

The Austrian - Bulgarian cooperation project for solar observations

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Dechev, M., Kozarev, K.

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

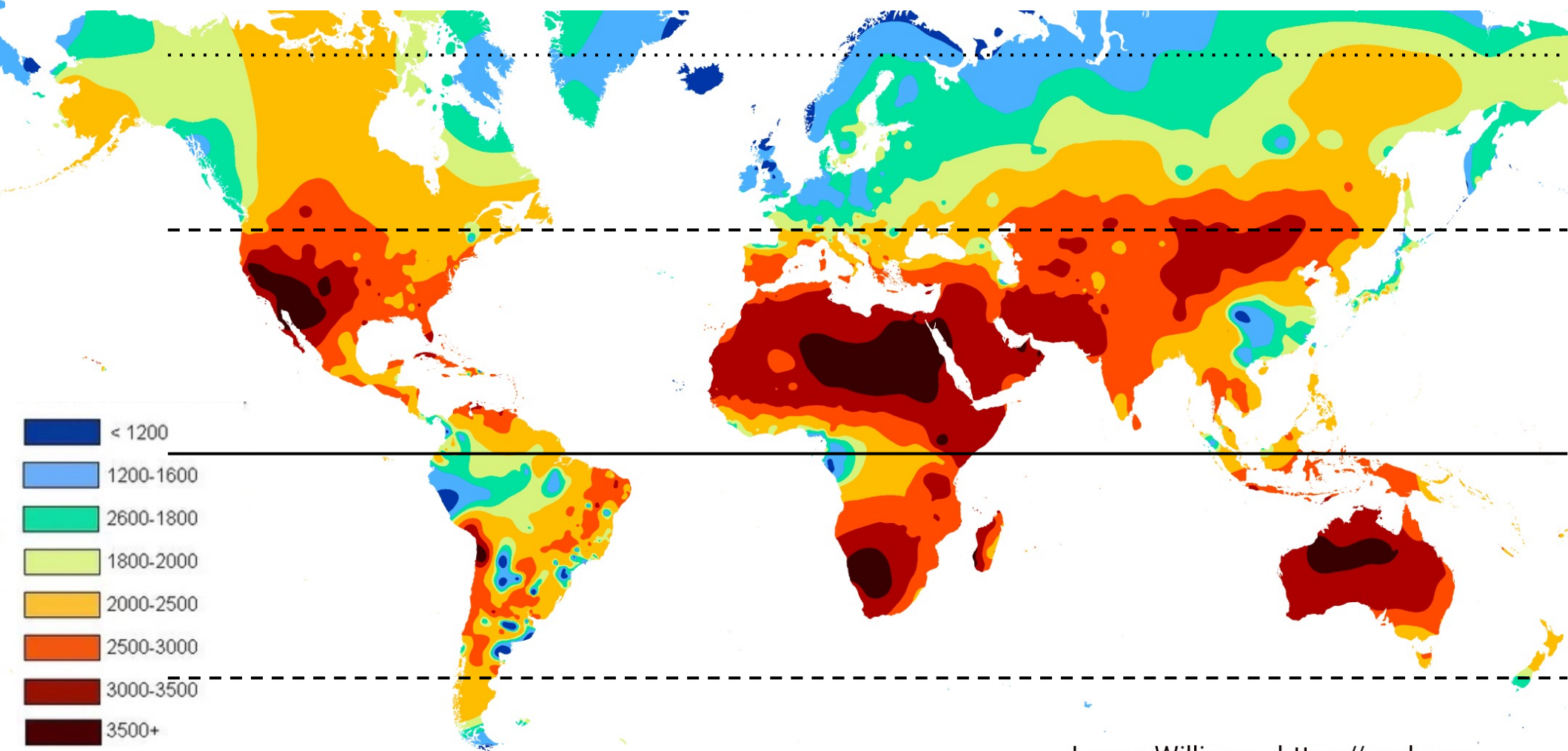
Workpackages and Tasks

- WP1 - Technical support of NAO Rozhen Chromosphere Telescope (RCT) and observation campaigns with KSO facilities
 - Telescope installation
 - Data processing
 - Observation Campaign
 - Image enhancement
- WP2 - Joint investigations of solar chromospheric and coronal activity → Rositsa Miteva
- WP3: Dissemination of the project results→ Rositsa Miteva

Why solar observations in Bulgaria

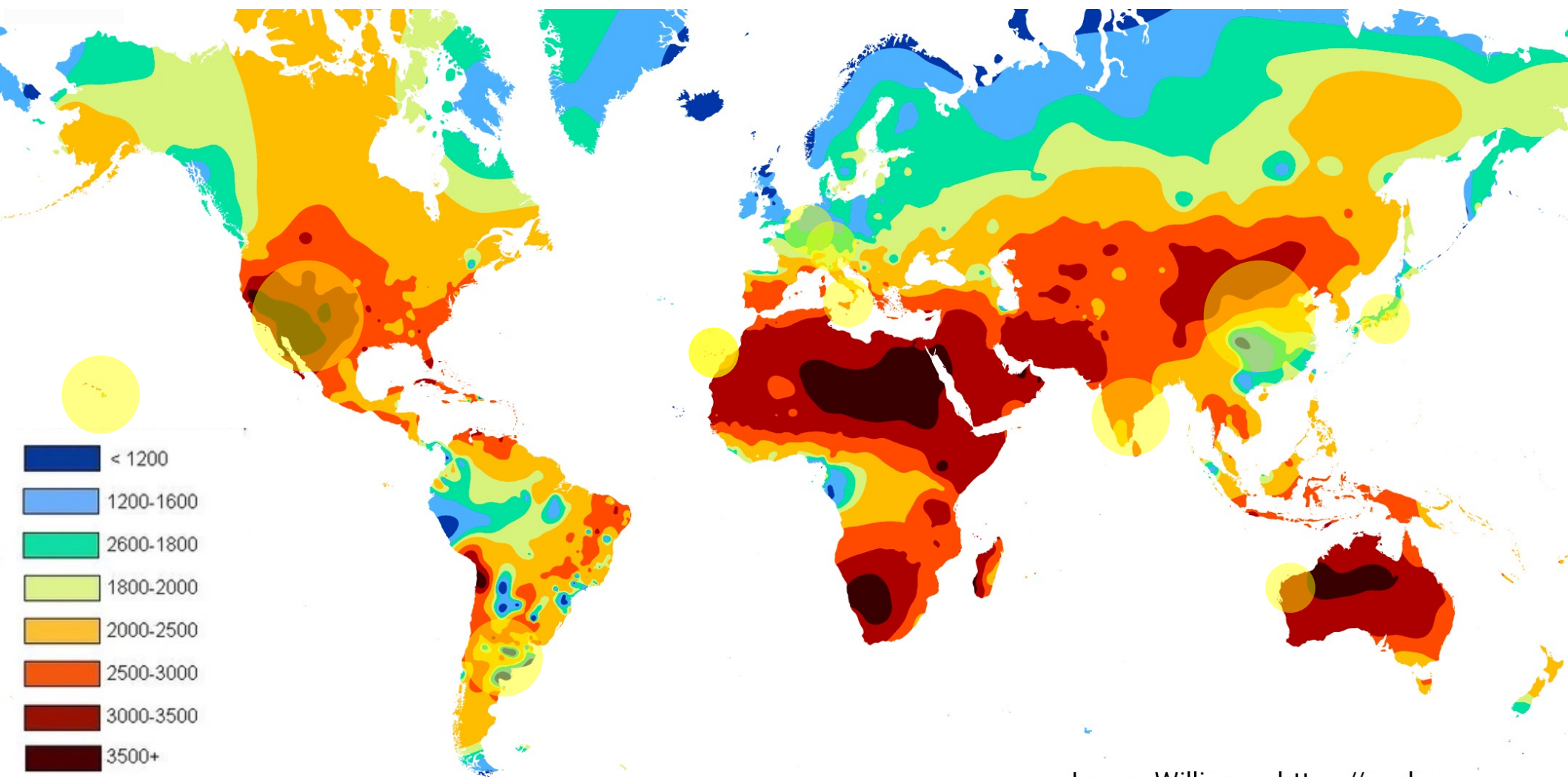
- There is a long tradition in astronomy (1952 founding of Astronomical Department at BAS).
- There exist facilities for astronomical observations: Рожен, Белоградчик
- There is expertise in solar physics in Bulgaria.
- There is a observational gap between UT-1 and UT-6 hours.

Annual Sunshine Duration



Logan Williams, <https://exclav.es>

Where are the observatories?

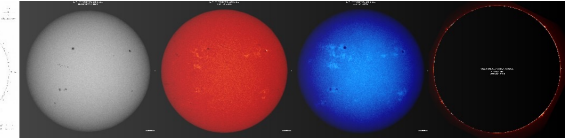
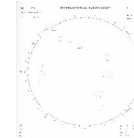


Logan Williams, <https://exclav.es>

Telescope?

Three places for a telescope:

- **Рожен** Telescope and dome need larger upgrades, there are other plans and aims for this telescope.
- **Белоградчик** Staff available, telescope has to be installed, filter was delivered a few days ago.
- **София** Not the best location, near the institute, staff is available, a functioning telescope is there.



Рожен



Белоградчик

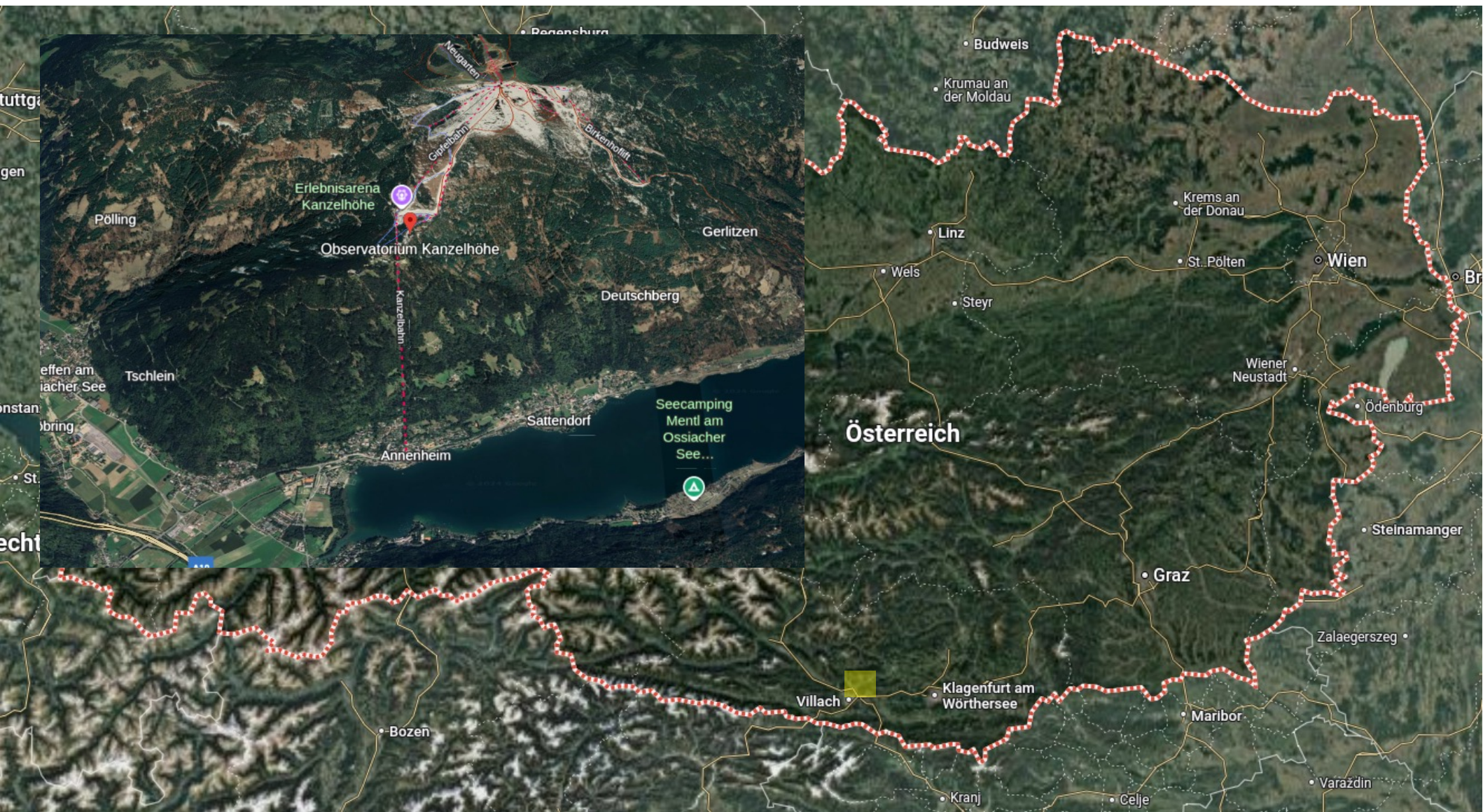


What can be done?

e.g. Observatory Kanzelhöhe in Austria

- long tradition (since 1944)
- small telescopes ($F/L \sim 2000/100\text{mm}$)
- chromosphere/photosphere
- 4 people
- 365(6) days per year

Location



Instruments

1) H-alpha:

F/L = 2000/82mm

Lyot Filter: 0.4\AA @ 6562.8\AA

2) White-Light:

F/L = 2000/120mm

Filter: 100\AA @ 5450\AA

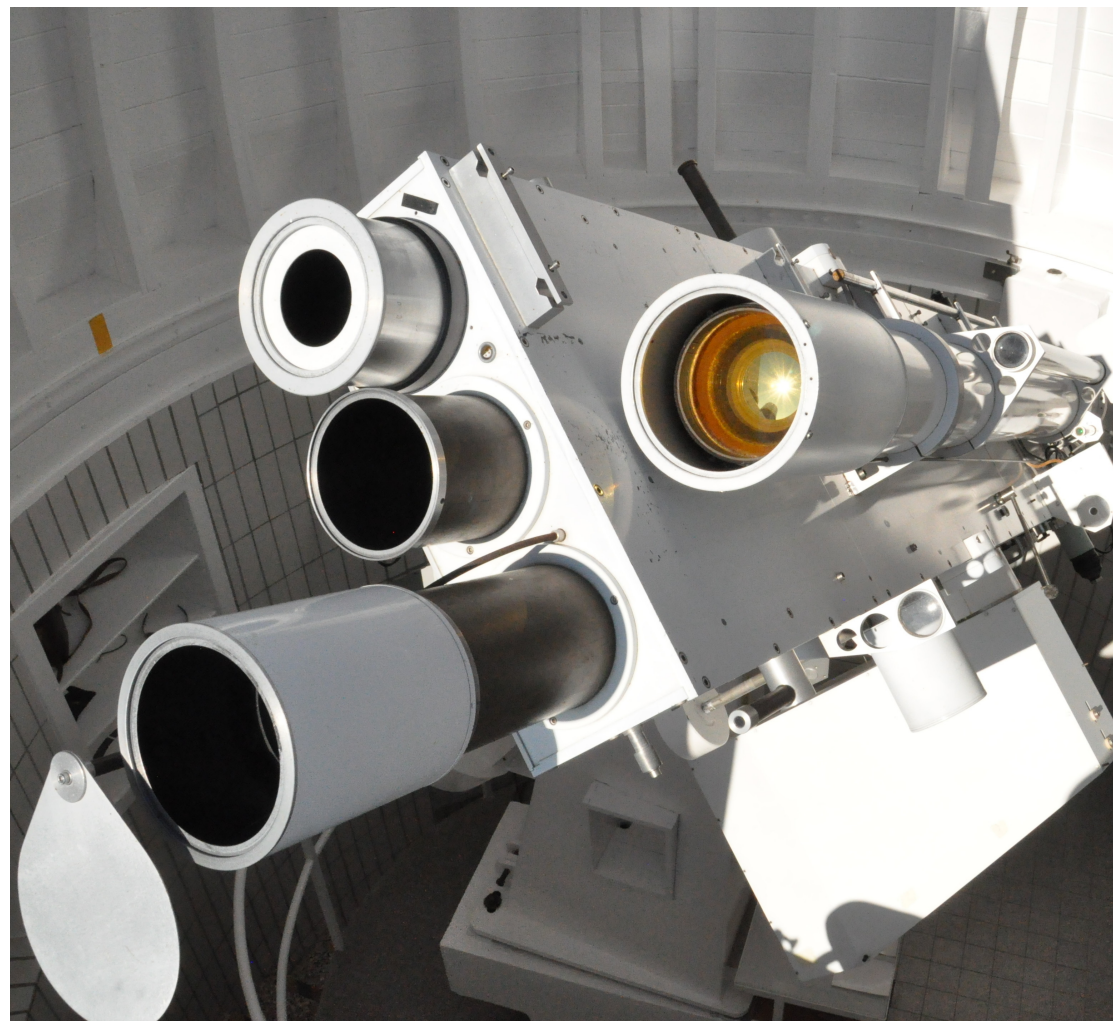
3) Ca II K:

F/L = 1650/70mm

Lunt Filter: 3\AA @ 3933.7\AA

10 images/min

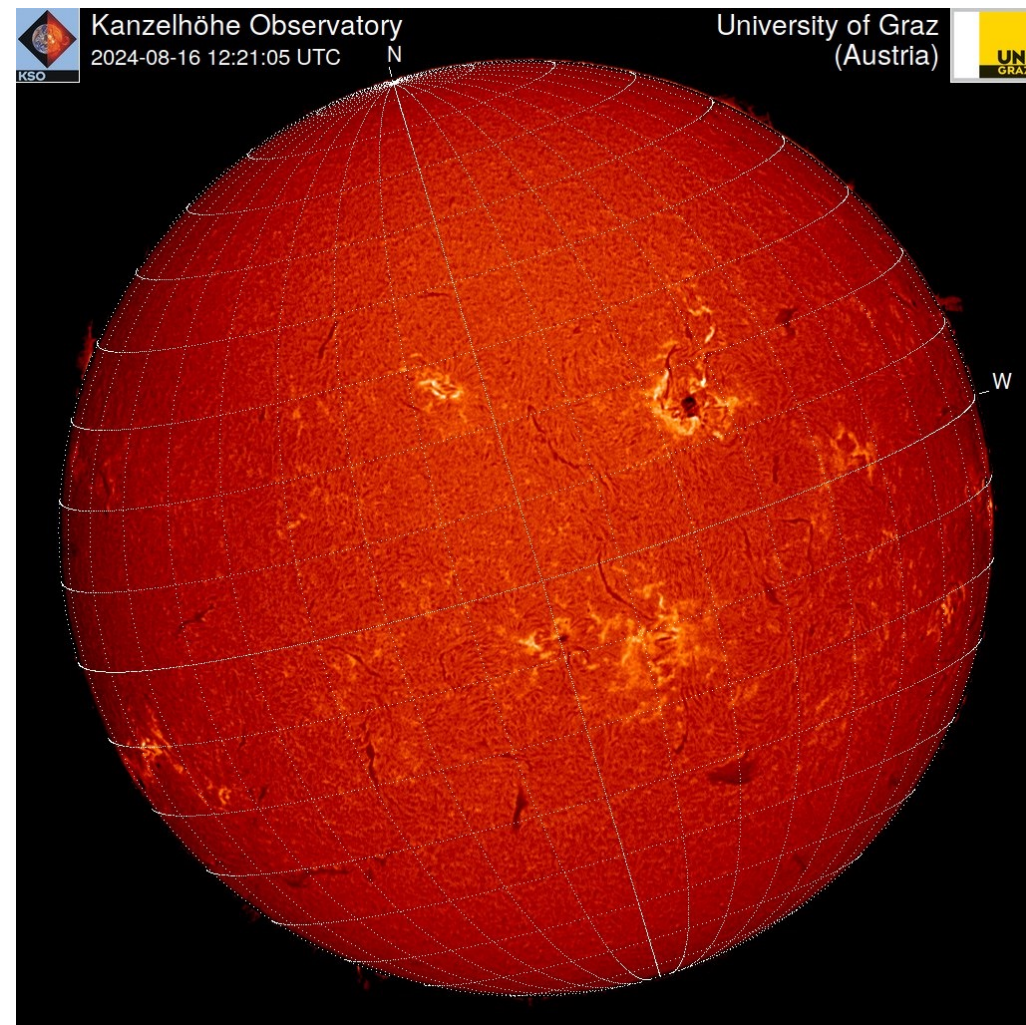
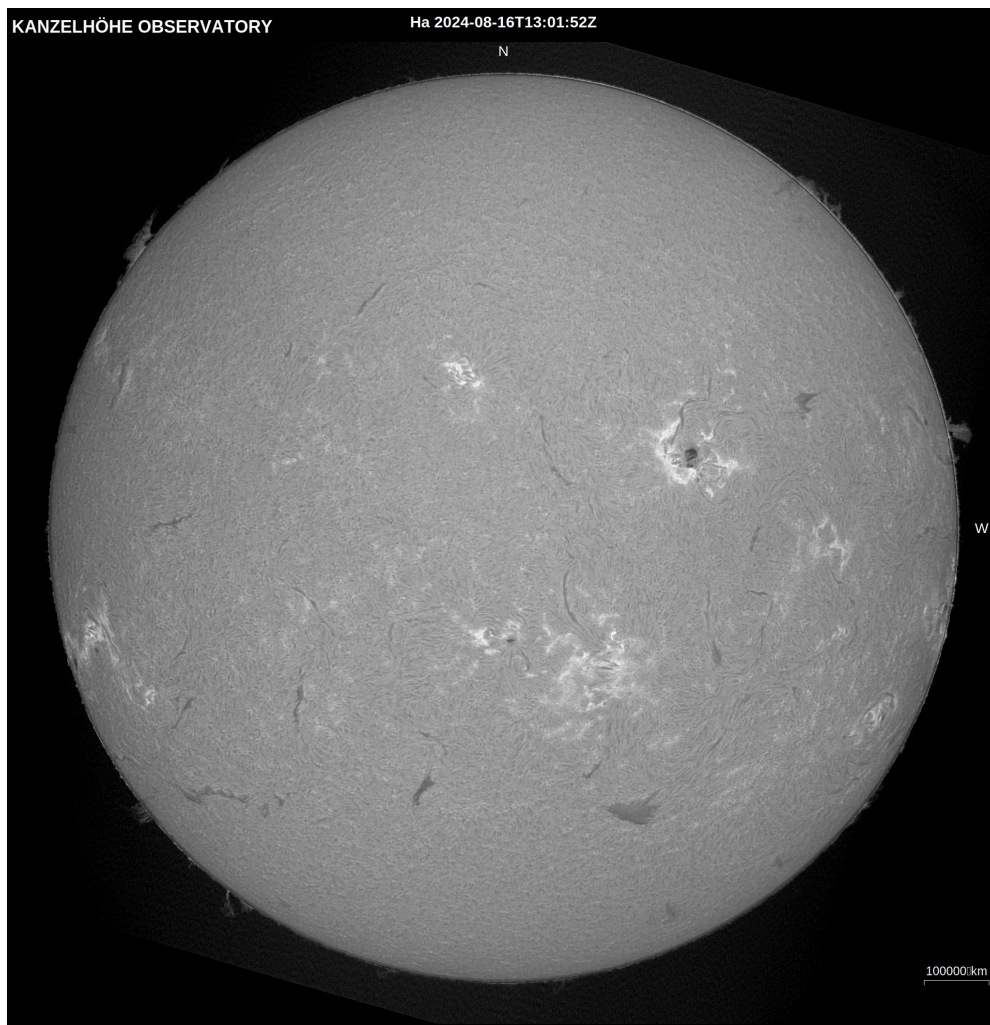
2048x2048 Pixel/12bit

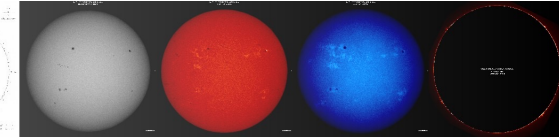
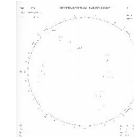


Data products

- Images: H-alpha, White-light, CaIIK
raw FITS, processed JPEGs (with/without grid,
grey/ coloured, derotated (N up), CLV-
corrected)
- Flares: automatically detected, visually
detected
- Filaments: automatically detected
- Prominences: by overexposing H-alpha images
- Sunspot numbers: from drawings, visually

H-alpha images





Werner Pötzi → THE EUROPEAN SPACE AGENCY

CURRENT SPACE WEATHER

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SPACE WEATHER AT ESA ▾

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- ESC Solar Weather
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- ESC Space Radiation
- ESC Ionospheric Weather
- ESC Geomagnetic Conditions

INFORMATION FOR USERS ▾

USER FEEDBACK

CONTACT THE HELPDESK

TERMS OF USE

H-alpha ESA Spaceweather

Expert Service Centres / ESC Solar Weather / kso-S107a-federated /

Welcome to the ESA Space Weather Service Network



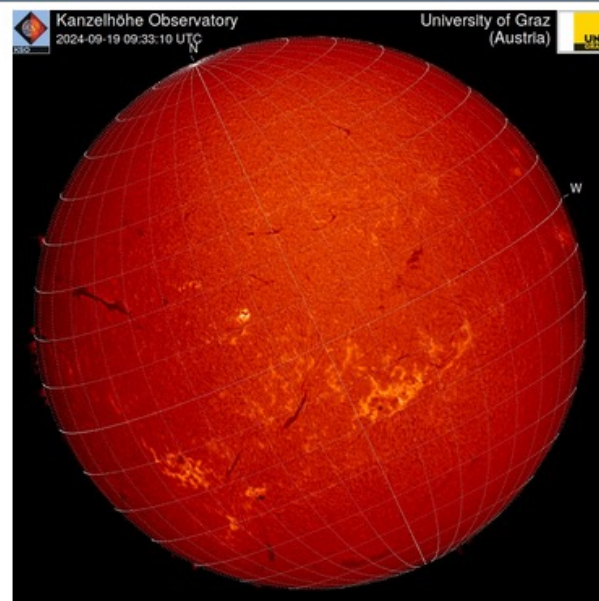
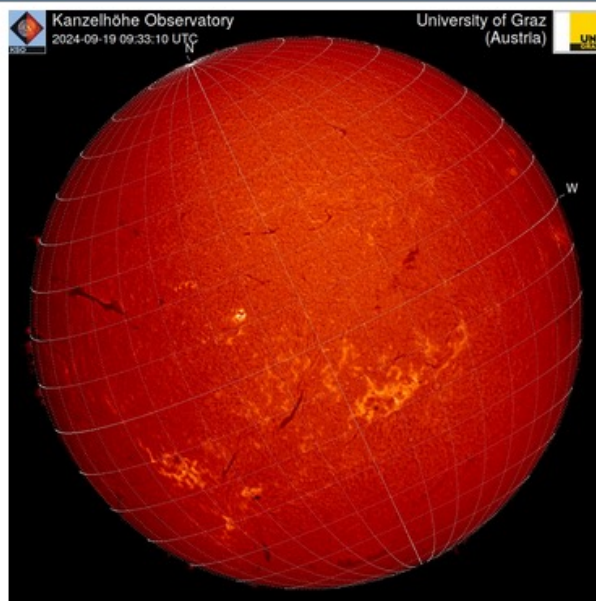
Federated products from the Kanzelhöhe Observatory for Solar and Environmental Research (UNIGRAZ)



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Ha images and movie - Latest

At Kanzelhöhe Observatory, the chromosphere is observed in H α every day from about 8:00 to 16:00 CET/CEST (when the weather is sufficiently clear). The images are processed immediately and available in near real-time as coloured JPEGs with a heliographic grid overlaid. Additionally images with removed large scale variations like limb darkening are made available as high contrast images. These images and the raw FITS data is transferred to the archive every five minutes. The 360-degree panoramic view shows the real-time weather conditions at the observatory.



Hourly images: **05 06 07 08 09 10 11 12 13 14 15 16 17**

[Show Contrast Viewing Mode](#)

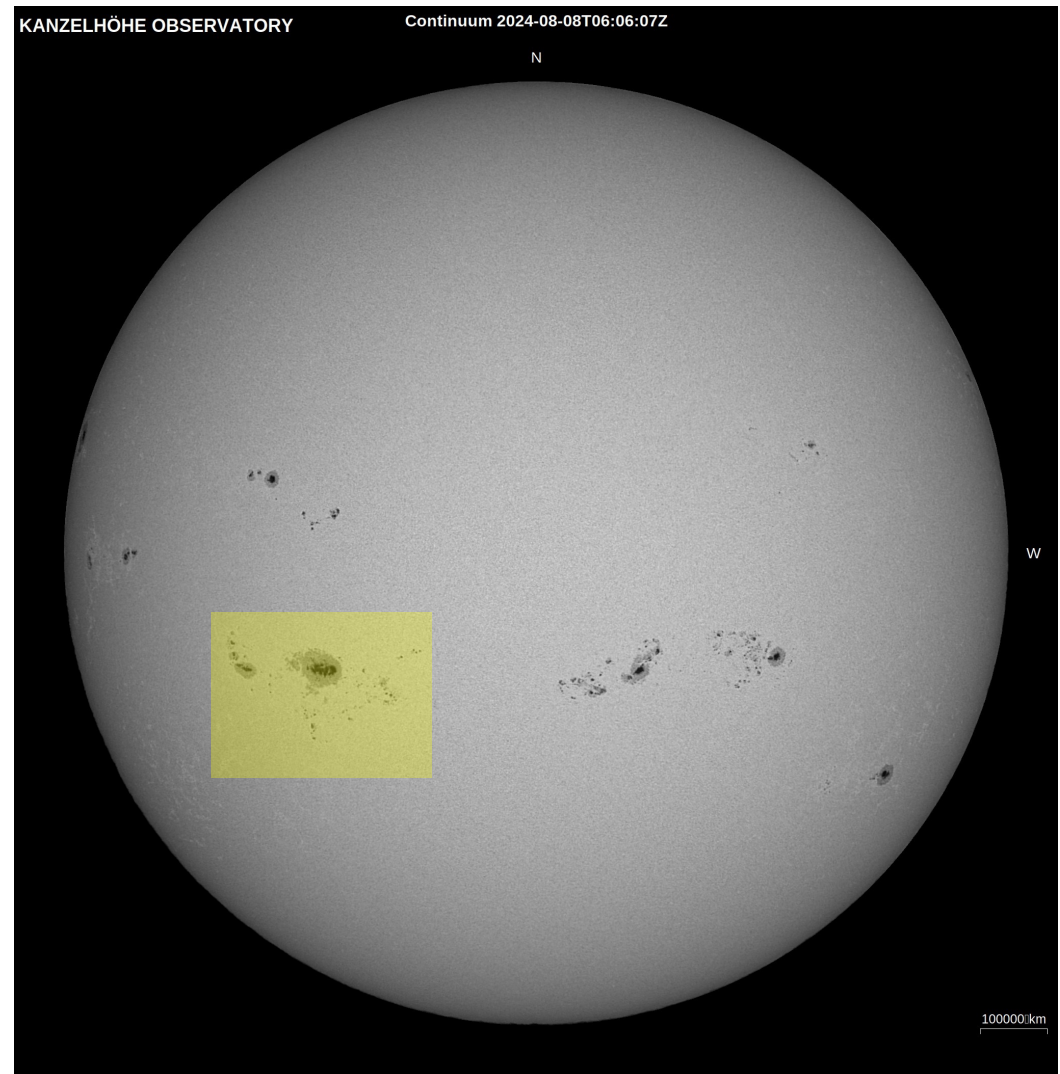
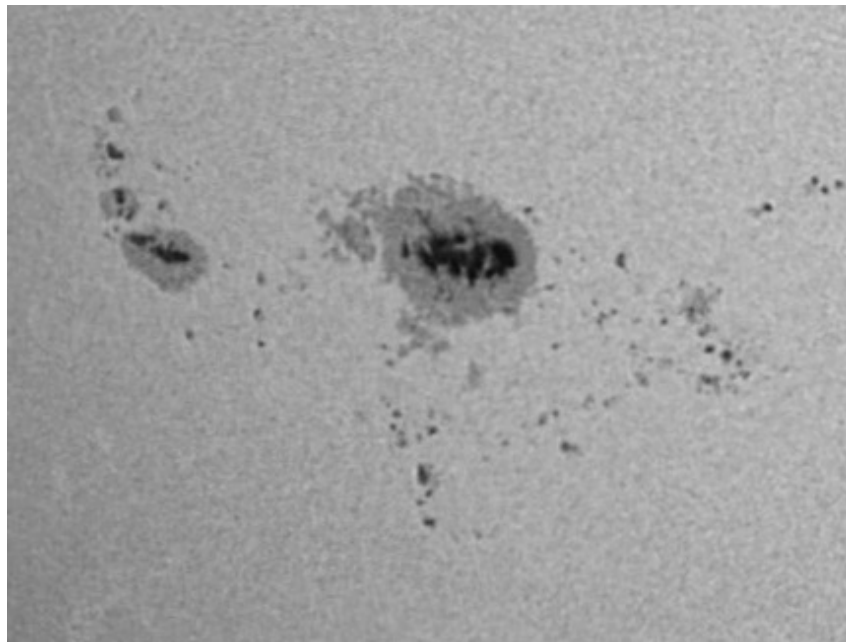
[Start](#) [Faster](#) [Slower](#) [Step](#) [Reverse](#) [Swing Mode Off](#)
[Pause](#) [5](#) /sec [Frame 10 of 10](#) [Download Files](#)



- every minute
- live archive
- uncorrected
- CLV-corrected
- grid

White-light images

1) White light flares?



White-light ESA Spaceweather

CURRENT SPACE WEATHER

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ESC Heliospheric Weather

ESC Space Radiation

ESC Ionospheric Weather

ESC Geomagnetic Conditions

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TERMS OF USE

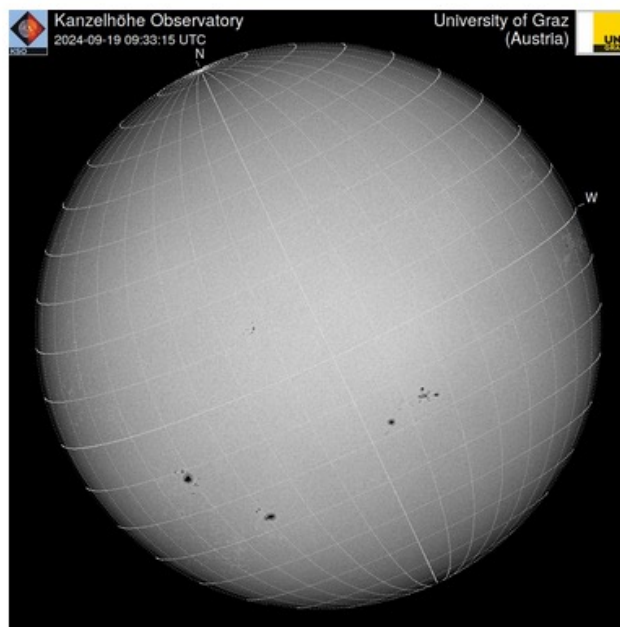
Federated products from the Kanzelhöhe Observatory for Solar and Environmental Research (UNIGRAZ)



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Whitelight images - Latest

At Kanzelhöhe Observatory the photosphere is observed in Whitelight every day from about 8:00 to 16:00 CET/CEST (when the weather is sufficiently clear). The images are processed immediately and available in near real-time as JPEGs with a heliographic grid overlaid. Additionally, images with removed large scale variations like limb darkening are made available as high contrast images. These images and the raw FITS data is transferred to the archive every five minutes. The 360-degree panoramic view shows the real-time weather conditions at the observatory.



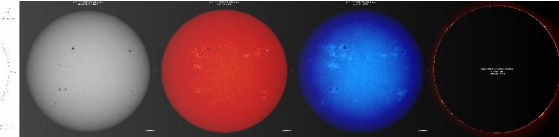
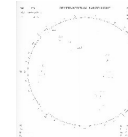
Show Contrast Viewing Mode

Hourly images:

04 UT no image	05 UT no image	06 UT no image	07 UT no image
08 UT 	09 UT 	10 UT no image	11 UT no image
12 UT no image	13 UT no image	14 UT no image	15 UT no image
16 UT no image	17 UT no image	18 UT no image	19 UT no image



- every minute
- live archive
- uncorrected
- CLV-corrected
- grid



Flaredetection

Flare detection - Archive

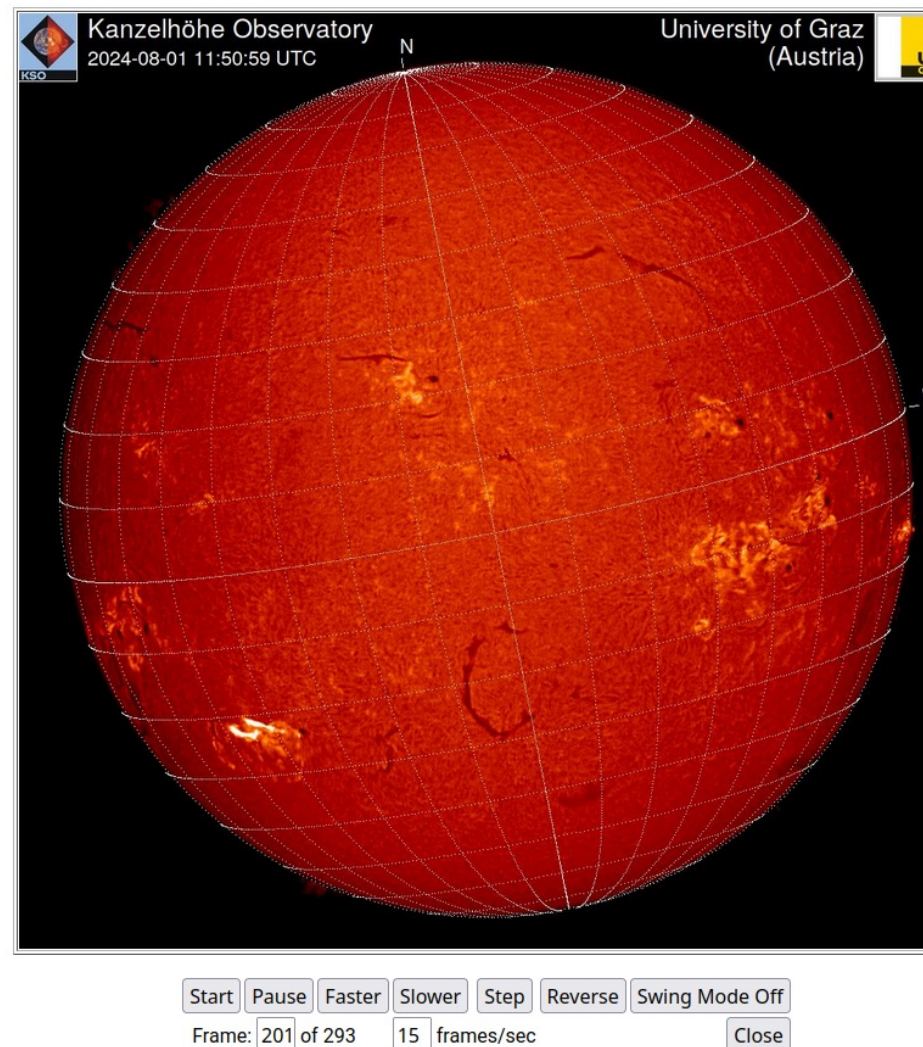
All detected flares during a given time period are displayed in a list and a link to the flare movie is provided.
The selected date marks the end date of the desired period, that can range from one day up to the complete data set (back to 20
The alert archive is updated at the end of the observation day.

End date	Year	«		2024		2023		2022		2021		2020		»					Month		1	2	3		
	Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22		
Coverage		1 day				1 week				1 month				1 year							same month				

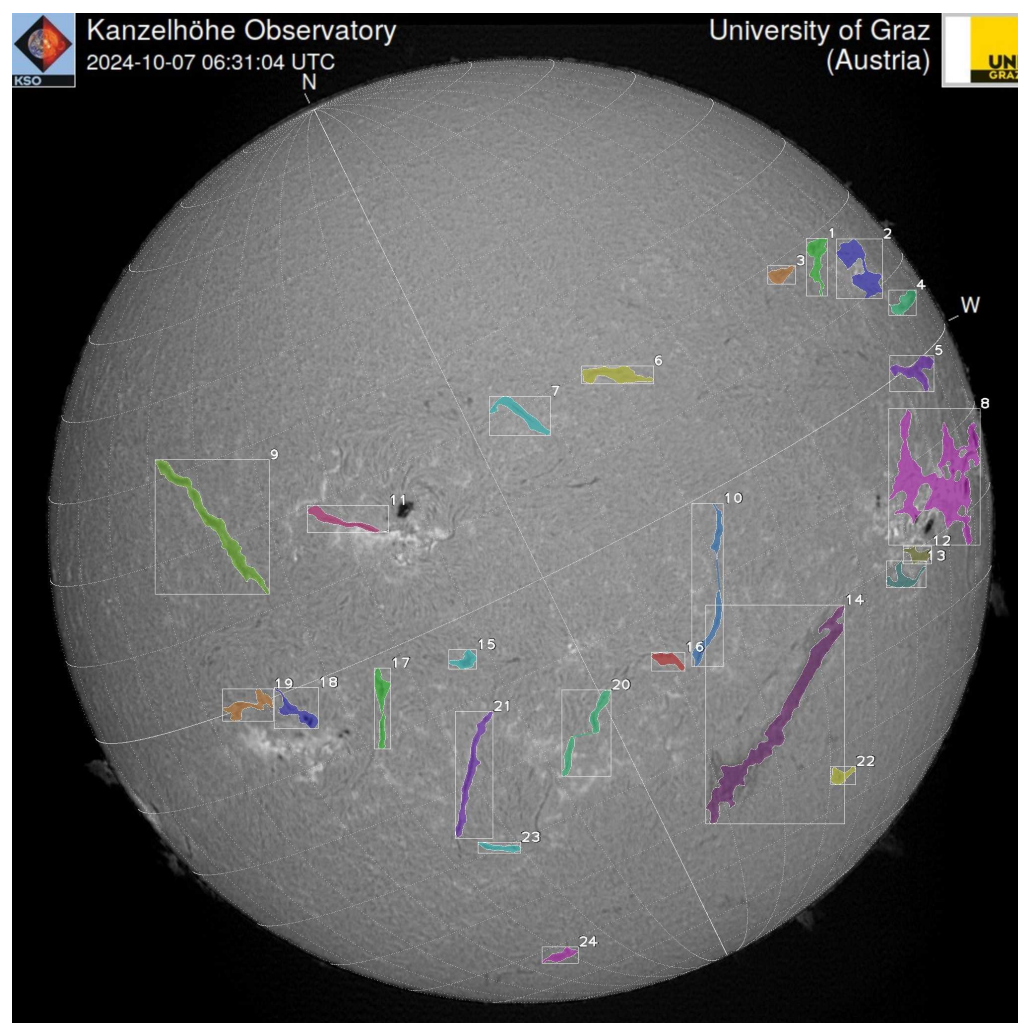
44 database entries found

Date	Start	Peak	End	Position	Type	Area	AR	Zürich Class	Magn. Class	Link to Movie
2024-08-25	06:05:00	06:07:00	06:12:00	S27/E05	SF	69	13800	E-16	Beta-Gamma	»Flare Movie
2024-08-25	11:43:00	11:44:00	11:50:00	S26/E00	SF	49	13800	E-16	Beta-Gamma	»Flare Movie
2024-08-25	12:14:00	12:16:00	12:23:00	S26/W01	SF	56	13800	E-16	Beta-Gamma	»Flare Movie
2024-08-25	12:54:00	12:55:00	13:02:00	S03/W19	SF	22	13796	D-18	Beta-Gamma	»Flare Movie
2024-08-25	12:52:00	12:53:00	12:57:00	S27/E01	SF	29	13800	E-16	Beta-Gamma	»Flare Movie
2024-08-25	13:10:00	13:10:00	13:11:00	S12/E10	SF	37	13799	D-18	Beta-Gamma	»Flare Movie
2024-08-25	13:23:00	13:29:00	13:33:00	S26/E00	SF	37	13800	E-16	Beta-Gamma	»Flare Movie
2024-08-25	13:43:00	13:44:00	13:50:00	S27/W00	SF	40	13800	E-16	Beta-Gamma	»Flare Movie
2024-08-25	13:46:00	13:51:00	14:00:00	S04/W19	SF	29	13796	D-18	Beta-Gamma	»Flare Movie
2024-08-25	11:23:00	11:27:00	11:33:00	S26/E00	SF	53	13800	E-16	Beta-Gamma	»Flare Movie
2024-08-25	10:16:00	10:18:00	10:31:00	S26/E00	SF	66	13800	E-16	Beta-Gamma	»Flare Movie
2024-08-25	10:04:00	10:06:00	10:07:00	N19/W62	SF	38	13794	C-05	Beta	»Flare Movie
2024-08-25	06:20:00	06:22:00	06:31:00	S26/E04	SF	48	13800	E-16	Beta-Gamma	»Flare Movie
2024-08-25	06:48:00	06:53:00	07:32:00	S26/E05	1N	100	13800	E-16	Beta-Gamma	»Flare Movie
2024-08-25	07:08:00	07:09:00	07:10:00	S11/W02	SF	37	n/a	n/a	n/a	»Flare Movie
2024-08-25	07:42:00	07:45:00	08:00:00	S26/E04	SF	90	13800	E-16	Beta-Gamma	»Flare Movie
2024-08-25	08:52:00	08:53:00	09:00:00	S26/E02	SF	39	13800	E-16	Beta-Gamma	»Flare Movie
2024-08-25	08:49:00	08:49:00	08:52:00	S14/E13	SF	25	13799	D-18	Beta-Gamma	»Flare Movie
2024-08-25	09:36:00	09:42:00	09:45:00	S26/E02	SF	43	13800	E-16	Beta-Gamma	»Flare Movie
2024-08-25	09:52:00	10:08:00	10:15:00	S04/W18	SF	53	13796	D-18	Beta-Gamma	»Flare Movie
2024-08-26	11:17:00	11:35:00	11:38:00	S06/W30	SF	55	13796	D-12	Beta-Gamma	»Flare Movie
2024-08-27	10:26:00	10:27:00	10:31:00	N08/E11	SF	22	13801	D-11	Beta-Gamma	»Flare Movie
2024-08-28	08:41:00	08:45:00	08:53:00	N08/W02	SF	67	13801	C-05	Beta	»Flare Movie
2024-08-28	08:30:00	08:31:00	08:32:00	S28/W45	SF	22	13800	E-15	Beta-Gamma	»Flare Movie
2024-08-28	08:21:00	08:22:00	08:25:00	N08/W01	SF	29	13801	C-05	Beta	»Flare Movie
2024-08-30	14:03:00	14:05:00	14:05:00	S16/E01	SF	54	n/a	n/a	n/a	»Flare Movie
2024-08-30	13:23:00	13:24:00	13:31:00	S16/E02	SF	34	n/a	n/a	n/a	»Flare Movie

H-alpha Flare movie for 20240801 1104-1218 Type:1N Pos:S22E42



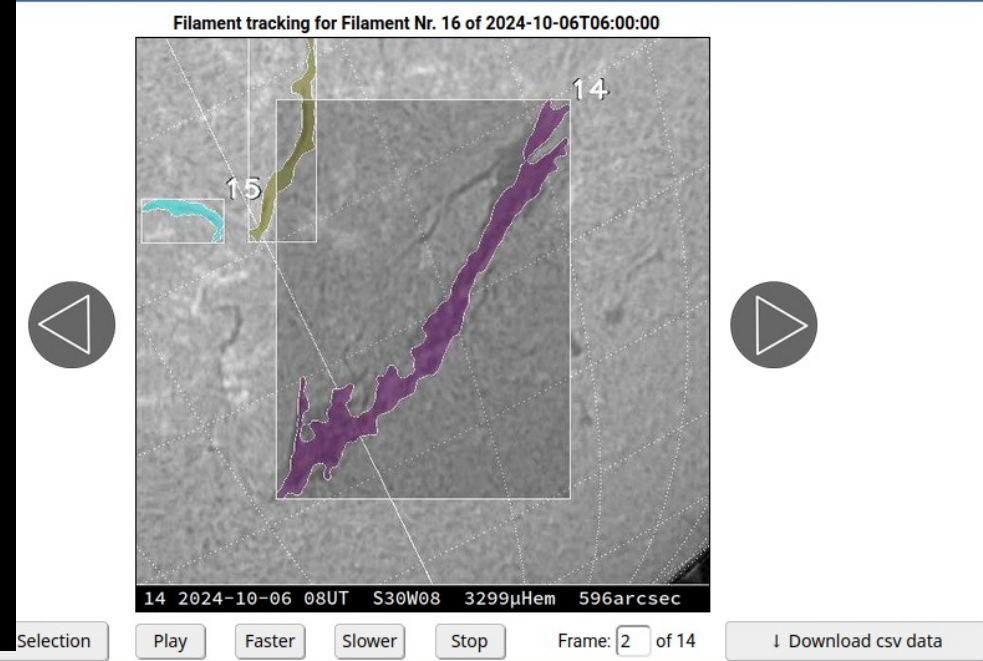
Filament detection/tracking

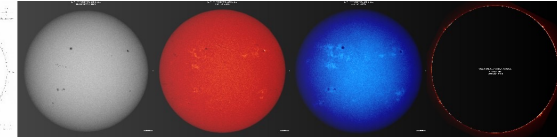
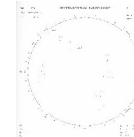


Filament Tracking

Detected by the feature recognition algorithm are combined to a single filament image. For each filament the position, the area, the length, and the north extends are calculated.

Tracking via the table on the right or from the filament map on the left. The interface will change to filament tracking mode, to go back for filament selection to 'Filament Selection' button. The tracked filament data can be downloaded.





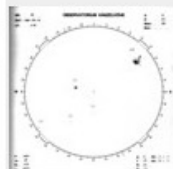

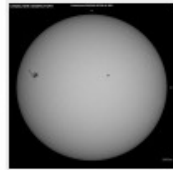
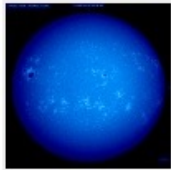
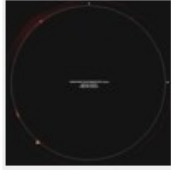

Archive



Kanzelhöhe Observatory Synoptic Archives

KARL-FRANZENS-UNIVERSITÄT GRAZ
UNIVERSITY OF GRAZ



Navigation	Data	Docs & Info	About	Links
	2025-05-08 12:00 UTC	Julian Date: 2460797.0006 Dist. = 1.007 AU App. Diam. = 1905.4" Elevation = 56.20°	P = -23.98° B ₀ = -4.12° L ₀ = 288.4° Carr# 2297 Sunrise 03:49:32 UTC Sunset 18:14:14 UTC	
Live Data » Latest Images » Latest H α (ESA SSA) » Flare Monitoring (live)	Sun - Photosphere for 2025-05-01		Sun - Chromosphere for 2025-05-01	
Synoptic Data » Daily Overview » Two Weeks Photosphere » Two Weeks Chromosphere » Sunspot Numbers » Sunspot Drawings » H α » White-light » CaIIK » Filaments » Synoptic Maps		Kanzelhöhe Sunspot Drawing 06:35 UTC <i>Side reversed!</i> » Drawing Archive		Kanzelhöhe Hα 06:34:37 UTC Synoptic *.jpg *.fits.gz Contrast *.jpg *.fits.gz Movie Flares... » Synoptic Archive » Full H α Archive
		Kanzelhöhe White-light 06:41:56 UTC Synoptic *.jpg *.fits.gz Contrast *.jpg *.fits.gz Movie » Synoptic Archive » Full White-light Archive		Kanzelhöhe Ca II K 06:38:45 UTC Synoptic *.jpg *.fits.gz Contrast *.jpg *.fits.gz Movie » Synoptic Archive » Full Ca II K Archive
	Full Data Archive » Archive / Ftp-Server / Local » Fast Mirror Archive / Graz	<div>R_I = 73 g = 5 f = 35</div> <div>Observing Log Monthly Summary NOAA/SWPC Event List Hα/GOES Intensity Plot</div>		Kanzelhöhe Hα Prominence Images 06:25:30 UTC » Synoptic Archive
			<div>« 2025-04-30 « 1 Month 2025-05-01 2025-05-02 »</div> <div>Panorama: 2025-05-01 12:00 (UTC)</div> 	
			Since 01.01.2025: 60251 Visits / 1817899 Clicks	
Misc. » Solar Ephemeris » NOAA Solar Region Data	<div>» Data Policy » KSO Homepage » Astrophysics and Geophysics » University of Graz Contact</div>			

Telescope in Бѐлоградчик

- Celeston 11"
- 280 mm aperture
- 2800 mm focal/length
- $f/d = 10$

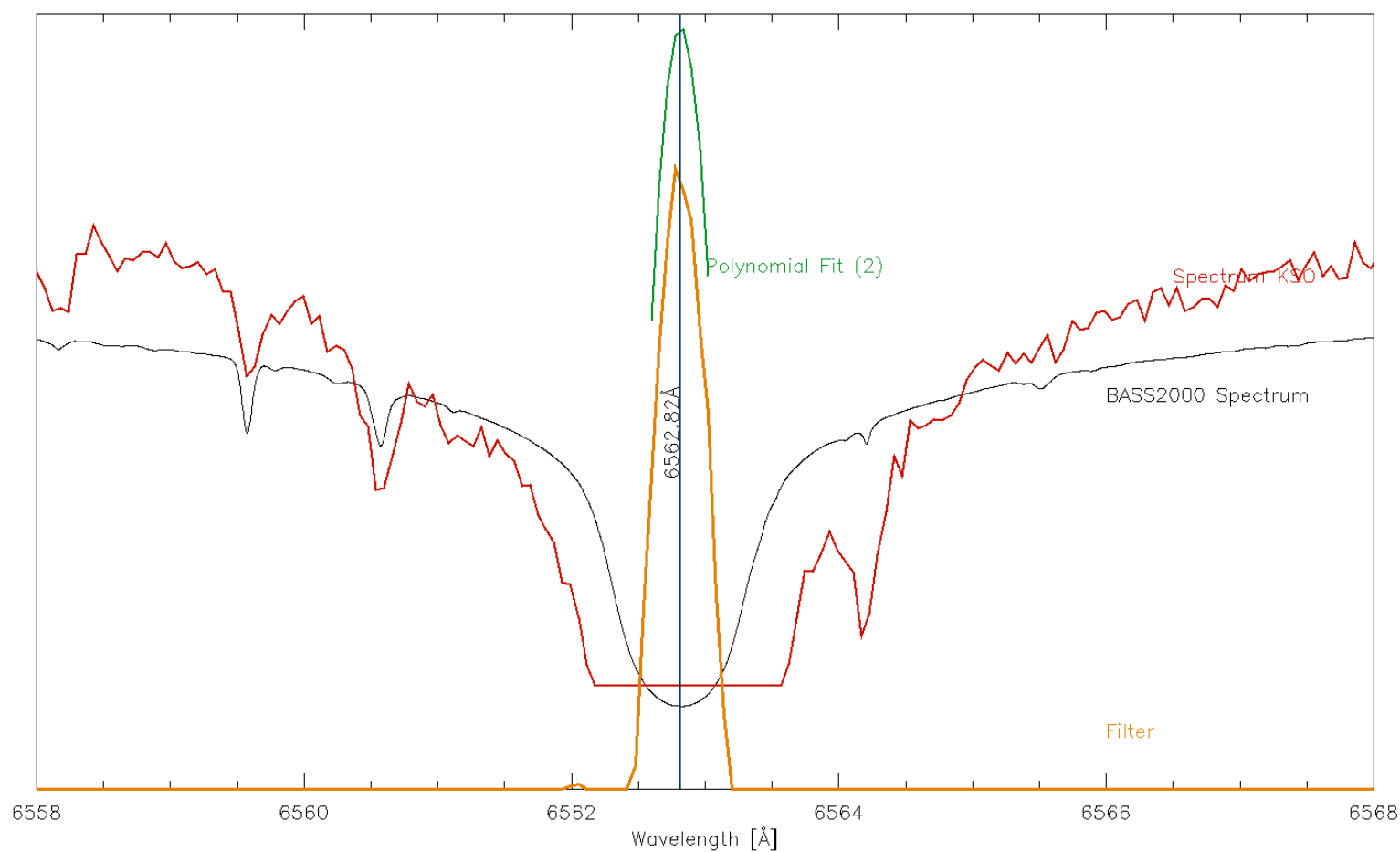
For filter $f/d = 1/30$

is needed \Rightarrow

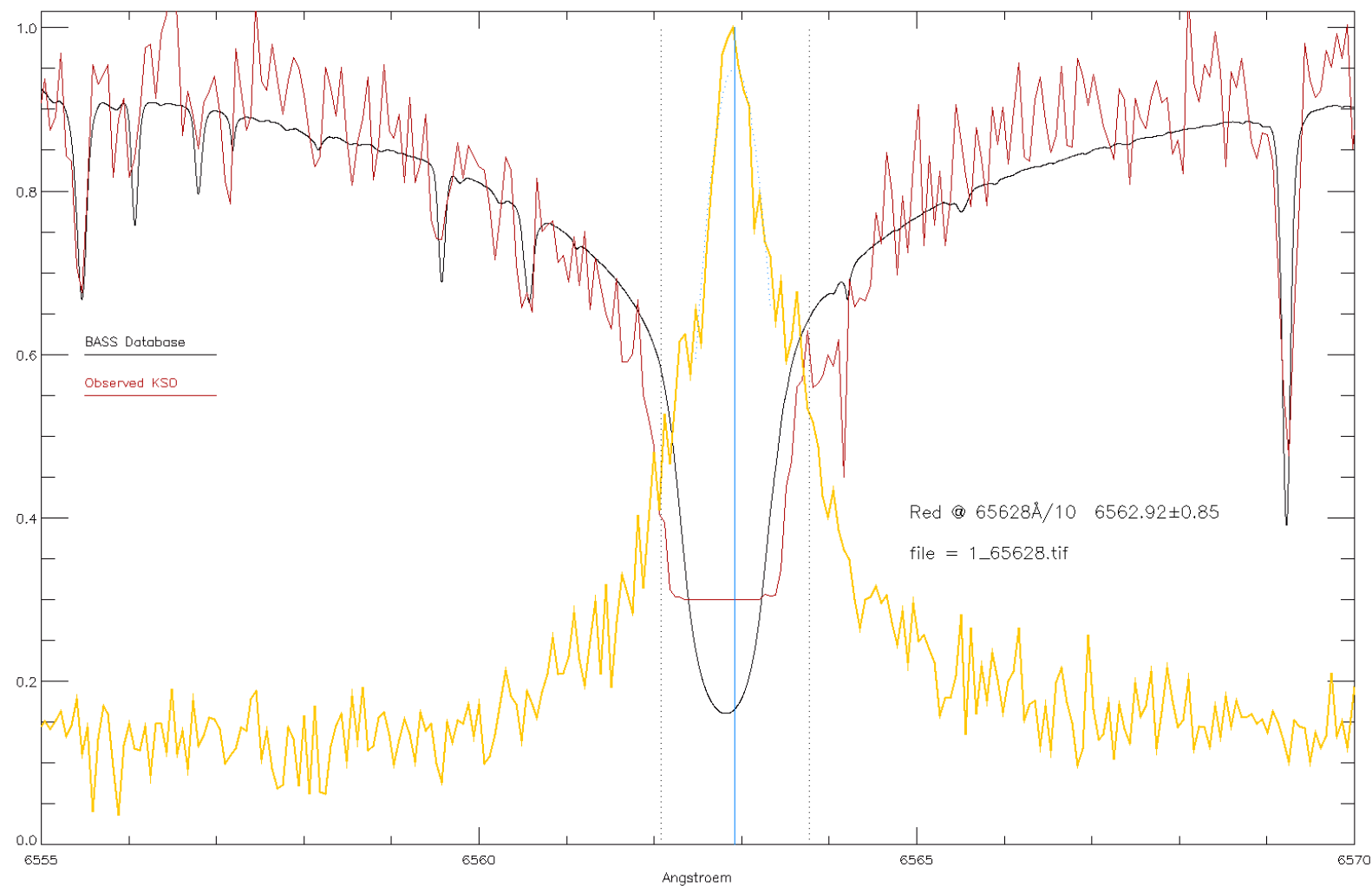
- 1) reduce aperture
- 2) enlarge focal length



H-alpha Filter – e.g. Lyot

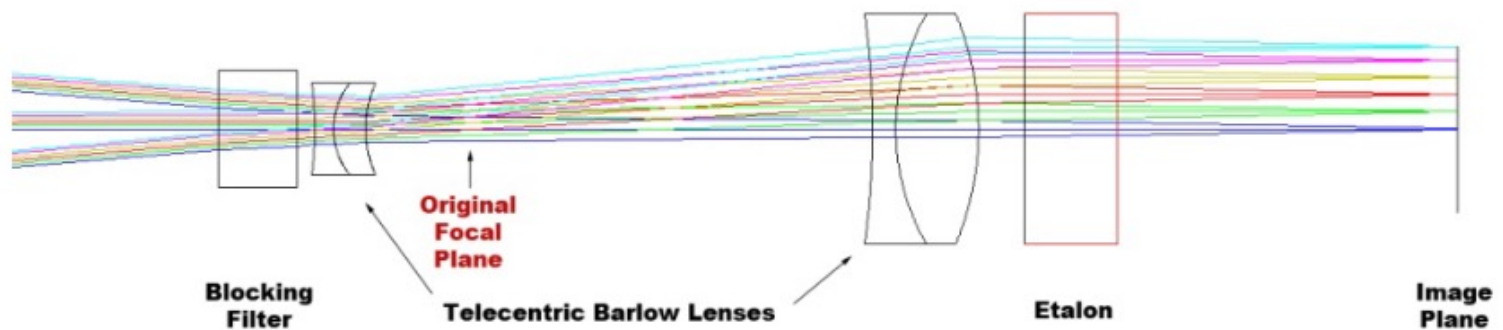


H-alpha Filter – e.g. Daystar



Daystar F/D<30

DayStar Quark Optical Configuration
Shown with 66mm F/6 example objective, for 0.6° field



Enlarge focal length

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

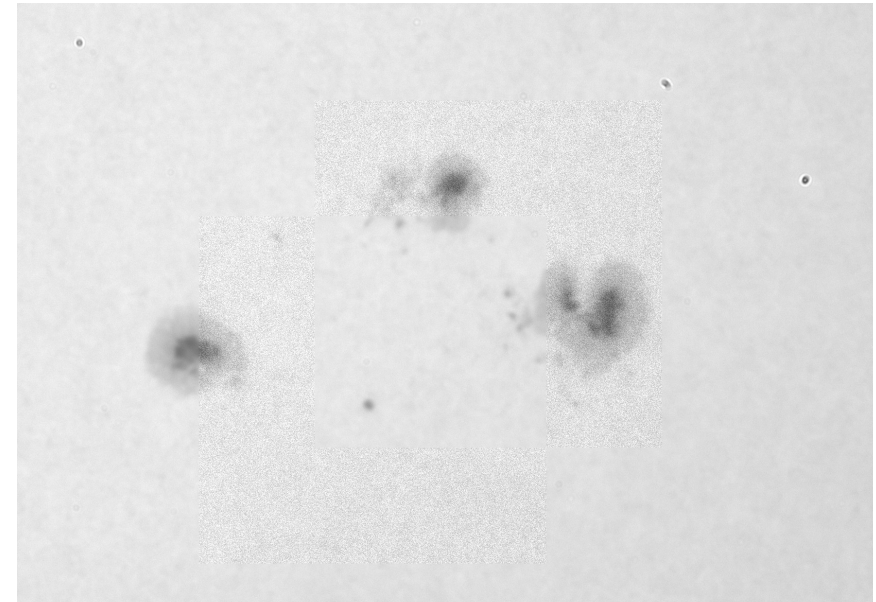
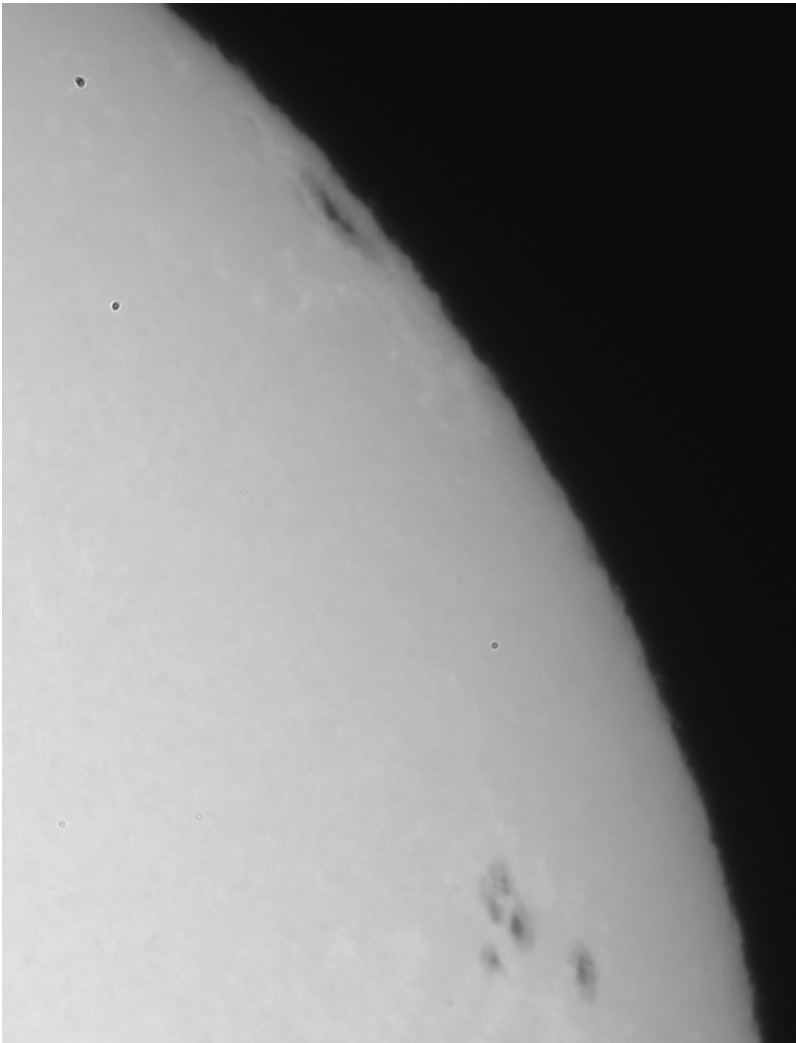
- 1) focal length of 2800 results in 26mm solar image
- 2) camera sizes are much smaller (5 to 10 mm)
- 3) only small part of Sun visible
- 4) high resolution leads to high noise level due to seeing
- 5) guiding more difficult
- 6) position on Sun not very clear
- 7) filter directly before camera – heat 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) f/l for filter is better
- 5) resolution still large enough for seeing conditions



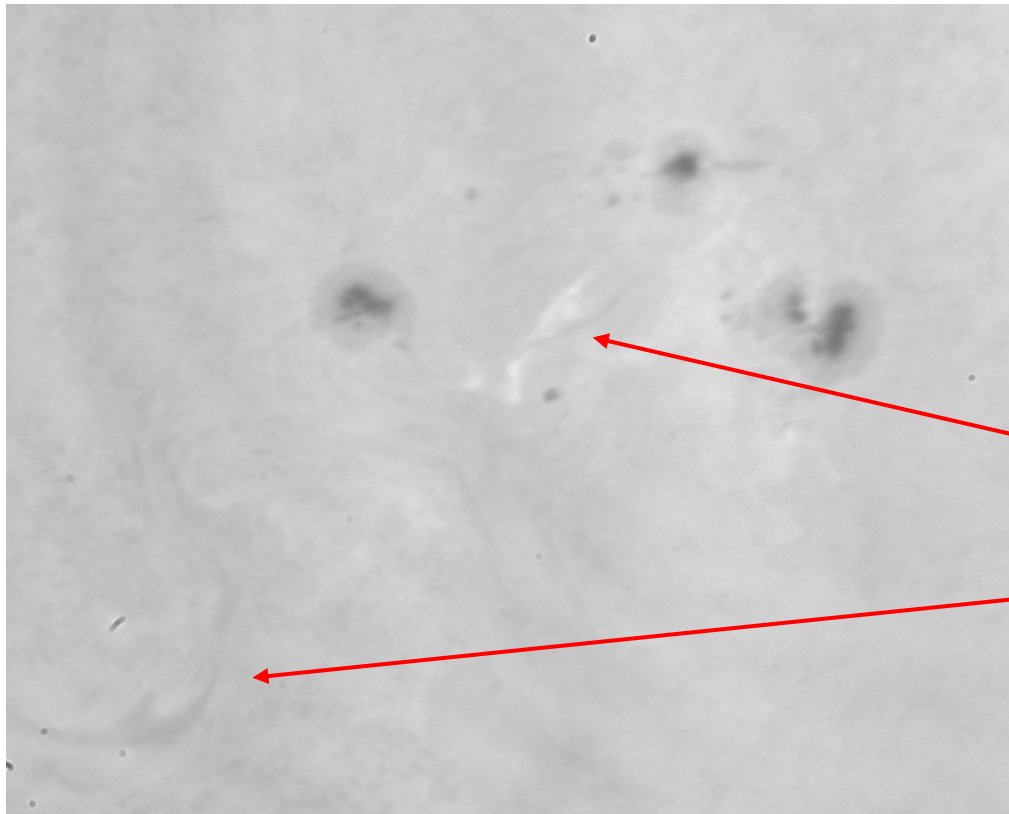
First tests in Белоградчик White-light



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 too low/high)
therefore contrast is low

but:

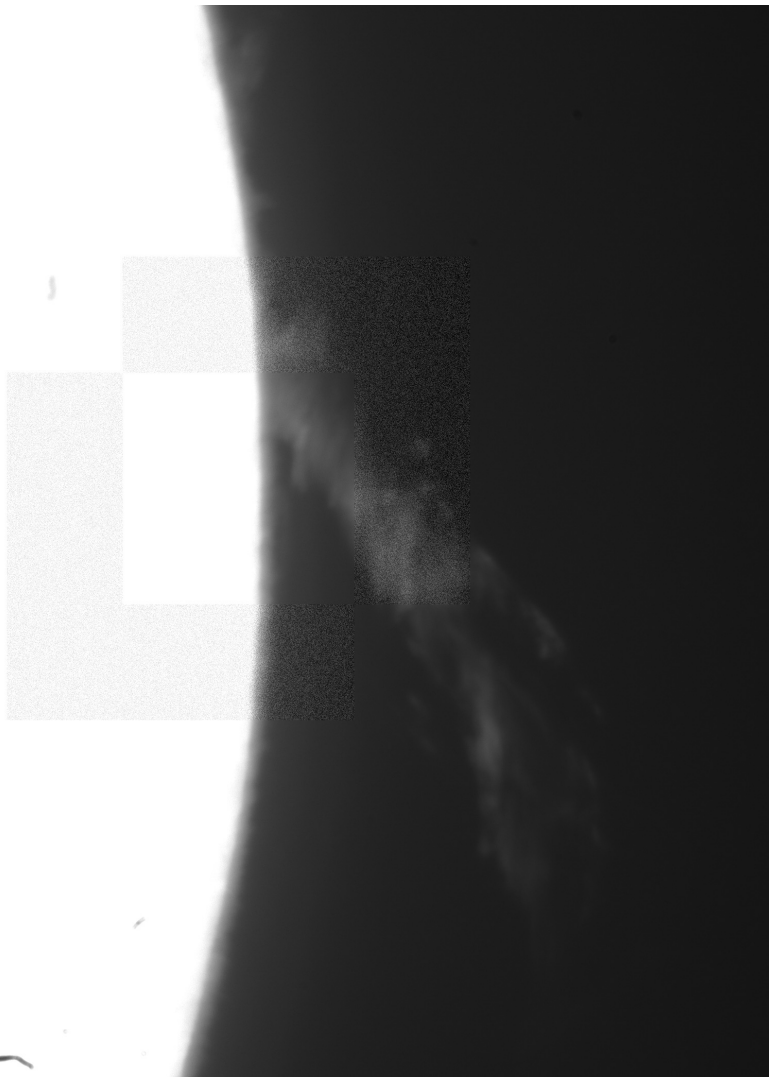
small flare is visible

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

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.