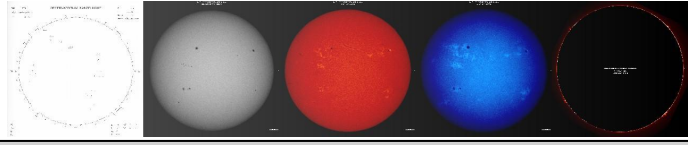


Solar Observations with the telescopes in Belogradchik observatory and at St. Georges International School

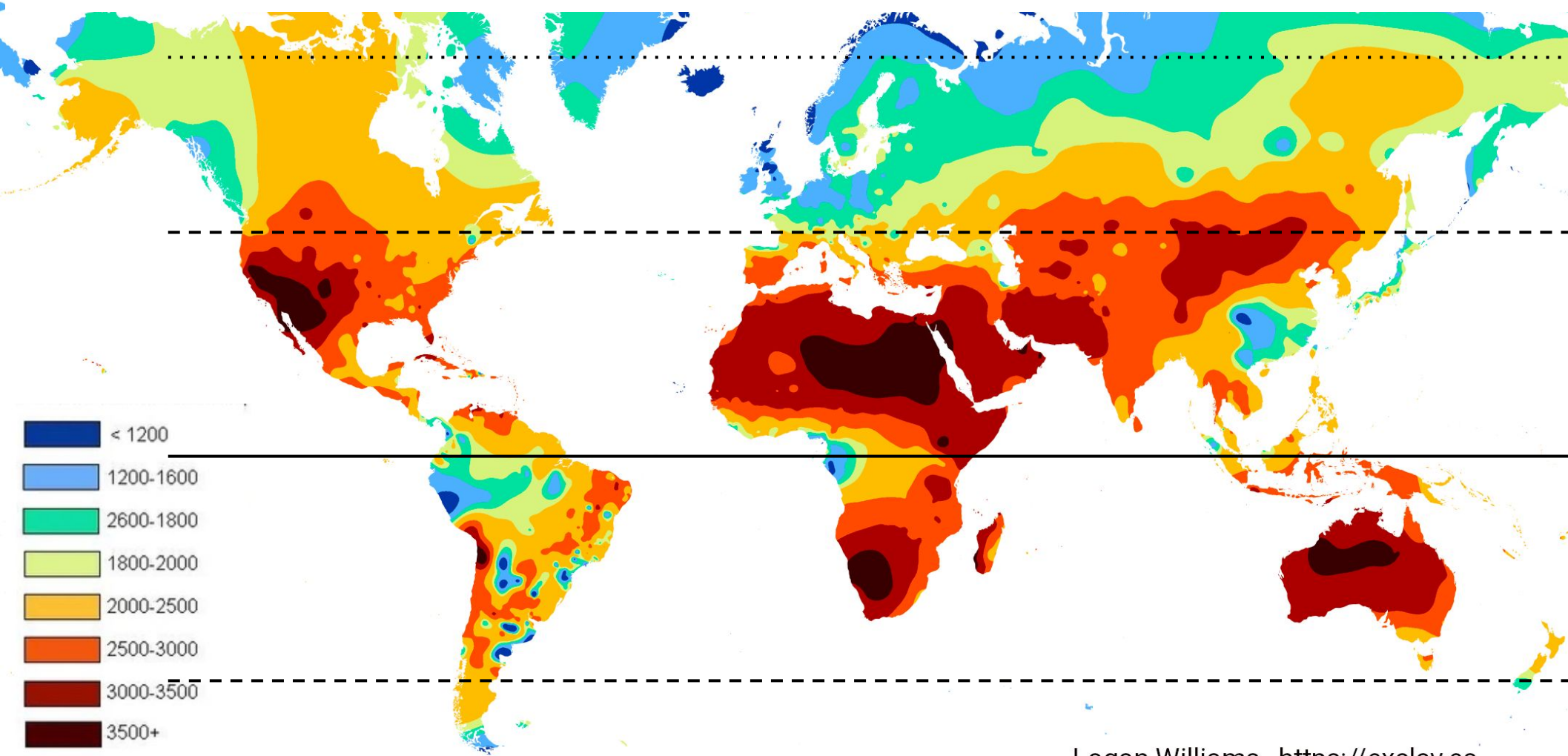
Pötzi W., Markishki P., Miteva R., Dechev M., Latev G., Kozarev K.

BNSF KP-06-Austria/5 (14-08-2023) and OeAD BG 04/2023

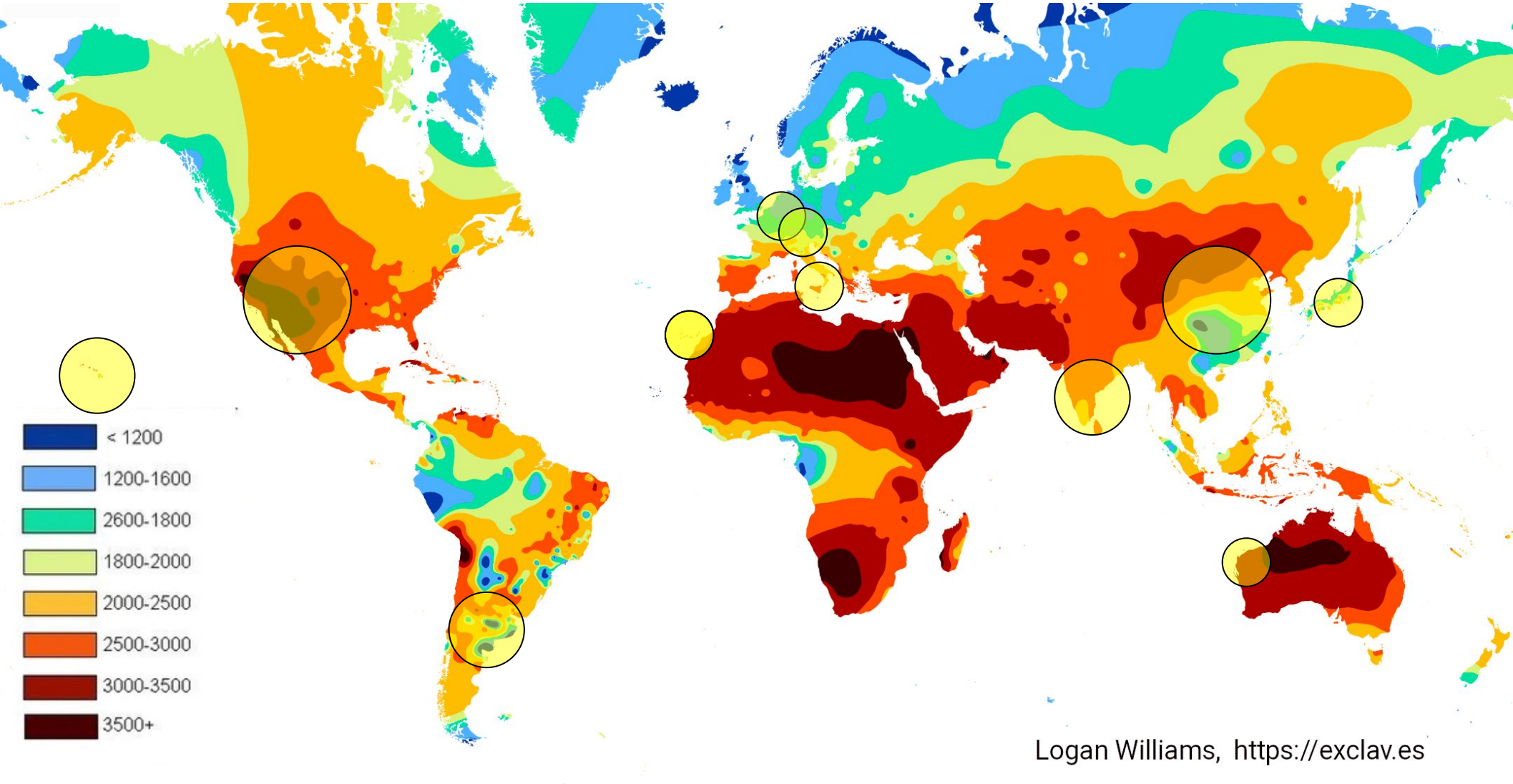
Why solar observations in Bulgaria

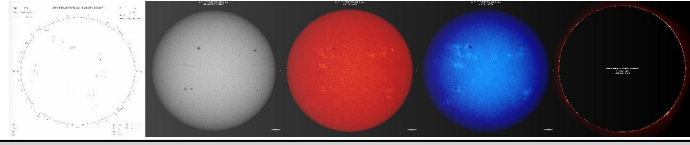
- There is a long tradition in astronomy (1952 founding of Astronomical Department at BAS).
- There exist facilities for astronomical observations.
- There is expertise in solar physics in Bulgaria.
- There is a observational gap between UT-1 and UT-6 hours.

Annual Sunshine Duration



Where are the observatories?





Telescope?

- **Рожен** Probably best location – but telescope and dome need larger upgrades, there are other plans and aims for this telescope.
- **Белоградчик** Limited staff available, telescope partially installed, filter and camera are there.
- **София** Not the best location – but near the institute, staff is available, a telescope is there.

St. George PSP Observatory

Guiding telescope:

- Refractor Celestron Omni XLT 120, D = 120 mm, f = 1000 mm, focal ratio: f/8.3
- Camera: Atik Horizon Color CMOS Panasonic MN34230, chip size: 17.6 x 13.3 mm (22 mm diagonal), pixel size: 3.8 µm, pixel area: 4644 x 3506
- Filter: various metallized filters, glass and special film, for example AstroSolar Photo Film OD 5 from Baader

AO-Belogradchik

Telescope:

- Celestron C11
- D = 279 mm, focal ratio: f/10
- Schmid-Cassegrain

Camera:

- JAI-GOX
- 4112x3008 px @ 12bit

Filter:

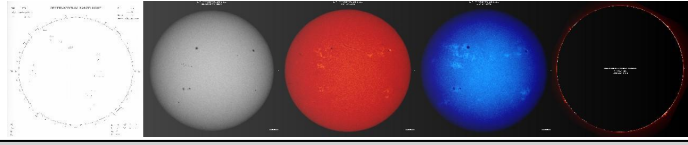
- Daystar H-alpha

Test observations in Belogradchik

focal ratio = 1/10

For H-alpha filter 1/30 is necessary ⇒

1) enlarge focal length
2) reduce aperture



Enlarge focal length

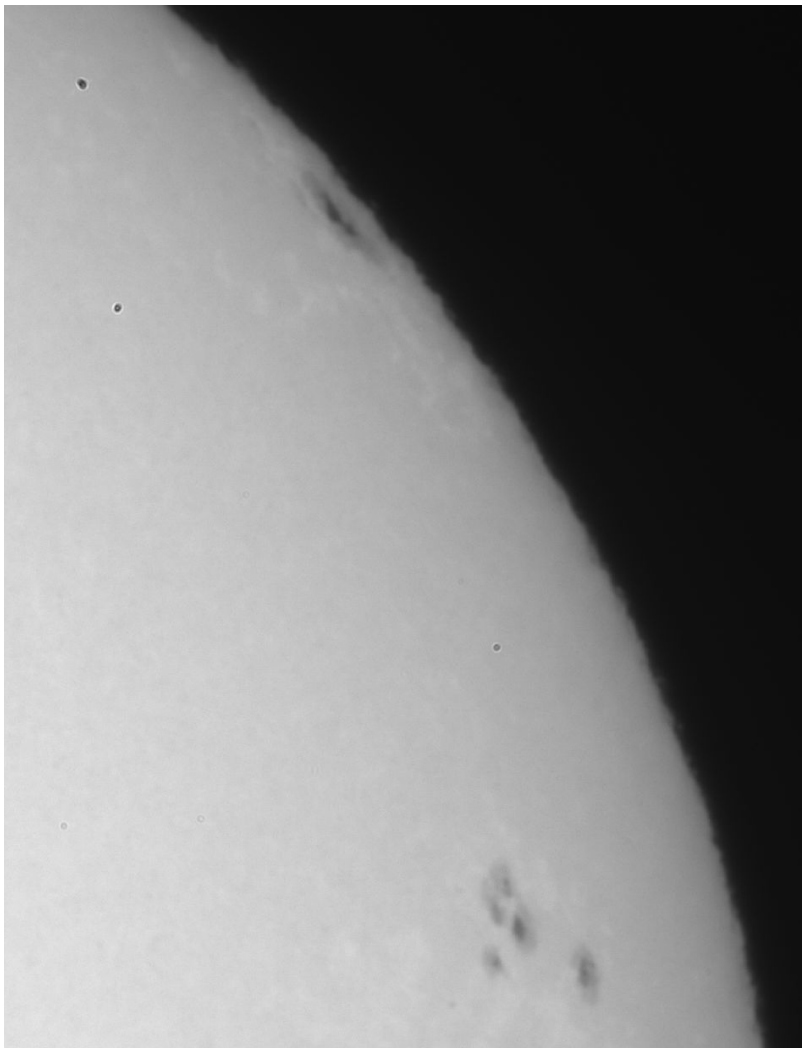
focal length enlargement by telecentric system leads to a very large solar image in focus:

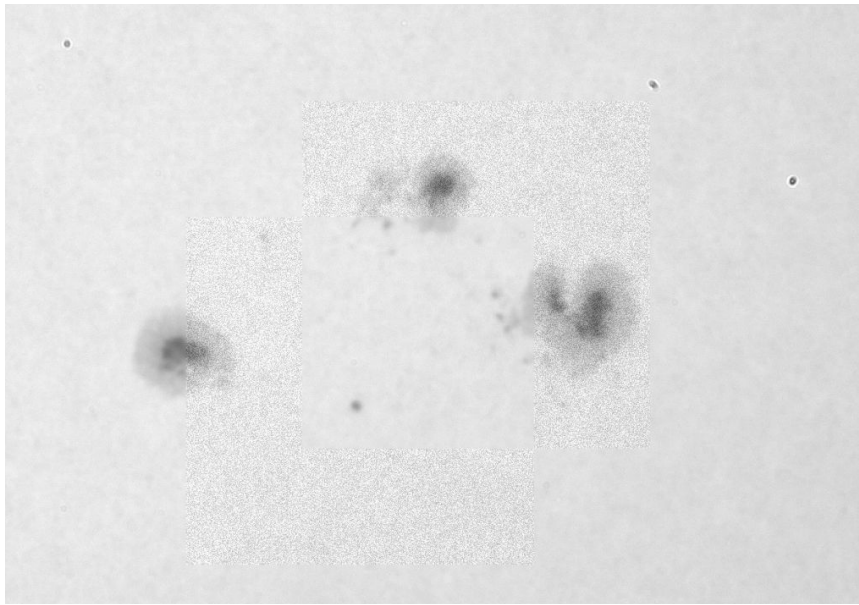
1) focal length of 2800mm results in 26mm solar image
2) camera sizes are much smaller (5 to 10 mm)
3) only small part of Sun visible
4) high resolution leads to high noise level due to seeing
5) guiding more difficult
6) position on Sun not very clear
7) filter directly before camera – heat has to be removed at front side of telescope – large filter size!

Reduce Aperture

1) less heat
2) less light – camera exposure time still very short
3) cheaper optical components
4) resolution still large enough for seeing conditions

First tests in Белоградчик White-light

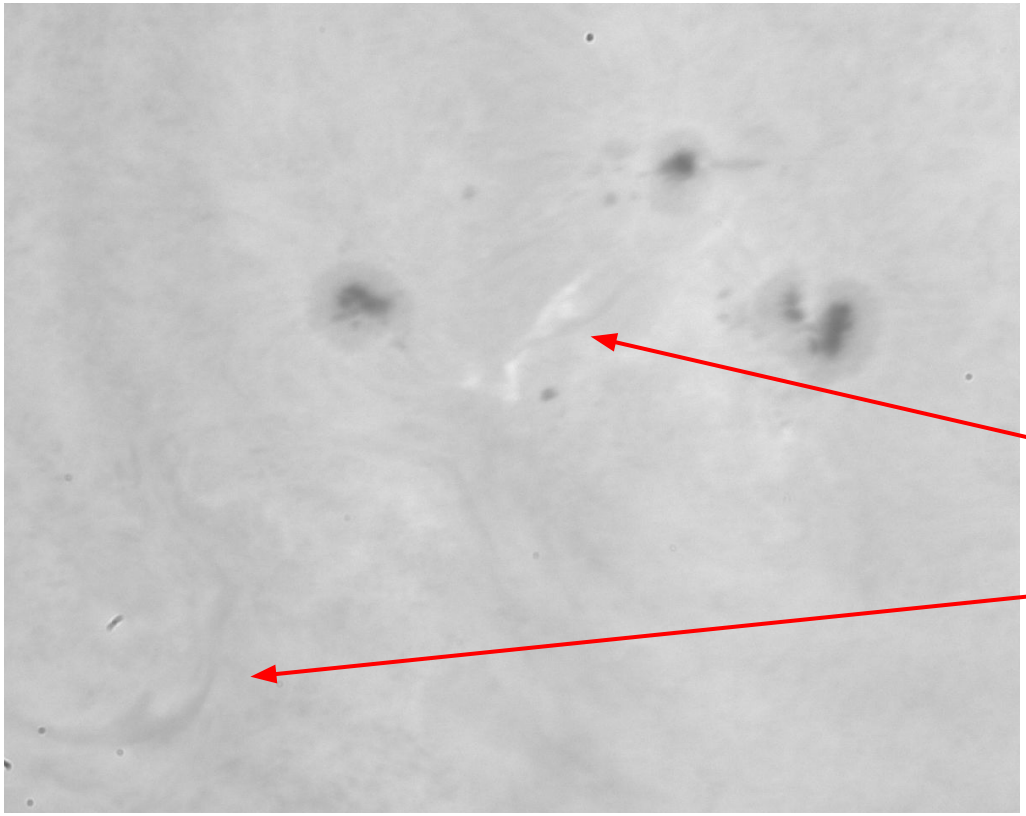




resolution is sufficient to resolve details

seeing conditions were bad (wiggly limb), but umbra and penumbra well separated

First tests in Белоградчик H-alpha



filter not in center of line (temperature to low/high) therefore contrast is low

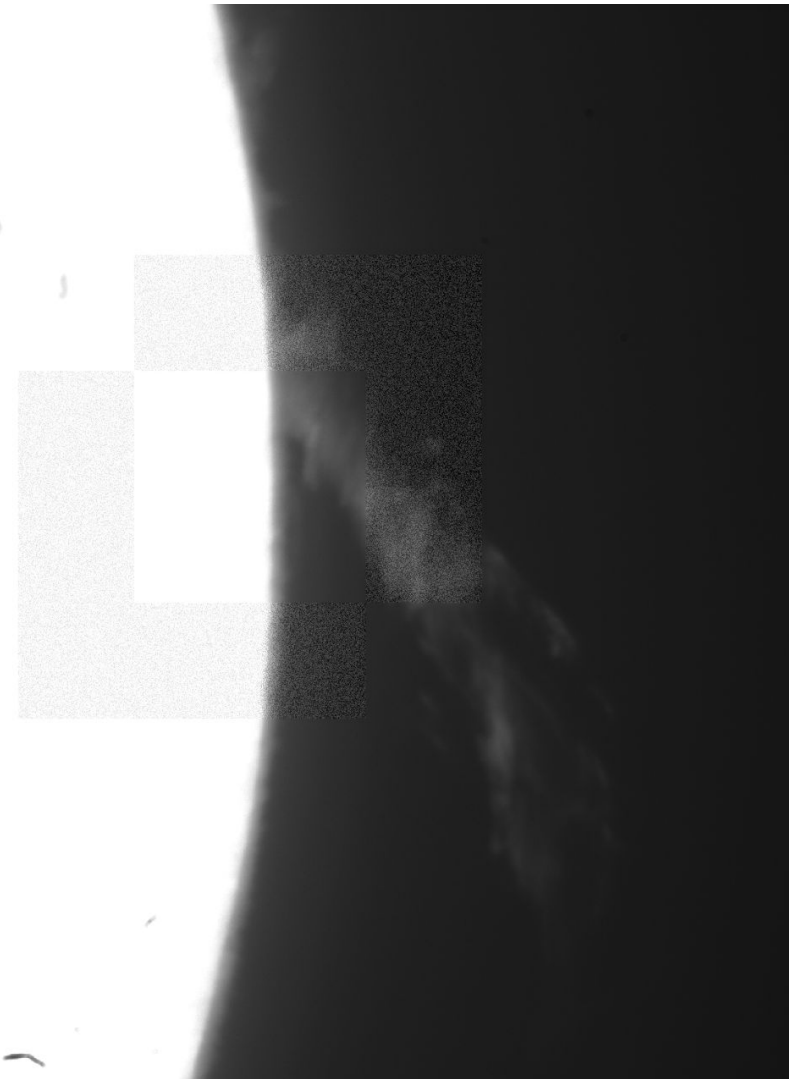
but:

small flare is visible

filament is visible

chromospheric network is visible

First tests in Белоградчик H-alpha Prominences



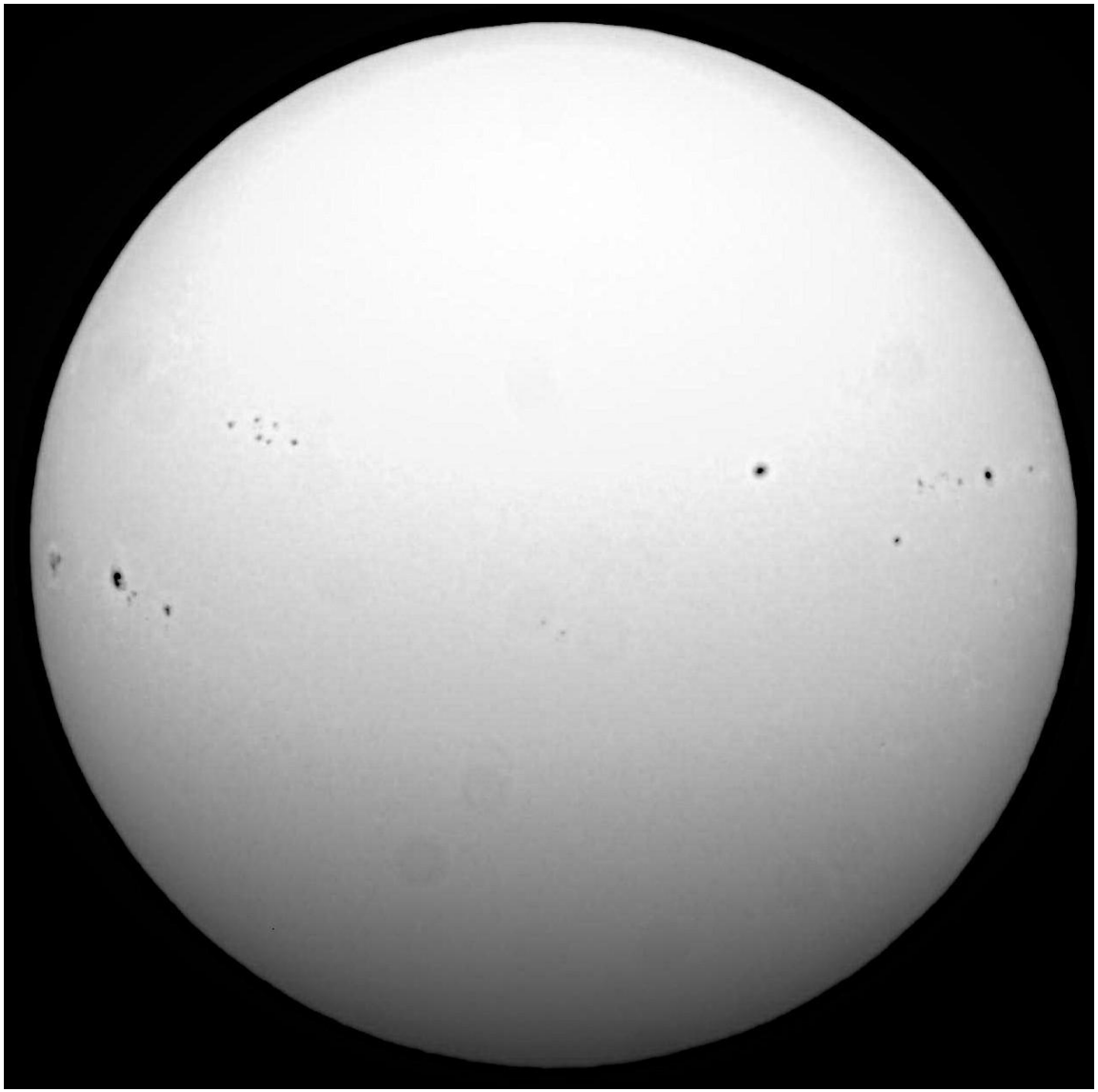
overexposed image shows prominence at limb

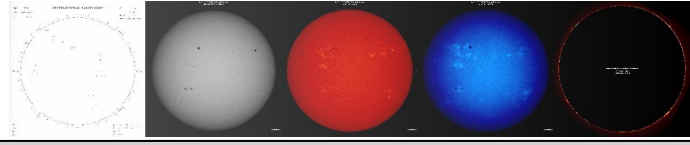
structures are visible

relatively good contrast

Tests in St. George PS June 2025

- Not the best observation conditions
- Photosphere can be observed well
- Could also be suited for Chromosphere – adapter for filter is necessary

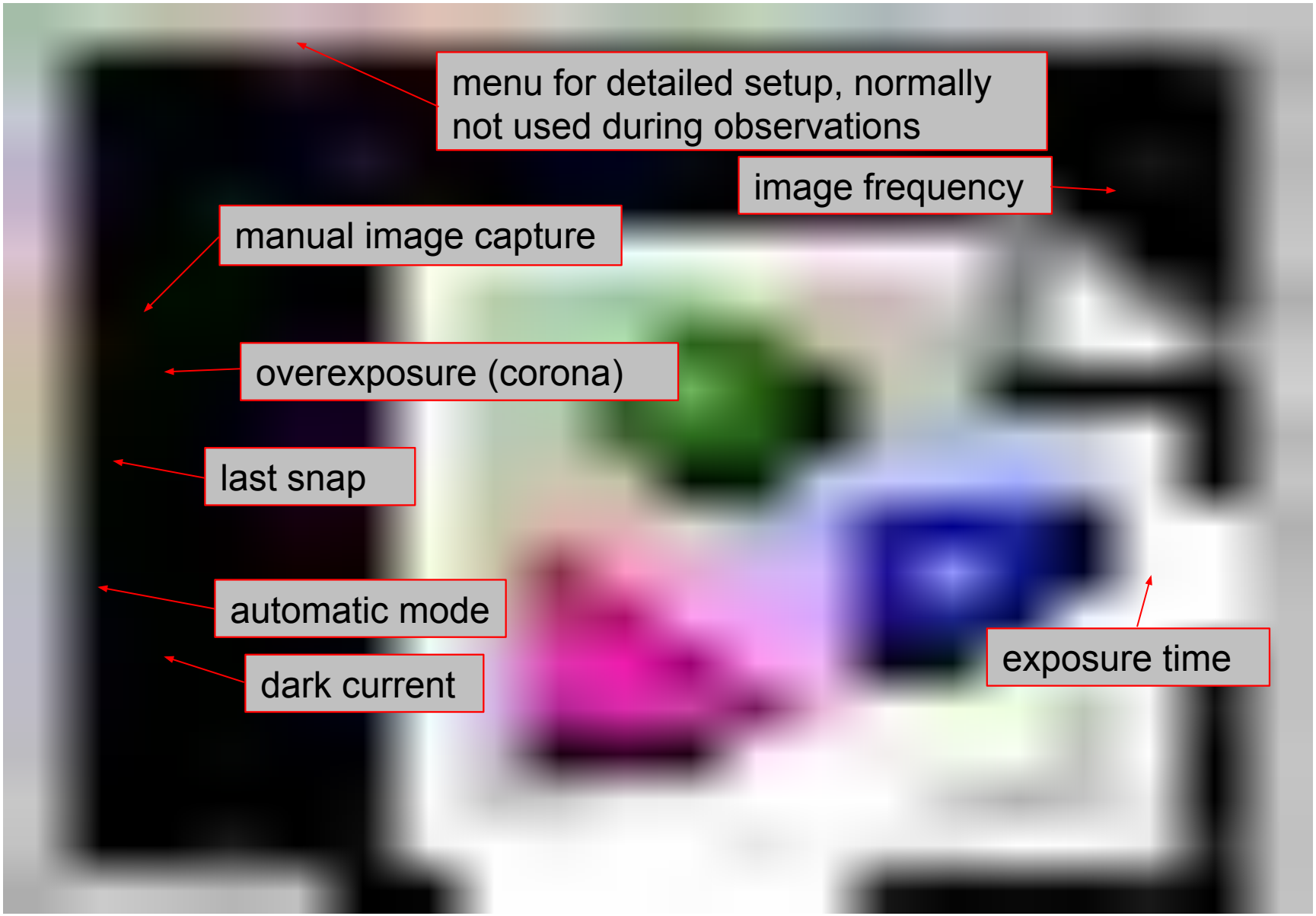




Белоградчик in May 2025

- Installation of observing software → failed due to new camera parameters, that were not known in advance – in the meantime the software is updated and should work
- Observe the Sun through H-alpha filter – luckily a flare occured and was captured!

Software interface to camera



acquisition – User I/F

AOI- Area of Intensity

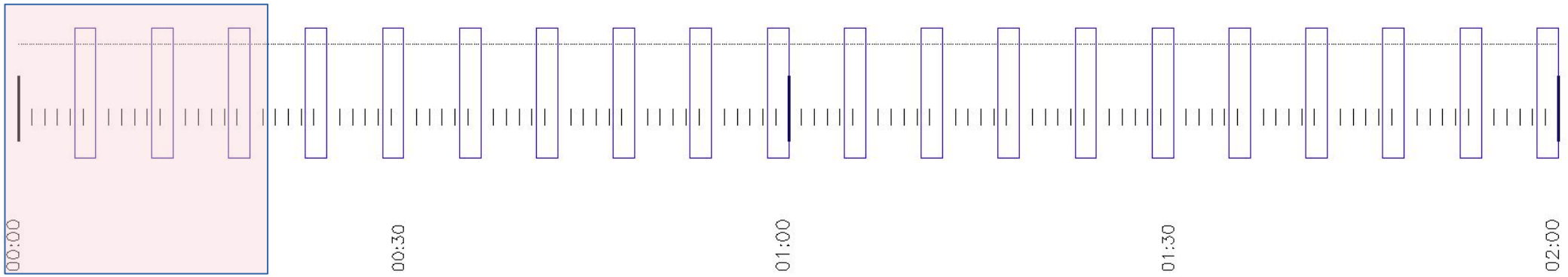
controls exposure time and frame-selection

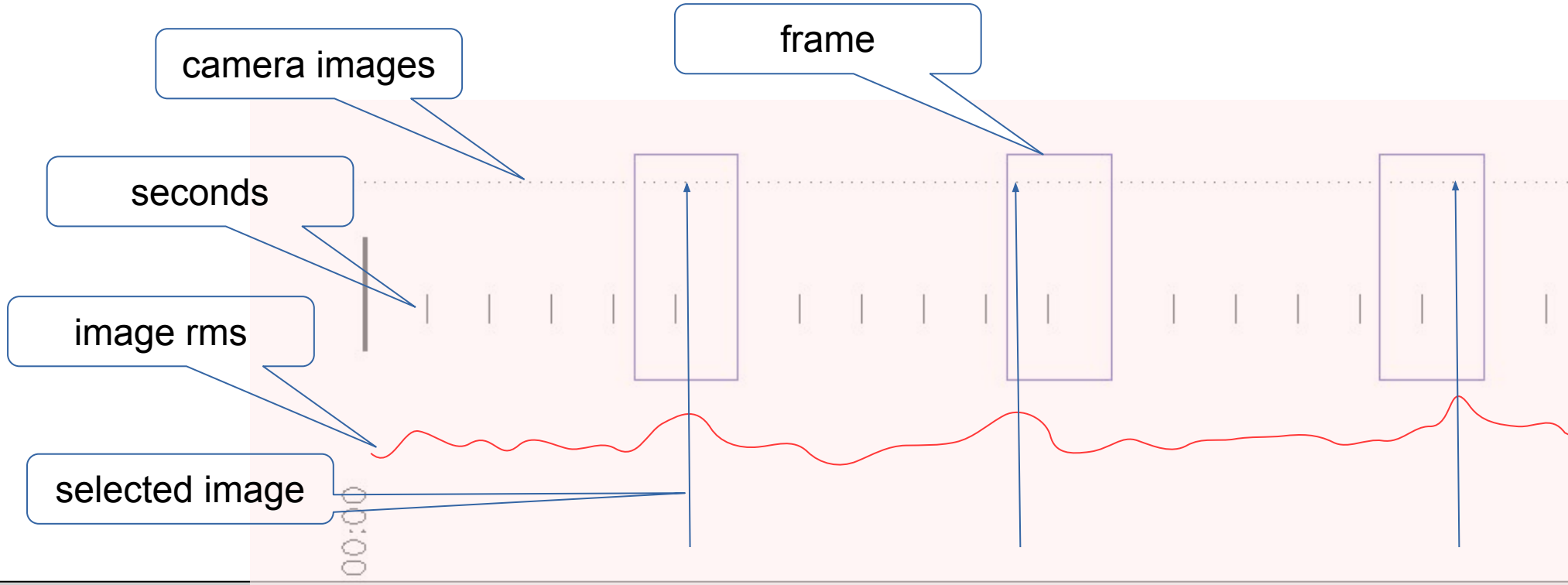
Exposure time: The mean intensity within the AOI is kept at a constant level (e.g. 600 counts)

In H-alpha flares can be very bright (up to 8 times above quiet Sun level!)

Frame selection: Not the image at the defined time is used, from a number of images (typically 10) directly before this time the one with the highest rms within the AOI is selected as the best image. This overcomes fast atmospheric turbulences.

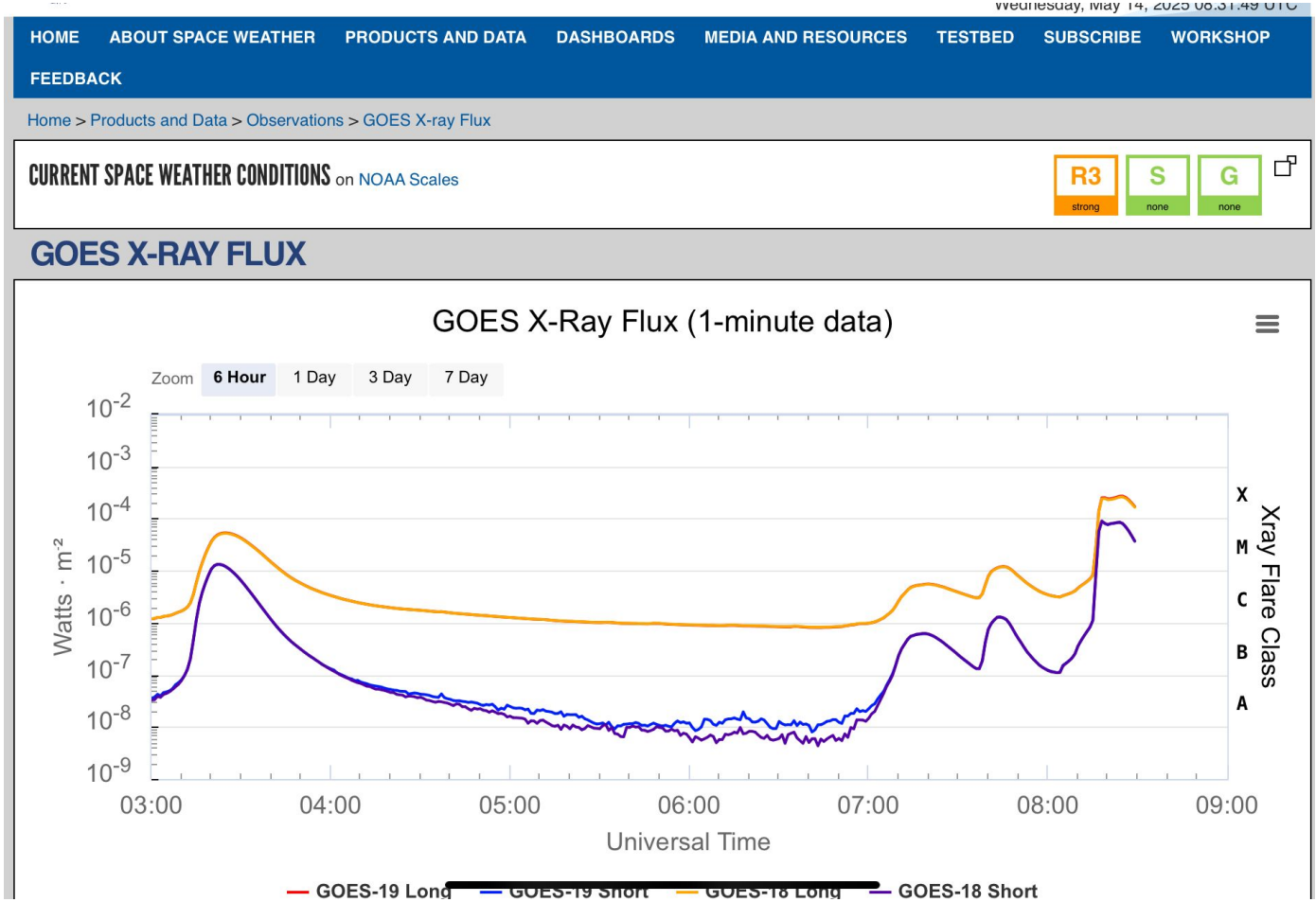
frame selection





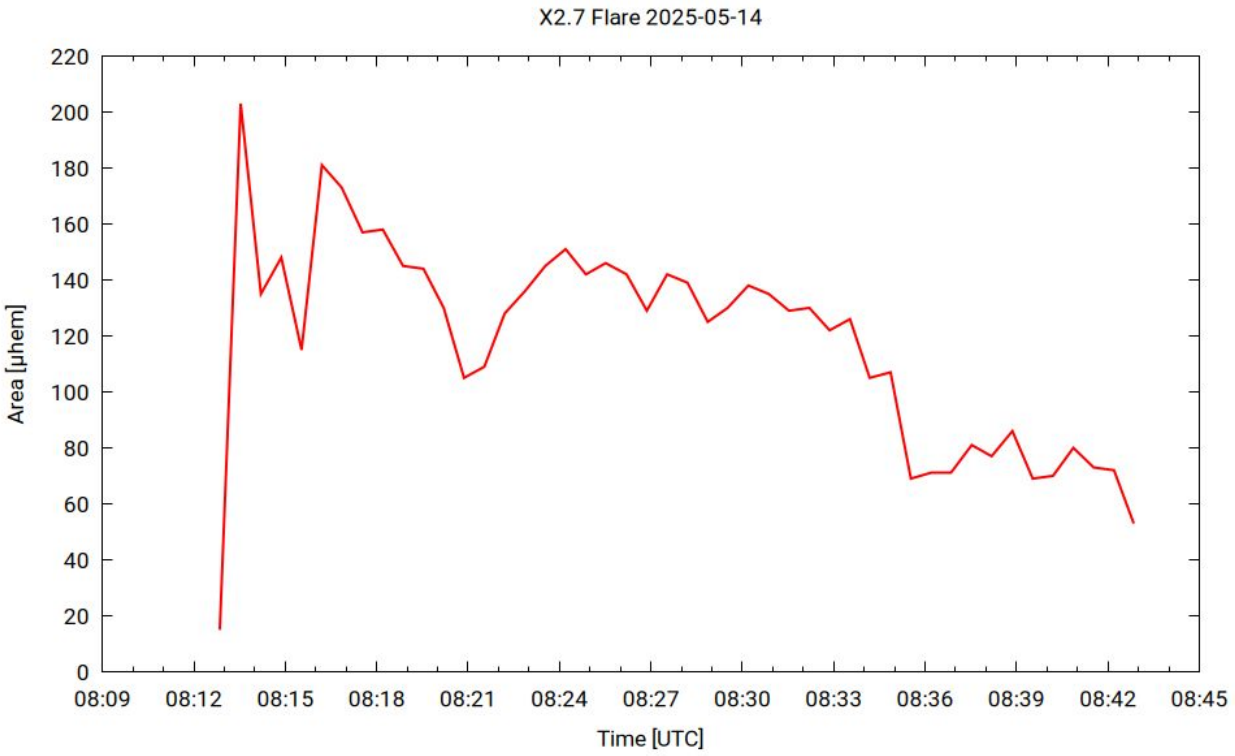
Flare observation May 2025

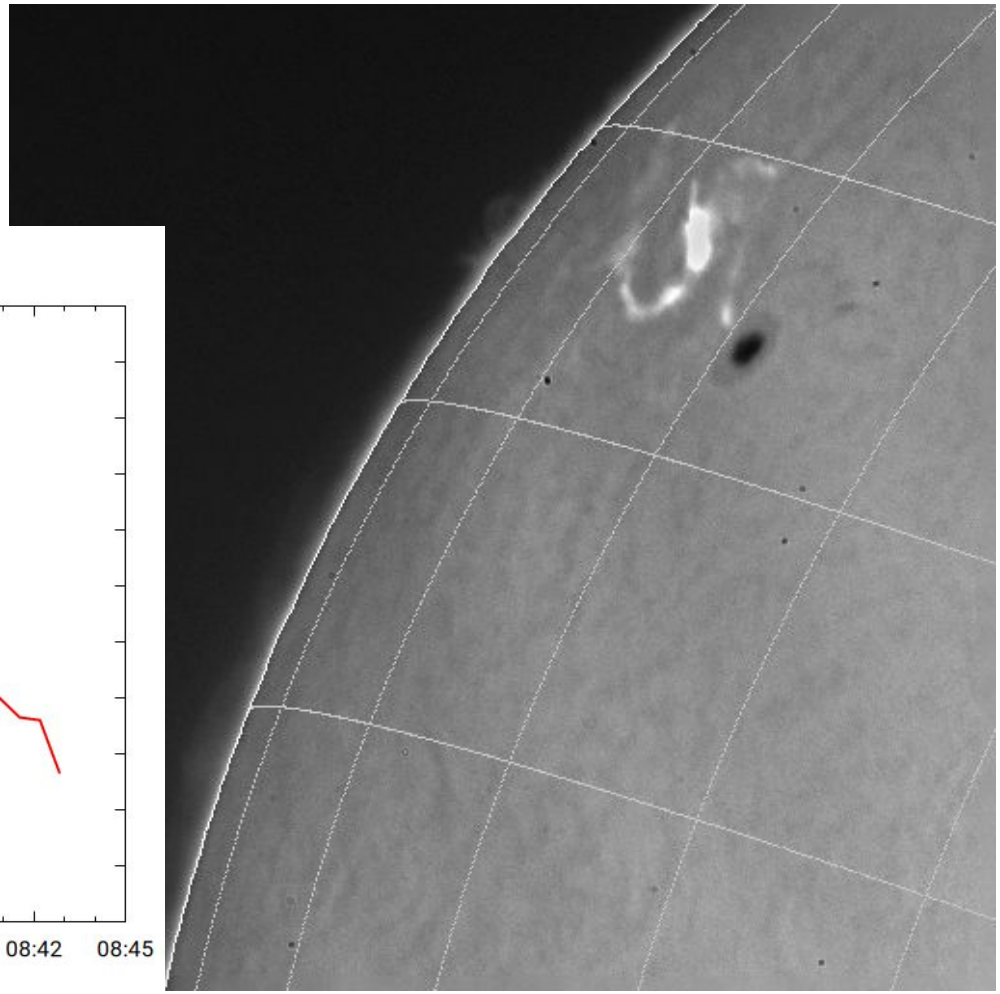
X-ray: X2.7 Flare
optical:
Importance-1B



Flare observation May 2025

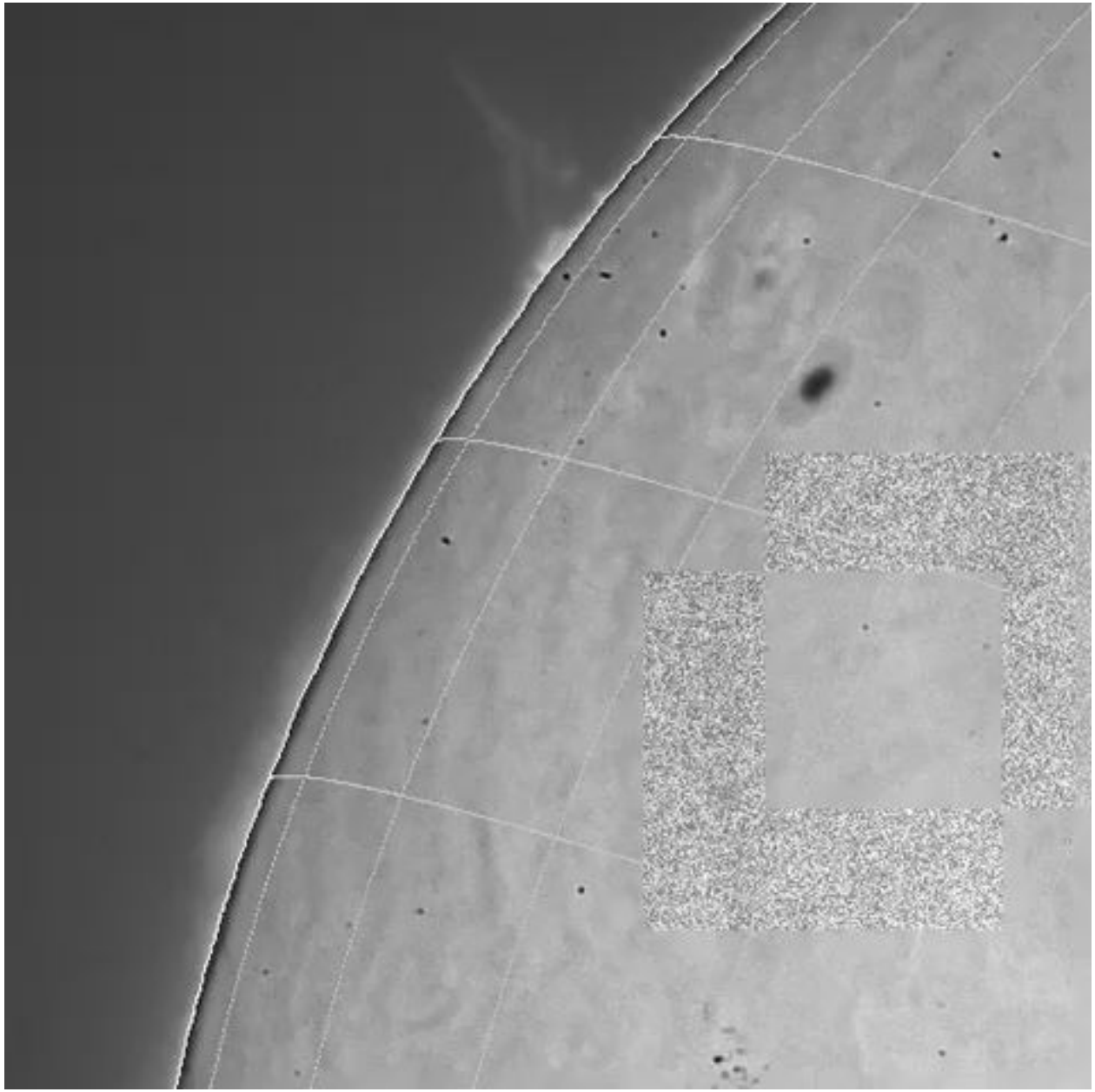
X-ray: X2.7 Flare
optical: Importance-1B

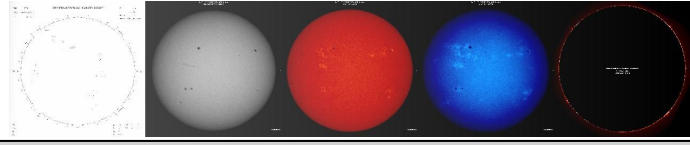




Flare observation May 2025

Publication:
H-alpha Imaging of Solar Phenomena Using a Modified Schmidt-Cassegrain Telescope at Astronomical Observatory – Belogradchik
Markishki, P.; Dechev, M.; Pötzi, W.
Bulgarian Astronomical Journal, 43, p.89





What can Bulgaria contribute to the community?

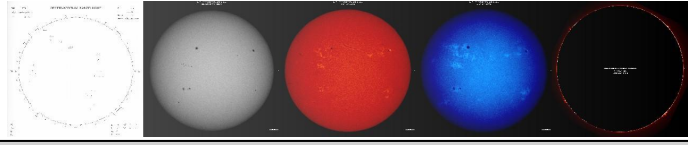
Two main possibilities:

1) **Do what all the others do:**
   Patrol observations of Chromosphere and Photosphere
   Just serve as an additional station to overcome gaps due to weather situation and day/night cycle.

2) **Don’t do what all the others do:**
   Focus on event observations, i.e. high resolution and maybe high cadence observations of solar flares in H-alpha or Whitelight.

Patrol observations

- Observations should be done as often as possible → staff problem!
- Complete data pipeline has to be established.
- Only with smaller telescope.
- Almost real-time processing shall be done!
- Programs, scripts are available and not everything has to be ‚invented again'.

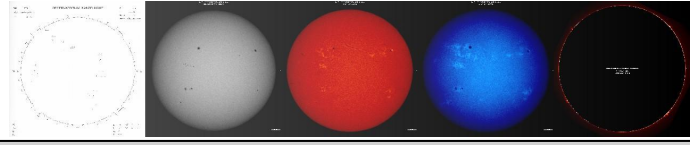


Event observations

- Mostly during high solar activity.
- The existing telescope can be used for high resolution observations.
- Data can be processed later.
- Forecast of events is unsure but sometimes very reliable (in case of very active regions)
- In combination with satellite data (magnetic field) the observations gain in value and shall be very suited for investigating solar events.

ToDo's

- Instrument improvement
- Campaign observations
- Coordinated monitoring program: semi-automatic routines
- Database: upload, storage and search options



Acknowledgements

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