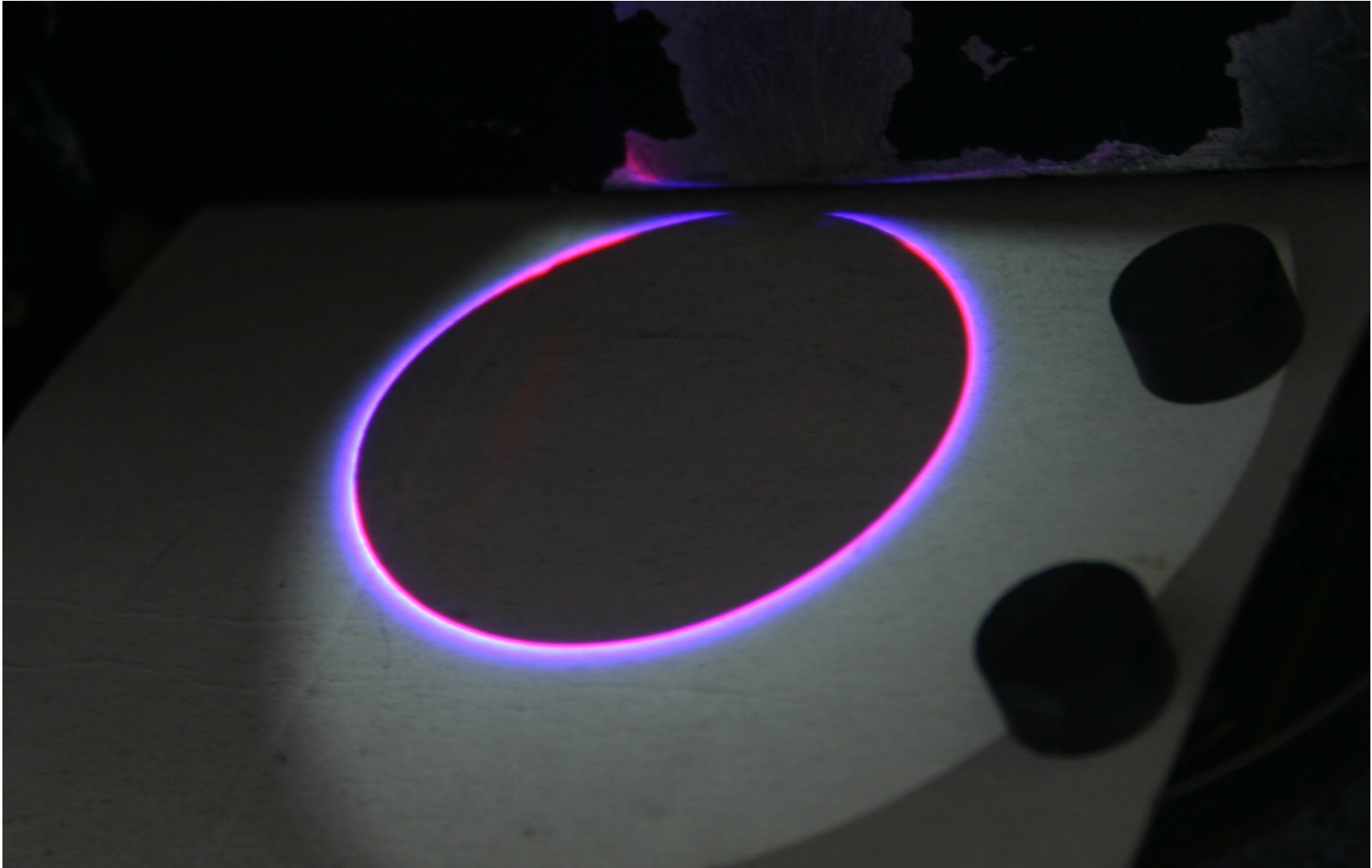
ZEISS coronagraph 200/3000/4000



ZEISS coronagraph 200/3000/4000



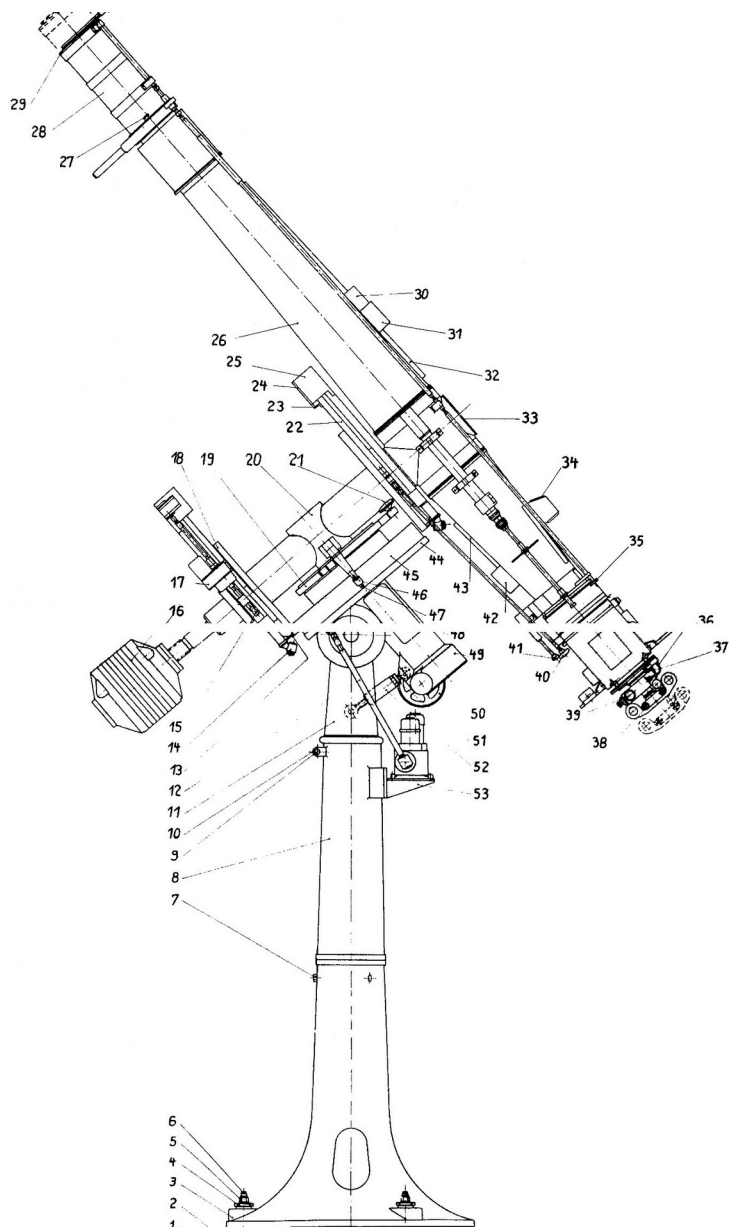
ZEISS coronagraph 200/30000/4000





Mount

ZEISS mount VII a



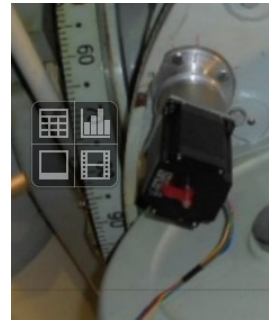
ZEISS mount VII a

- Theory ~ reality: all parts are bended depending on relative orientation of mechanical structures to the gravity vector direction → differential bending of the coronagraph → the solar disk image shift in the coronagraph focal plane
- Pointing systems correcting also for such effects are needed
- LSO: no active and/or adaptive optics



Pointing

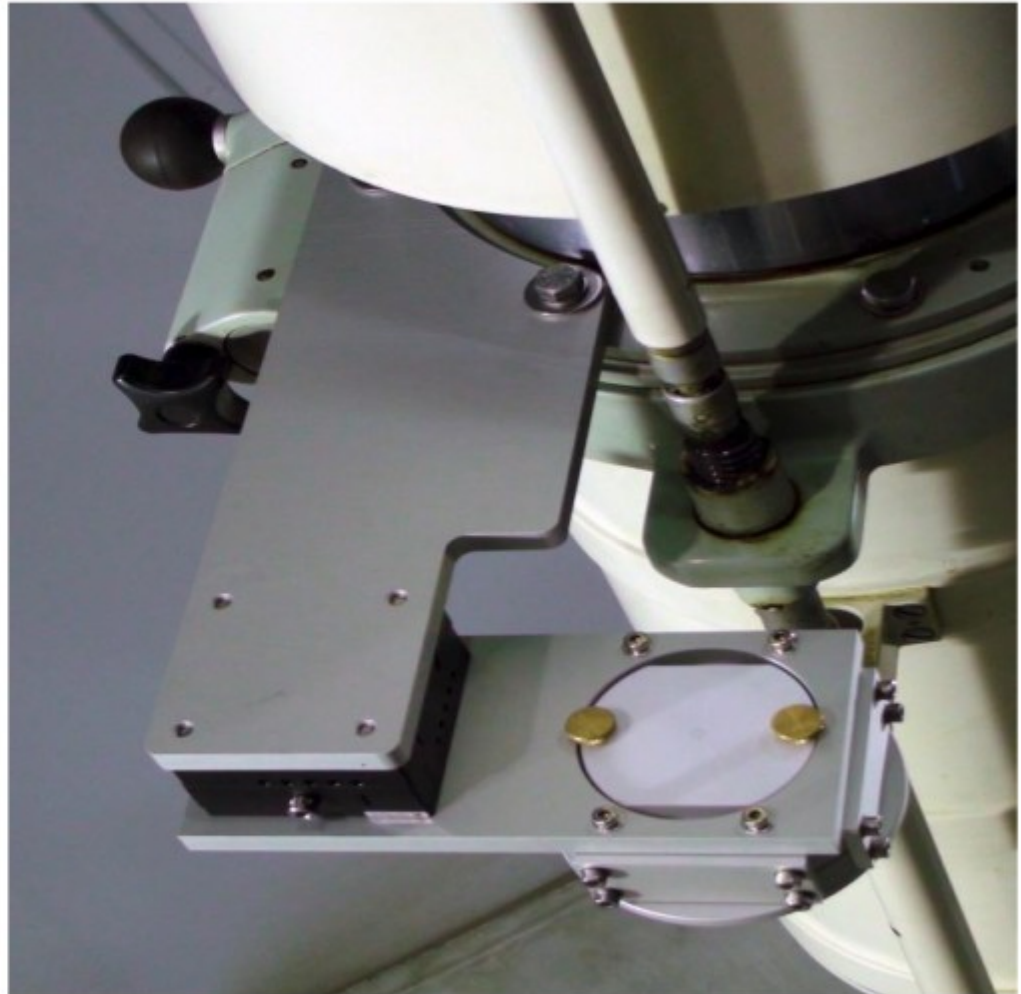
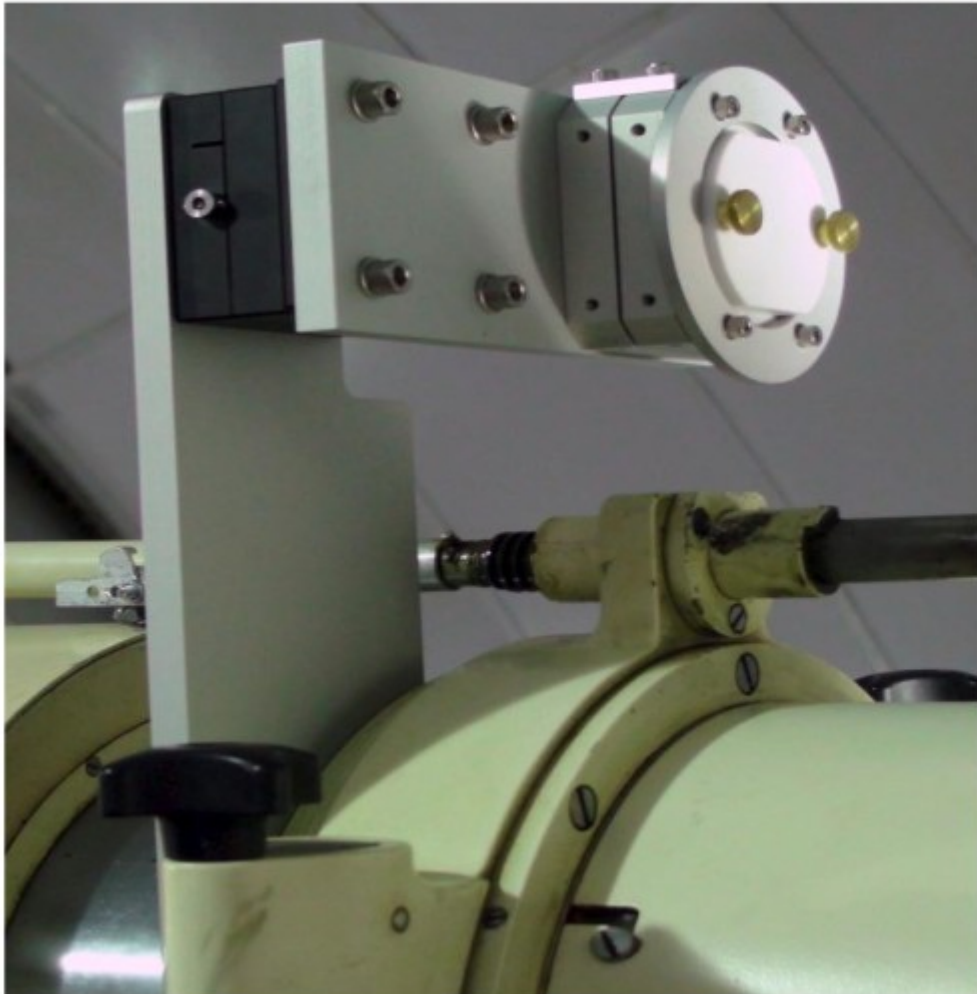
AISAS pointing for single coronagraph



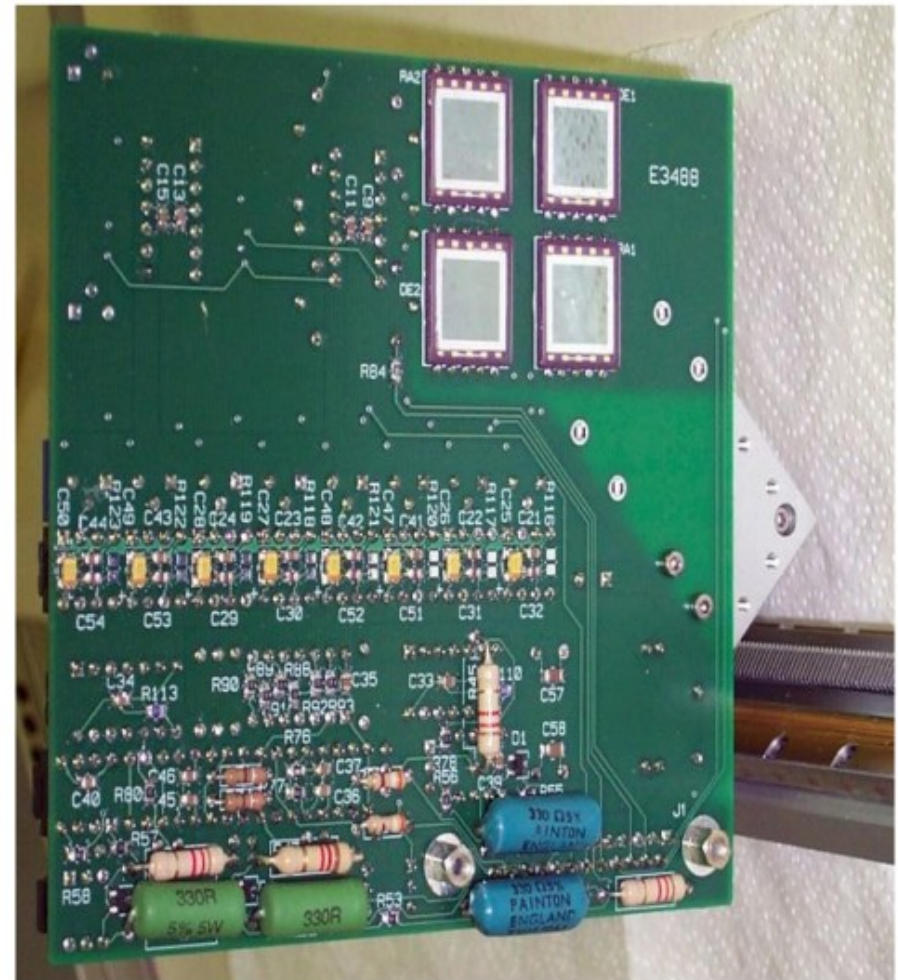
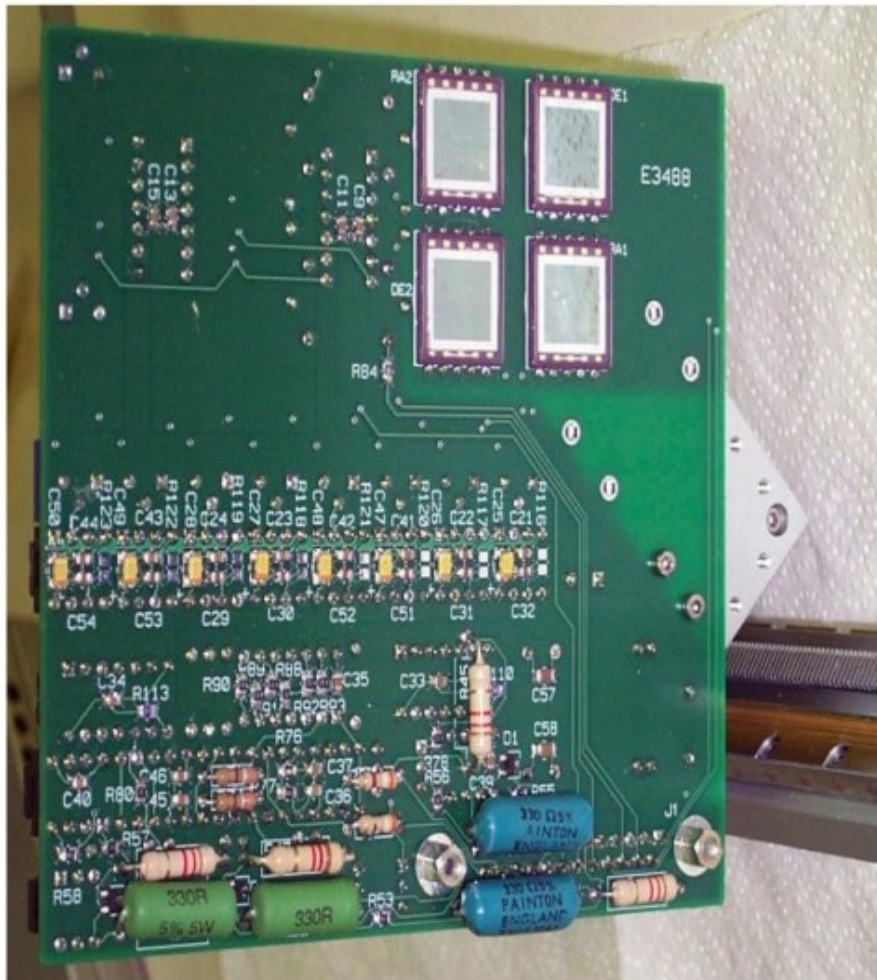
AISAS pointing for single coronagraph



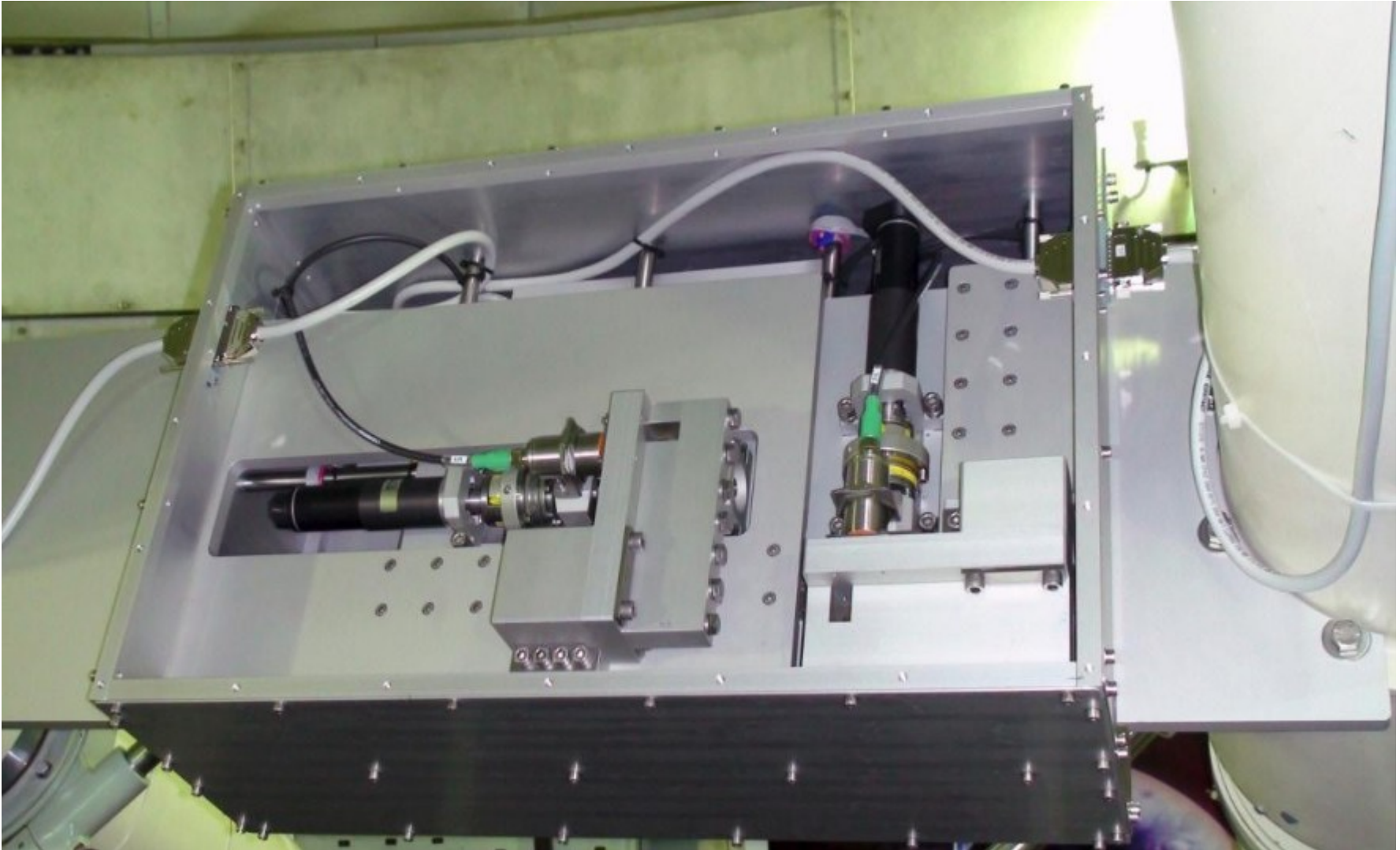
HANKOM pointing - the coronagraph twins



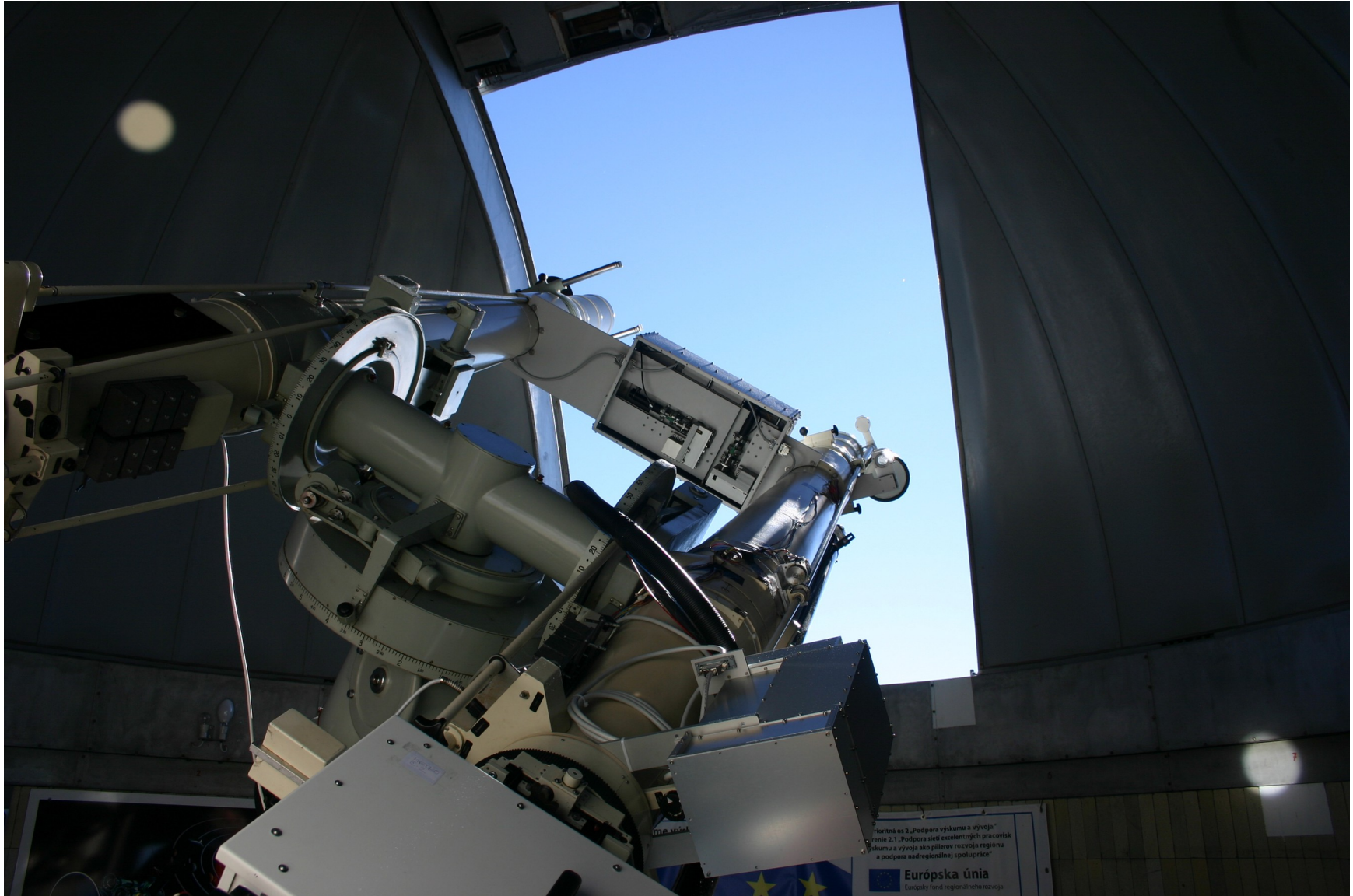
HANKOM pointing - the coronagraph twins



HANKOM pointing - the coronagraph twins



HANKOM pointing - the coronagraph twins





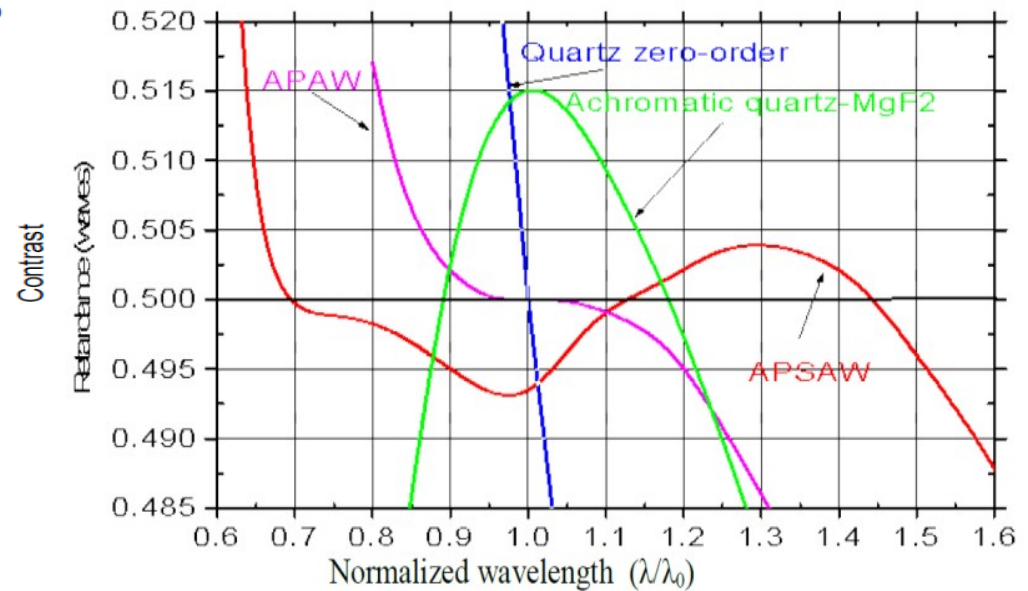
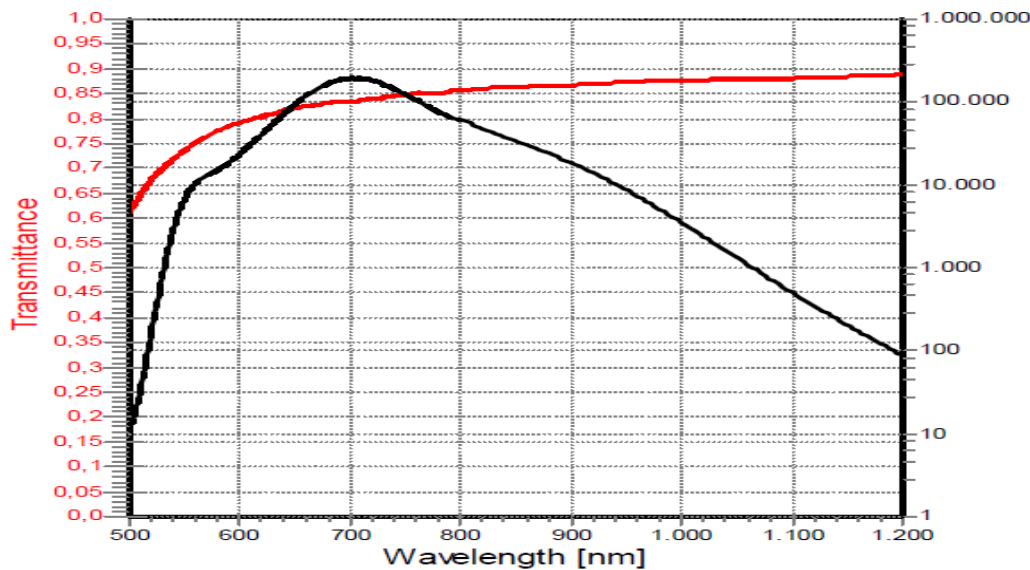
CoMP-S

CoMP-S

- NCAR/HAO product (S.Tomczyk) for the EU structural funds for science in Slovakia
- Tunable 4-stage Lyot filter + polarimeter
- Pre-filters + calibration optics
- Dichroich mirror
- Polarizing splitting cubes
- Pairs of detectors for the VIS and the IR
- Optics, heating, cooling

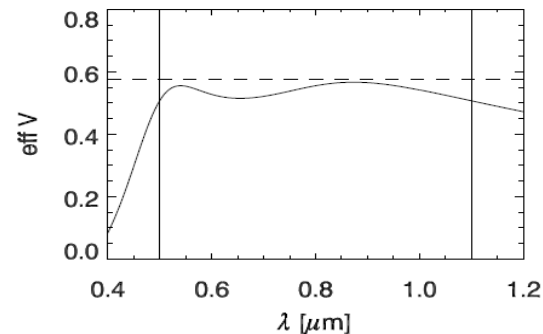
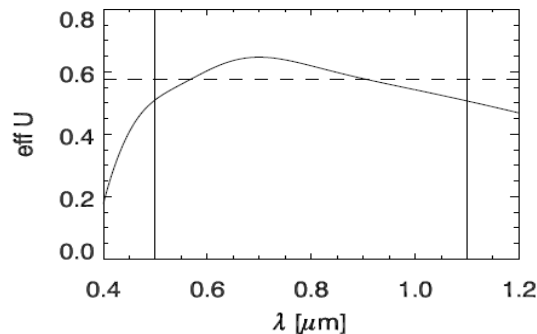
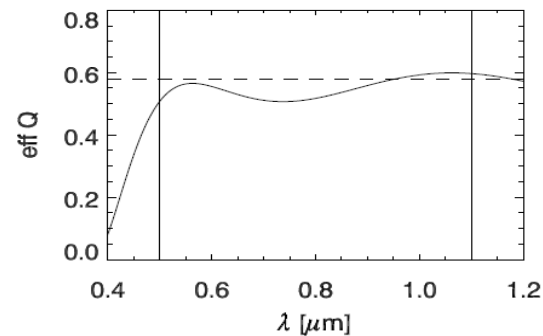
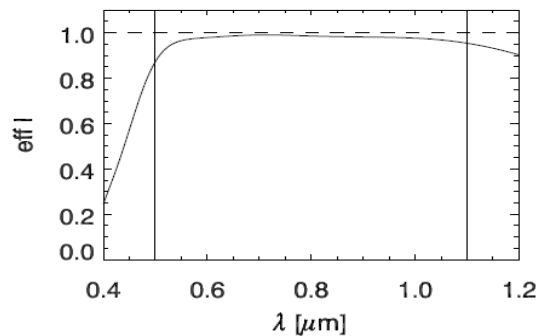
CoMP-S

- The Lyot filter:
 - birefringence: calcite, stages from two calcite partsfr
 - broadband polarizers: VIS700BC4 by CODIXX
 - super-achromatic $\lambda/2$ plates: APSAW by ASTROPRIBOR ($0.7-1.5 \lambda_0$)
 - FWHM: 0.03-0.13 nm (530-1083 nm)



CoMP-S

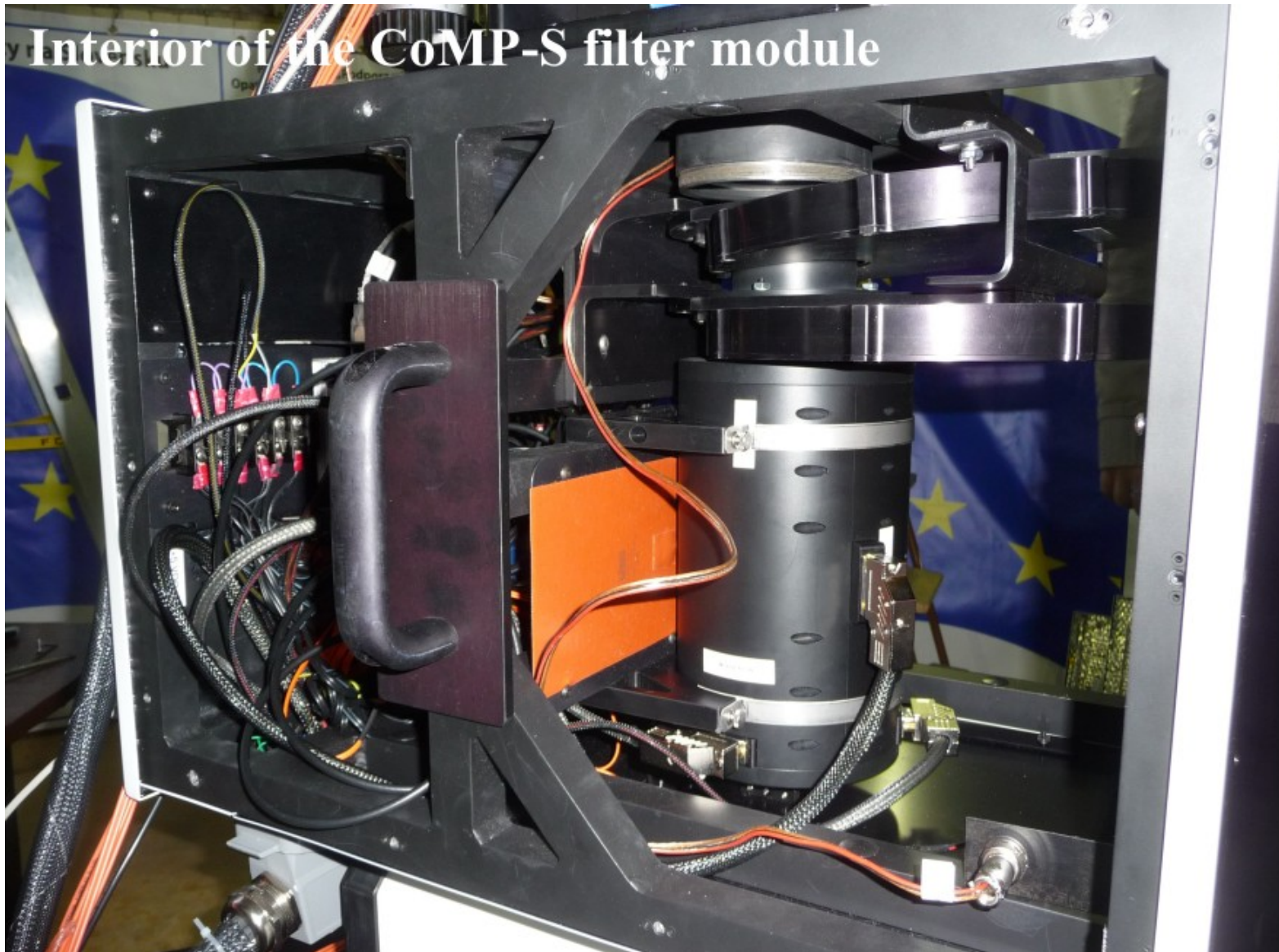
- The polarimeter:
 - polarization modulator: scheme from HAO Prominence Magnetometer (ProMag)
 - 2 ferro-electric liquid crystals (FLC) + fixed retarder - not achromatic → value of retardation and orientation are selected with a Monte Carlo procedure which optimizes the Stokes modulation efficiency over a very broad



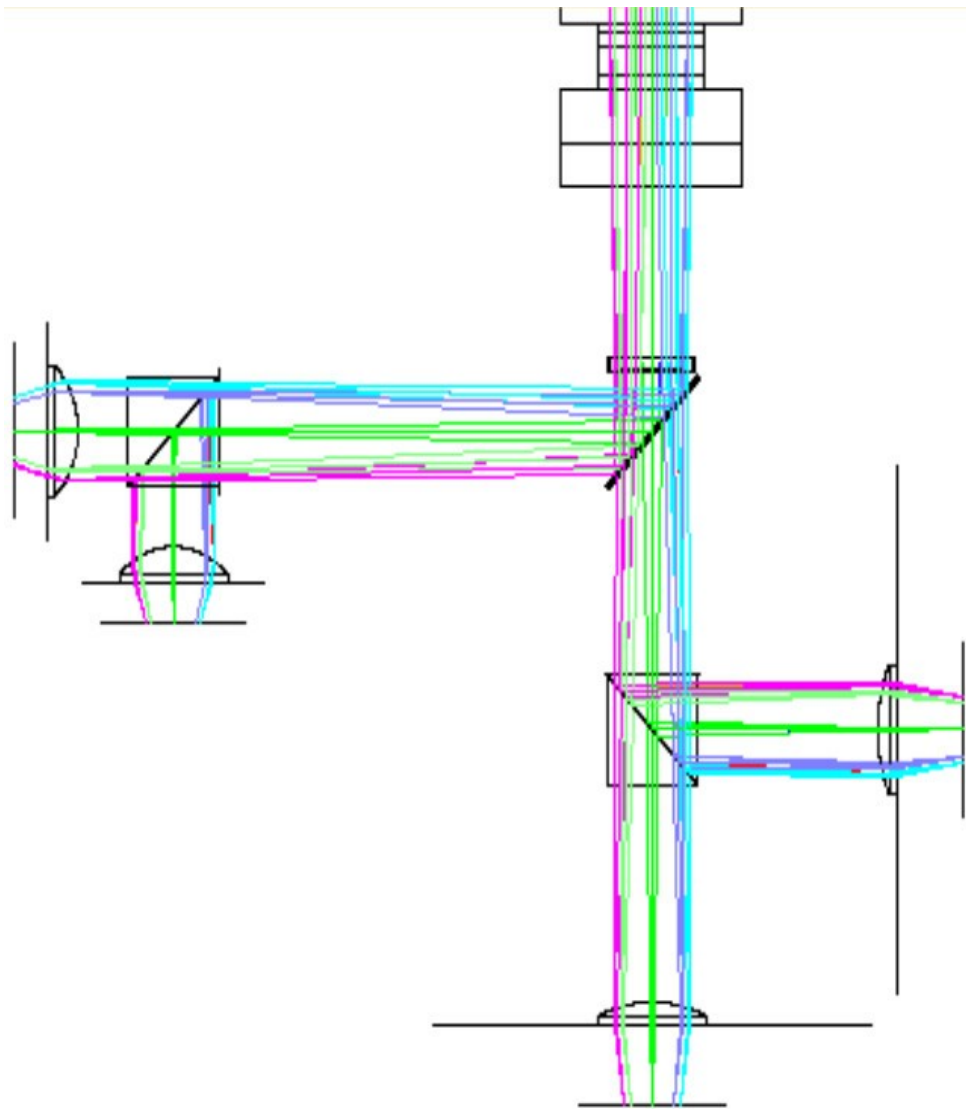
CoMP-S

- the polarimeter calibration:
 - HAO has proposed is based on the following articles:
 - del Toro Iniesta and Collados, Applied Optics, 39, 1637 (2000)
 - Tomczyk, Casini, de Wijn, Nelson, Applied Optics, 49, 2010
 - two HAO internal documents of Tomczyk and De Wijn
 - HAO has provided some IDL routines (but with problems reported)
 - AISAS:
 - the proposed polarimeter calibration has not been applied yet - in plan for 2023
 - The polarimetric calibration data are regularly acquired

CoMP-S: filter module



CoMP-S: camera module

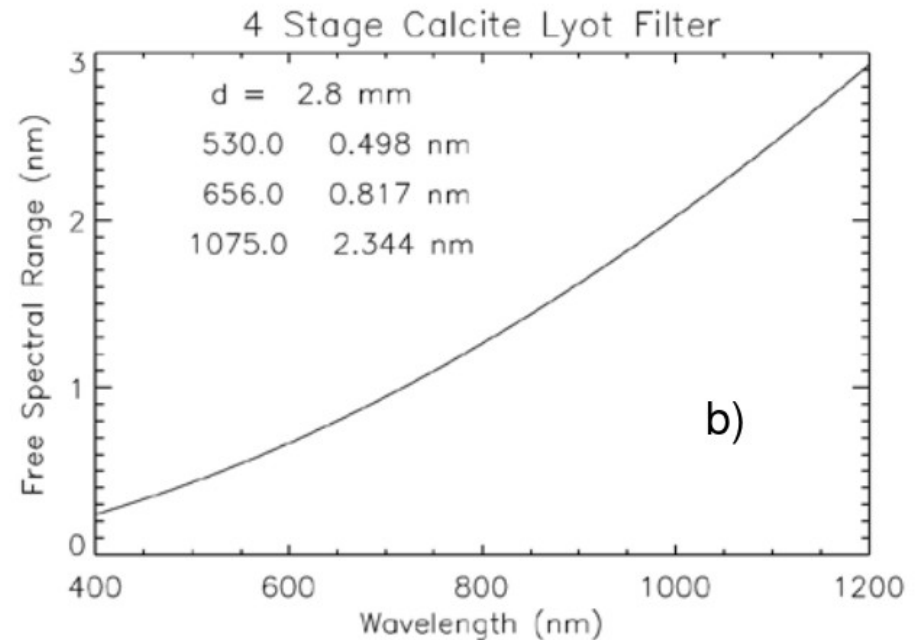
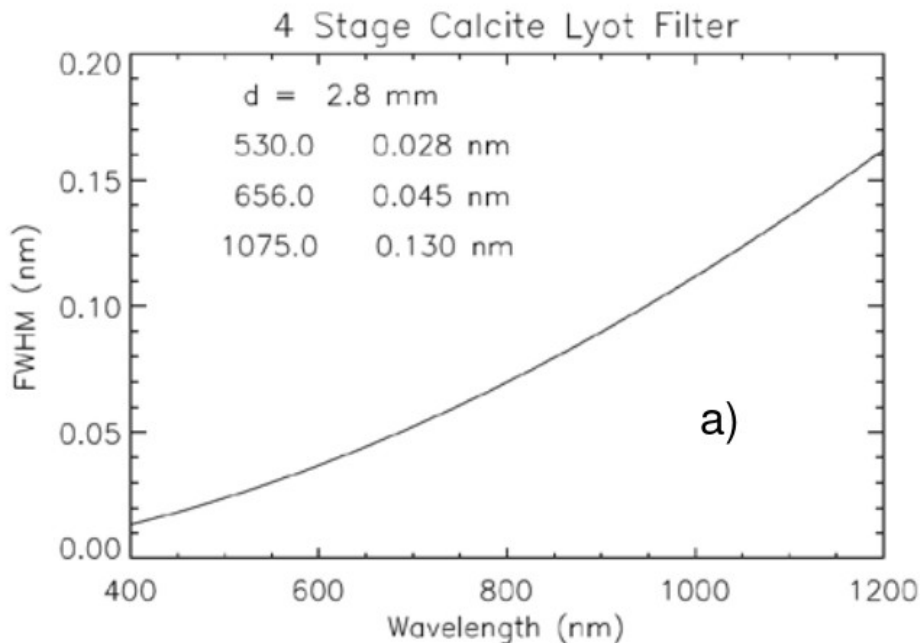


CoMP-S: camera module

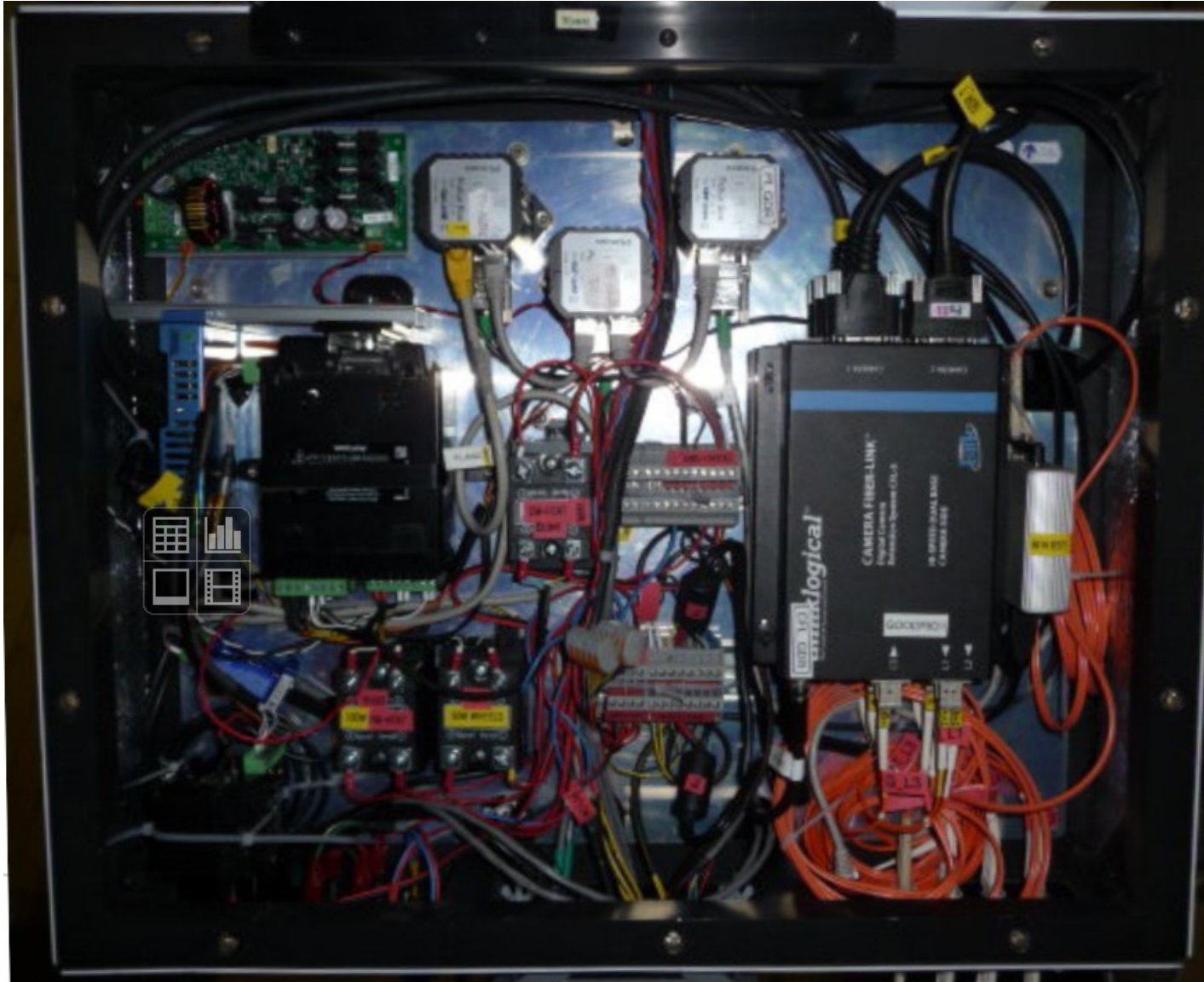


CoMP-S: the spectral lines

- Coronal lines: **Fe X 637 nm** (Fe XIV 530 nm, FE XIII 1074+1079 nm)
- Prominence lines: **He D3 587 nm, He I 656 nm, Ca II 854 nm** (He I 1083 nm)



CoMP-S: electronics



CoMP-S: electronics + computers



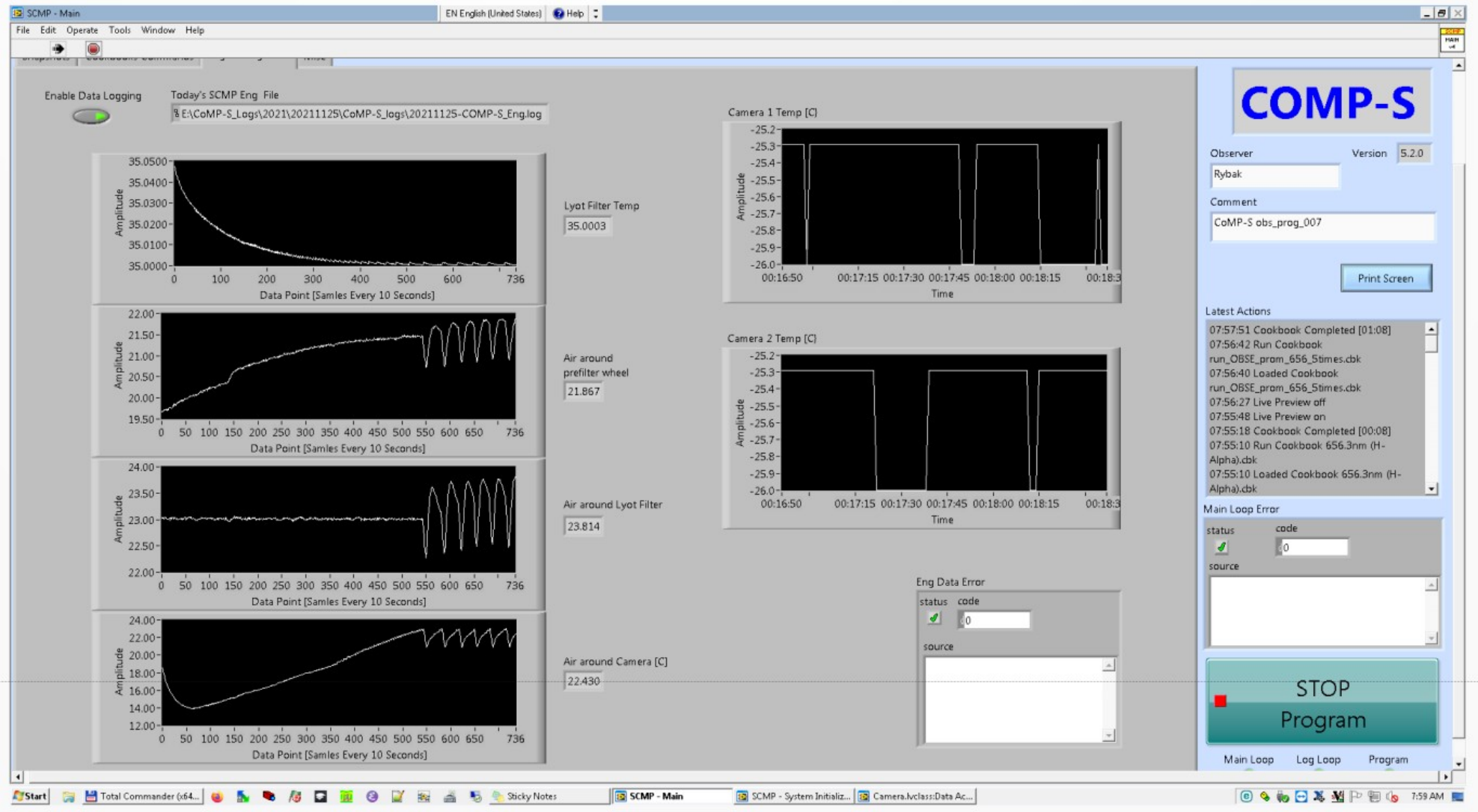
CoMP-S: operation

The screenshot displays the SCMP - Main software interface, which is used for operating the CoMP-S system. The interface is divided into several sections:

- Camera Images:** Two main image windows, "Camera T Image" and "Camera R Image", showing grayscale data. Below them is a "Camera T Image Zoom" window. Each image window has a vertical color scale on its right side, ranging from 0 to -215 or -209.
- Histograms:** Two histogram graphs, "Histogram Graph" and "Histogram Graph 2", showing the distribution of pixel values. The x-axis is "Pixel value" (0 to 250) and the y-axis is "count" (0 to 2M).
- Control Panels:**
 - Camera Settings:** Includes fields for "PI cam 1 (mm)", "PI cam 2 (mm)", and "PI cam 3 (mm)", along with "Exposure (s)" (20.0m), "Binning" (1x1), and buttons for "Snap Image" and "Live Preview".
 - Filter Wheels:** Includes "Andover Filter" (530.3nm/HWB 0.34nm (Fe XIV)), "Calibration Wheel" (Dark), and "Wavelength [nm]" (530.28).
 - Coronagraph+Instrument Setup:** Includes "focus/filter/PIs/tepx" (530.3nm (Fe XIV)) and a "Setup" button.
 - AISAS mechanisms:** Includes "In Beam" (Diffuser), "Focus" (127.00), and "Rotation [deg]" (145.0).
 - Occluder:** Includes a "Size" field (2R.R0) and a "Motor" control.
- System Information:** A panel on the right side displays "COMP-S" in large blue letters, the "Observer" (Rybak), "Version" (5.2.0), and a "Comment" (CoMP-S obs_prog_007). It also includes a "Print Screen" button and a "Latest Actions" list.
- Status and Error:** A "Main Loop Error" section shows "status" (green checkmark) and "code" (0). Below it is a "STOP Program" button.

The interface also features a menu bar (File, Edit, Operate, Tools, Window, Help) and a taskbar at the bottom with various system icons and the time 5:58 AM.

CoMP-S: operation



CoMP-S: operation

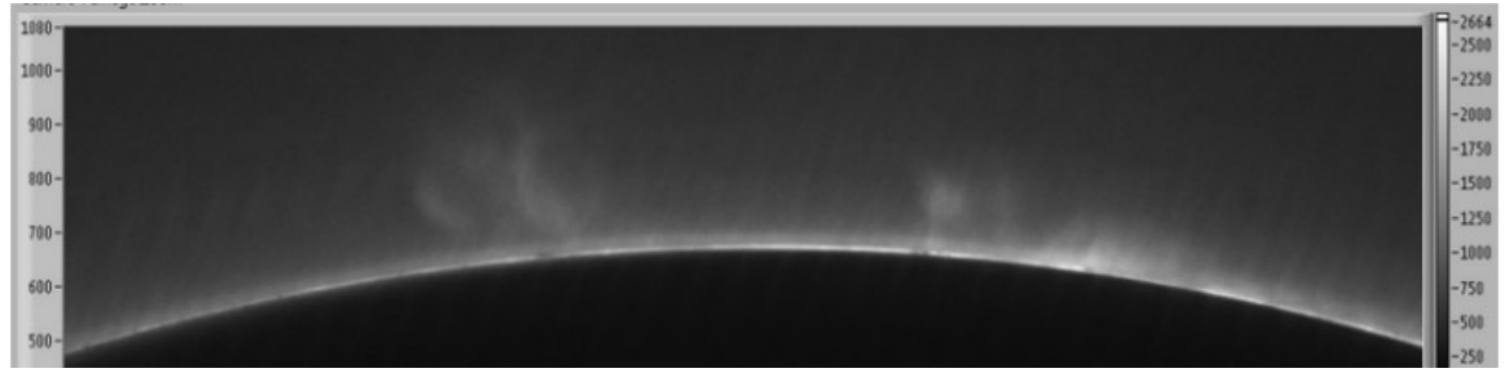
The screenshot displays the 'Camera.Ivclass:Data Acquisition - v8.vi' software interface. The window title bar includes 'EN English (United States)' and 'Help'. The menu bar contains 'File', 'Edit', 'Operate', 'Tools', 'Window', and 'Help'. The interface is divided into several sections:

- Triggered Acquisition Display:** Contains two main image windows: 'Camera T Image' and 'Camera R Image'. Both show grayscale images of a curved surface with a bright spot. The 'Camera T Image' has a vertical color scale from 0 to 1046. The 'Camera R Image' has a vertical color scale from 0 to 259. Below these is a 'Camera T Image Zoom' window showing a magnified view of the bright spot, with a vertical color scale from -1 to 1046. An 'Auto scale' checkbox is checked.
- Control Panel:** Located on the right side, it includes a 'Print Screen' button and various acquisition parameters:
 - Exposure (s): 5.00m
 - limit max FPS to: 49.0
 - Actual FPS: 37.8
 - Mod/Seq: Modulation
 - Cycles: 1
 - # Wavelengths: 9
 - # Images to acquire: 36
 - Actual Wavelength (nm): 656.23
 - Image No: 36
 - Image No 2: 36
 - # Images in queue: 20
 - # Images in queue 2: 19
 - Image Processing and Image 2 Processing progress bars (green).
 - Acquisition Estimate (s): 2.75
 - Image Acq (s) progress bar (blue).
 - Image Acq Started indicator (green circle).
- Output Paths:** Two text boxes for 'FITS Path Out' containing file paths:
 - FITS Path Out 1: %E\CO...\20211125\Isob_comp-s_0656_LM_20211125_080005_obse_C1_00005_145_lev0.0.fits
 - FITS Path Out 2: %E\CO...\20211125\Isob_comp-s_0656_LM_20211125_080005_obse_C2_00005_145_lev0.0.fits
- Error Handling:** Two 'error in' and 'error out' sections, each with 'status' (green checkmark), 'code' (0), and 'source' fields.
- Abort Button:** A large red button labeled 'ABORT'.

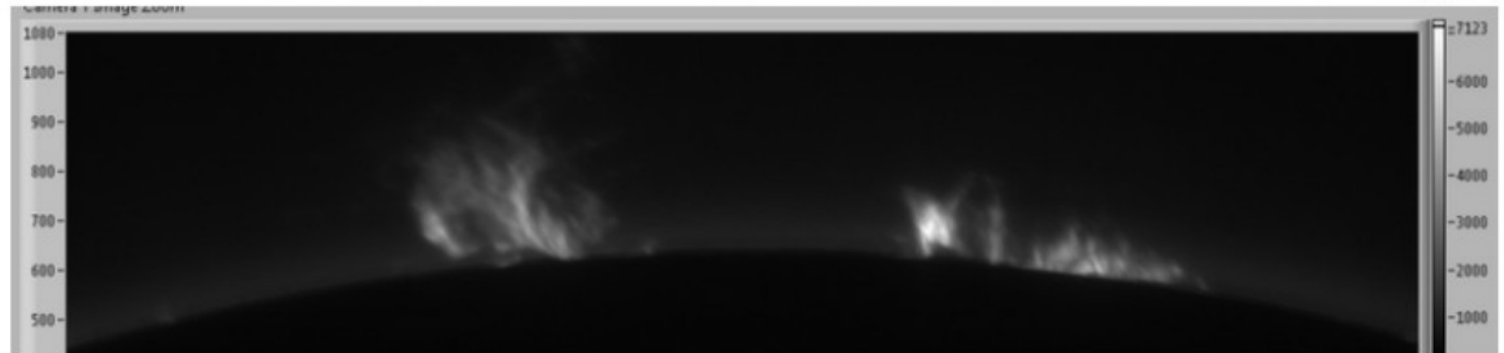
The Windows taskbar at the bottom shows the Start button, several open applications (Total Commander, Sticky Notes, SCMP - Main, SCMP - System Initializ..., Camera.Ivclass:Data A..., Camera.Ivclass:Run Co...), and the system tray with the time 8:00 AM.

CoMP-S: example frames

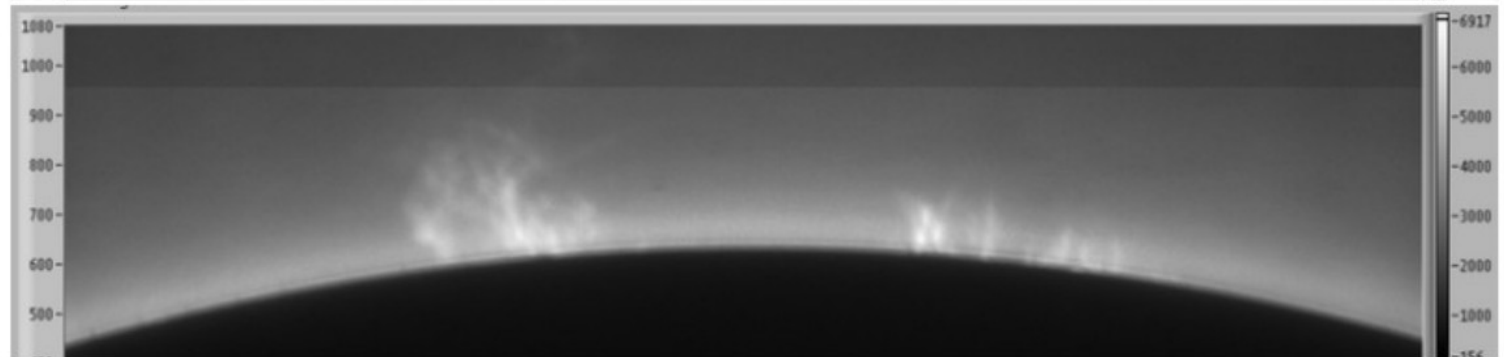
854 nm (100 ms)



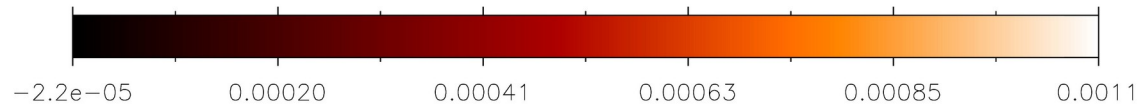
656 nm (50 ms)



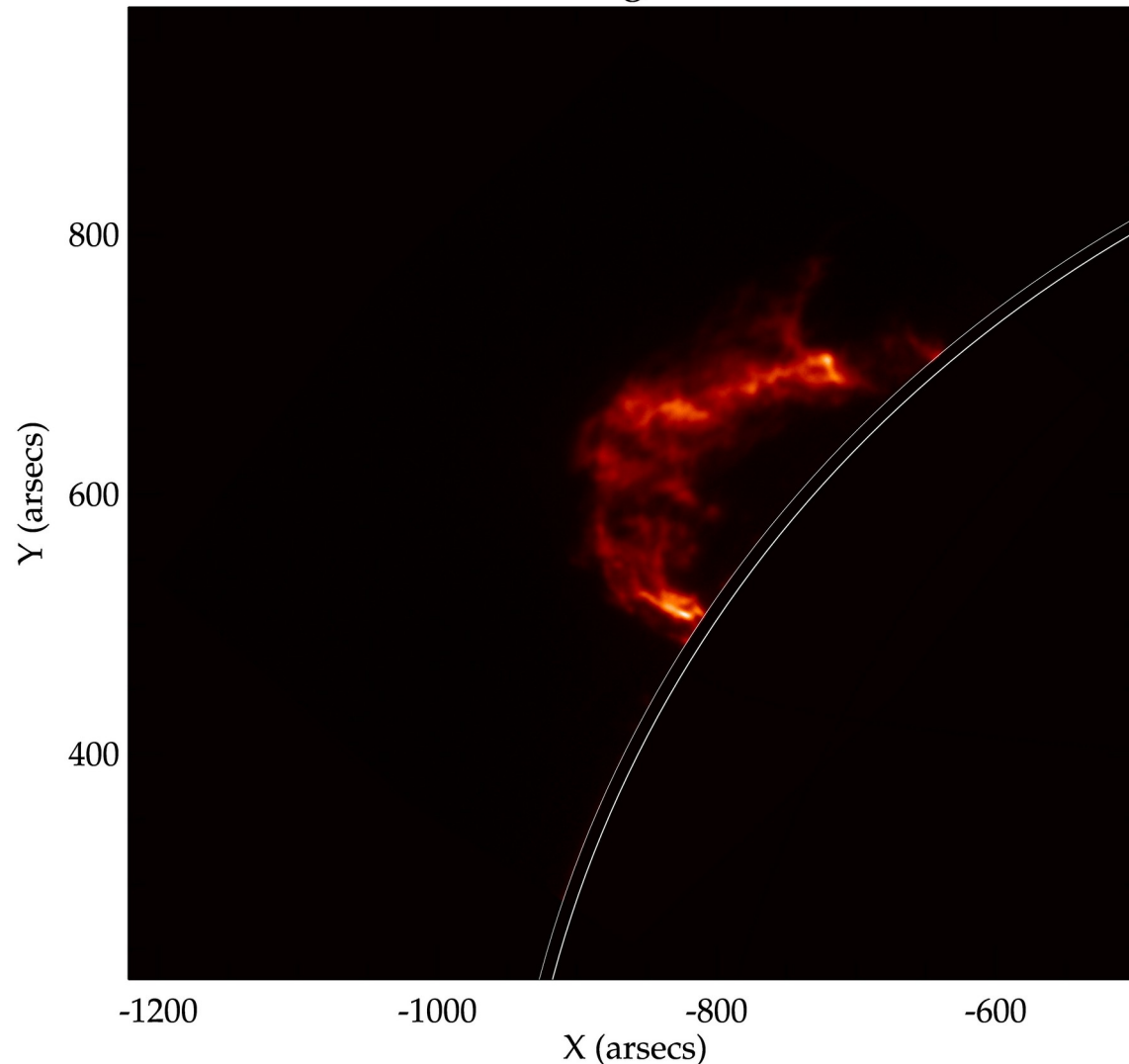
587 nm (500ms)



CoMP-S: example phot_red H alpha

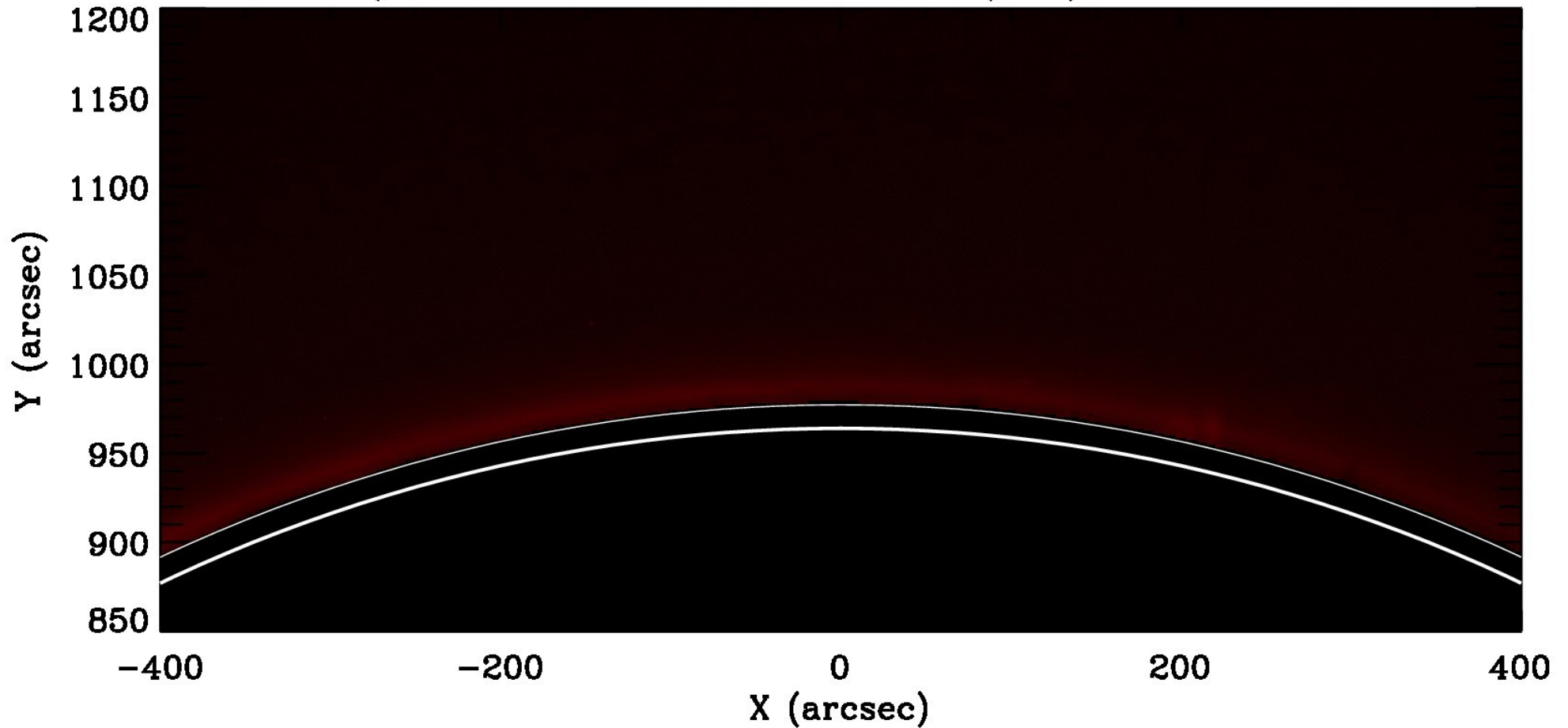


COMP-S/LSO: 4-Aug-2022 04:53:00.791 UT



CoMP-S: example H alpha scan

CoMP-S/LSO: H I 656.160 nm - 23/10/2012 06:20:57 UT



CoMP-S

- Observing programs:
 - old: H alpha tornadoes, Masses of proms
 - actual: He D3 in quiet/eruptive proms
 - future: 2023 open call
- Projects under development/improvements: CoMP-S instrument, SCD instrument, pointing system, LSO pipeline
- New projects for time to come: LSO → VSO, SLED instrument, dome motion, dome a la „THEMIS“, ...



LSO group and work

LSO group and work

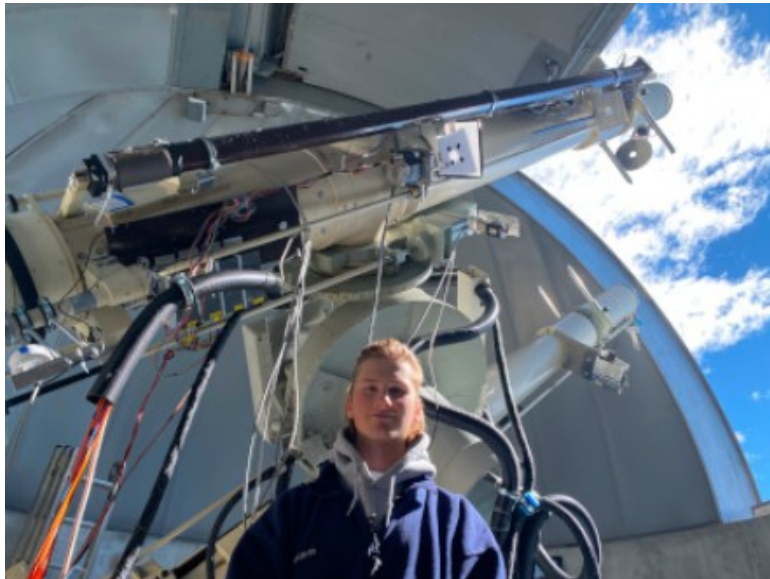
- LSO group:
 - handyman
 - observing assistants: 2 astronomers and 2 engineers
 - support from the headquarters: workshop, sys admin
- LSO duty shifts (~8 days):
 - cablecar transportation including all your things
 - cooking
 - observing or testing of instrumentation
 - own instrumental or scientific projects
 - day and night security officer as well
 - person on duty



LSO for students

LSO (summer or autumn) internships

- Student interested in a stay at the LSO to learn more about the g-b coronagraphic observations are welcome! Just send an email...
- Conditions: stay at the LSO is free of charge, travel including the cable car ticket and foodstuff is up to you.
- Small groups are preferred



2022 student Mark Morris @ LSO

In fine



The LSO group thank you for your attention