The data processing pipeline at Kanzelhöhe Observatory

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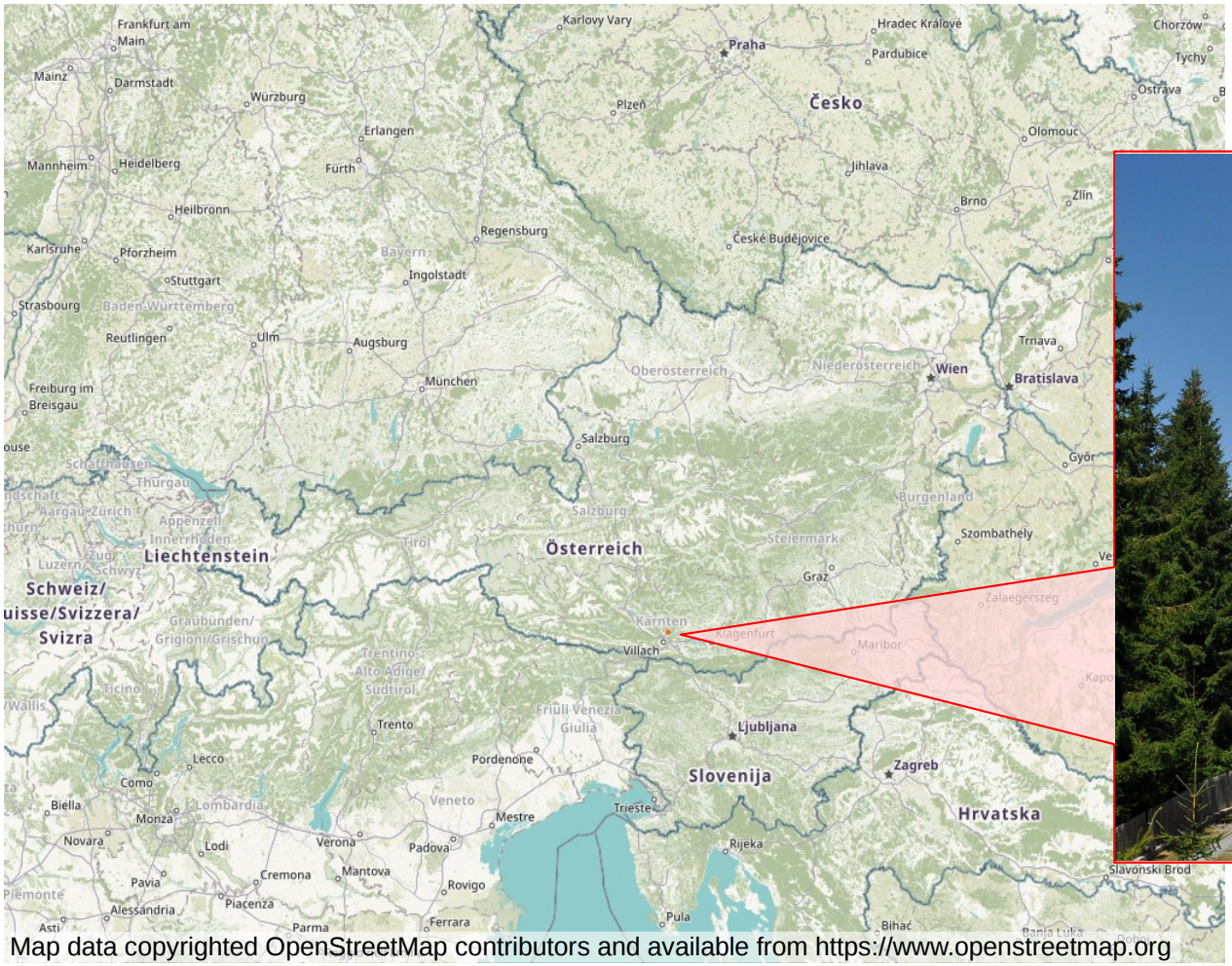


Map data copyrighted OpenStreetMap contributors and available from https://www.openstreetmap.org

N 46° 40′ 39.1″ E 13° 54′ 06″
1524 m ASL

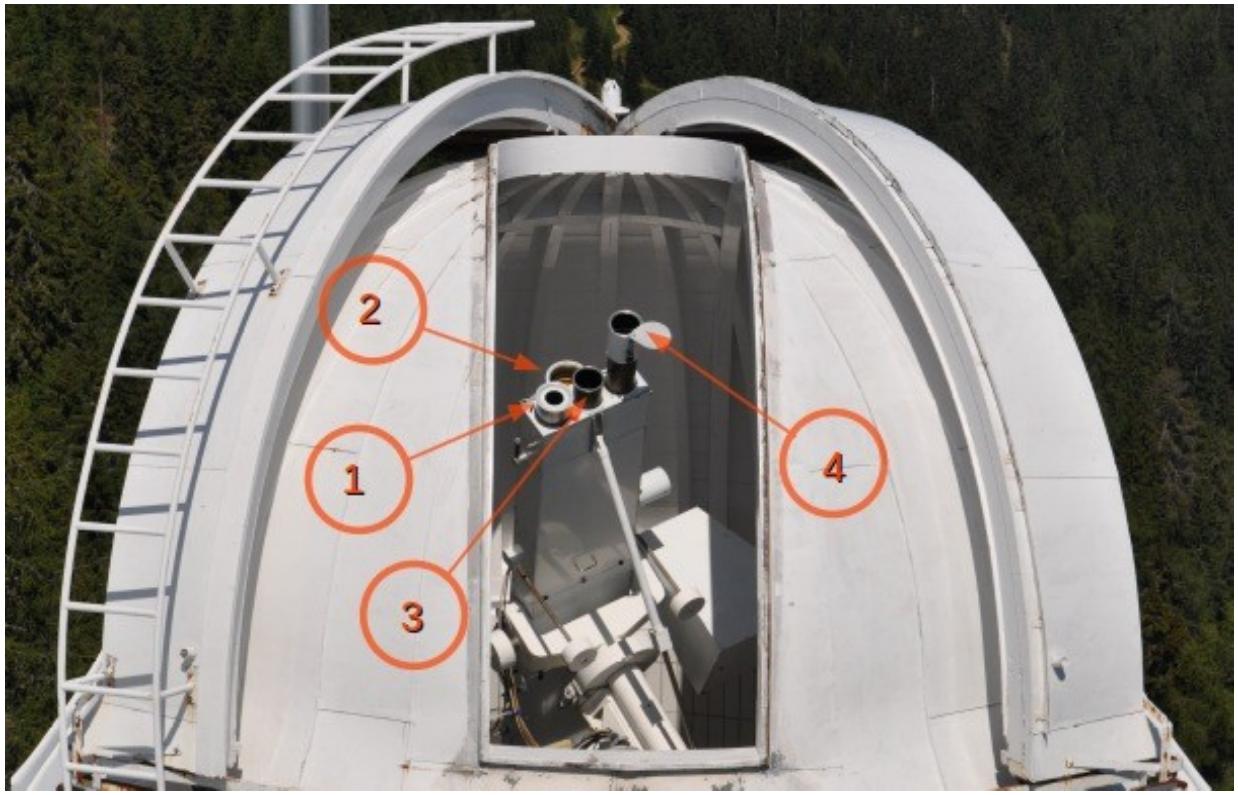
Telescopes

1 CaII K (Lunt, ≤0.3nm @ 3933.7)

2 White-light (50nm @ 5450)

3 Hα (Zeiss Lyot, 0.07nm @ 6562.8)

4 Drawing Device (Ø = 25cm)



Data Pipeline

1 Data acquisition

2 Quality check

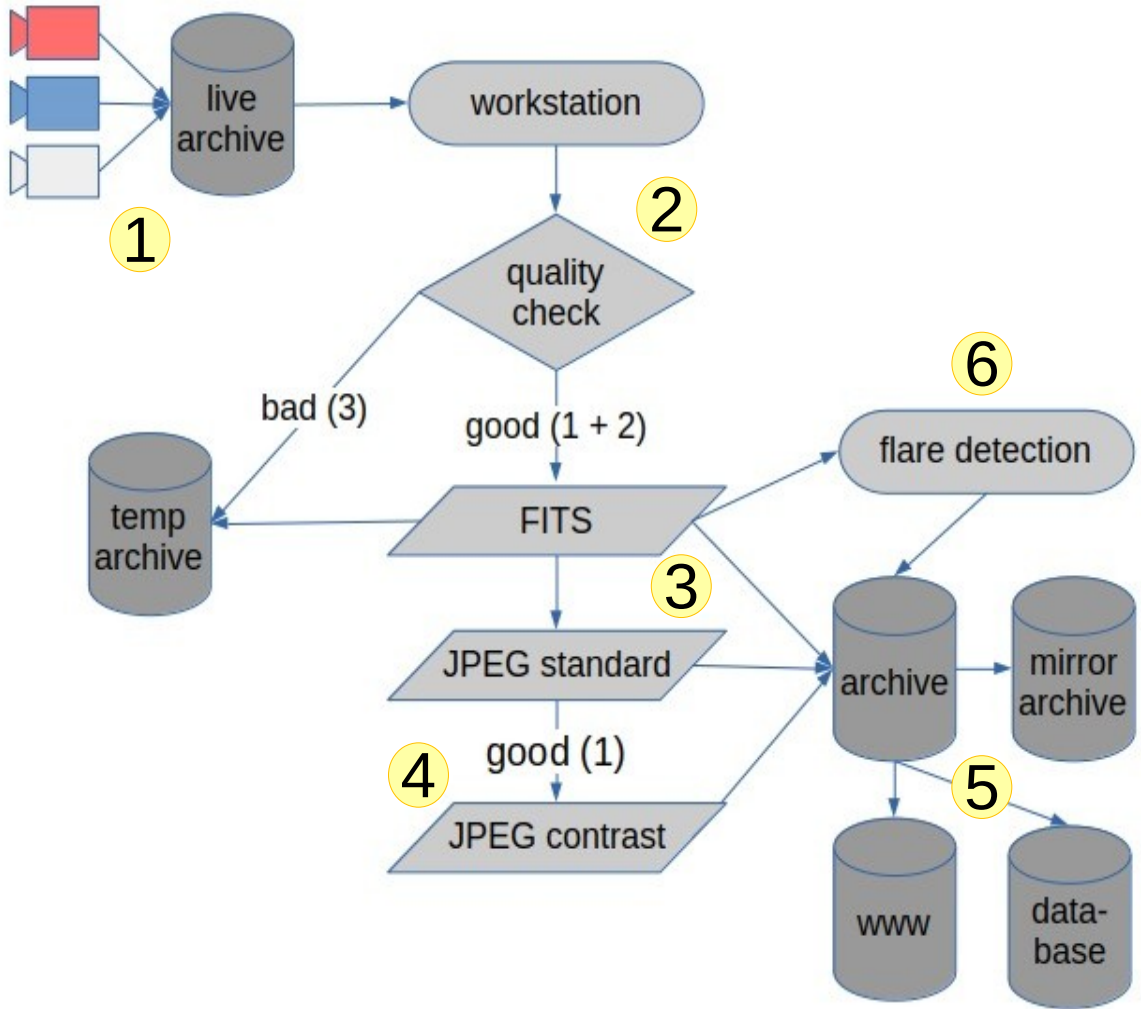
3 Standard processing

4 CLV correction

5 Archive+database

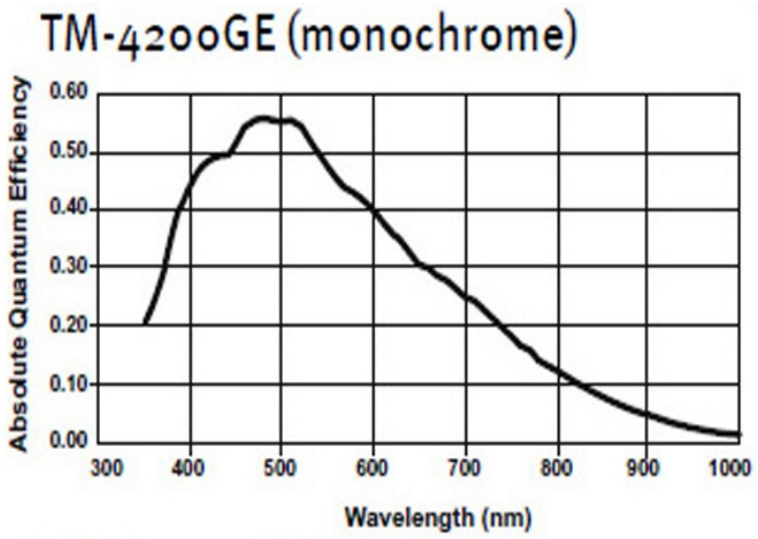
6 Flare detection

1 → 5 in 5 seconds



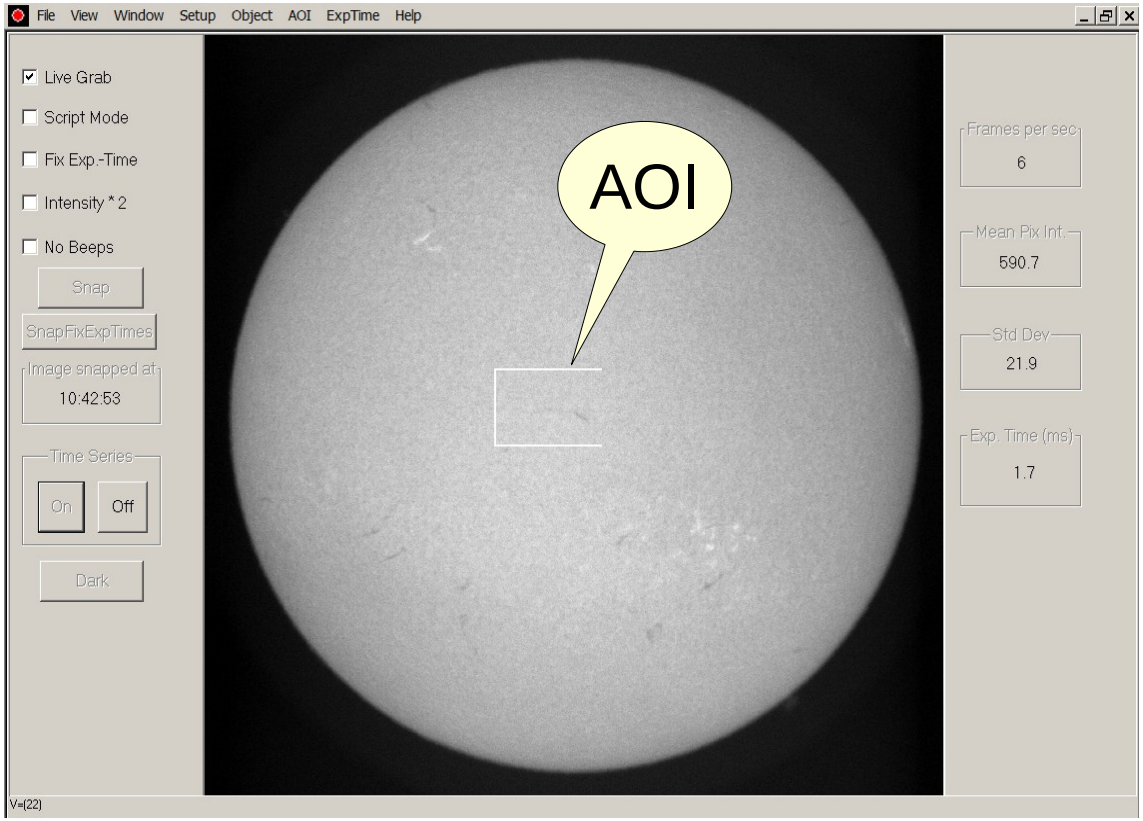
Data Acquisition - Camera

2048x2048 Pixel @ 12bit – 6-7 images/sec
no mechanical shutter, cadence 10 images/minute



1 Data Acquisition - Controller

- User I/F in Visual C++
- easy to use (just press "On")
- same for all cameras
- up to 3.5 images/sec (on local disc)



1 Data Acquisition - AOI

AOI – Area of intensity measurement:

- the mean intensity in this AOI is kept constant → exposure time varies
- used for frame selection (image with highest contrast out of 10 is stored)
- placed over active region → flares are not overexposed

1 Data Acquisition - Storage

no local storage in standard mode
→ central RAID system (live archive) for all cameras

in high cadence mode (3 to 4 images per second)
→ local disc (transfer to archive after observations)

2 Quality Check

1 workstation waits for images ariving on live archive

2 one processing task is running for each camera

3 new images are processed immediately

4 all images are stored in temporary archive

5 images that pass the quality criteria are processed further

2 Quality Check

1 limb detection

2 image inhomogeneities

3 image sharpness

4 exposure time

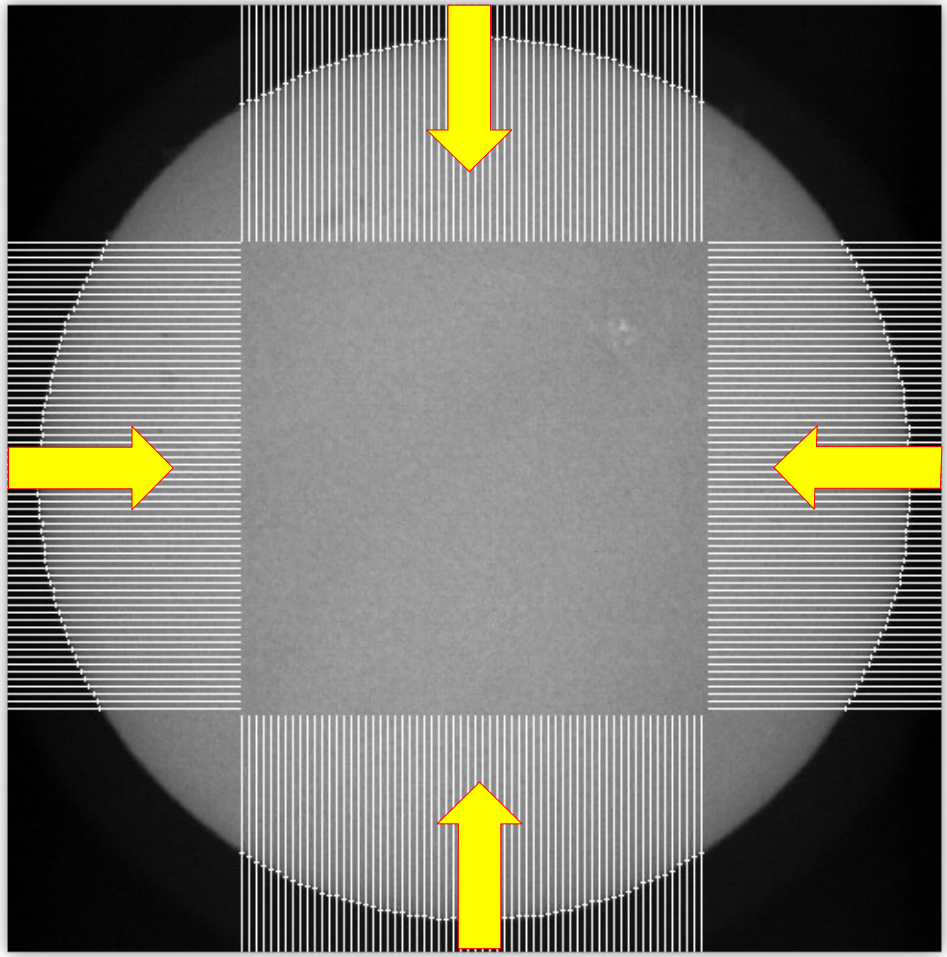
5 intensity of AOI

6 file size

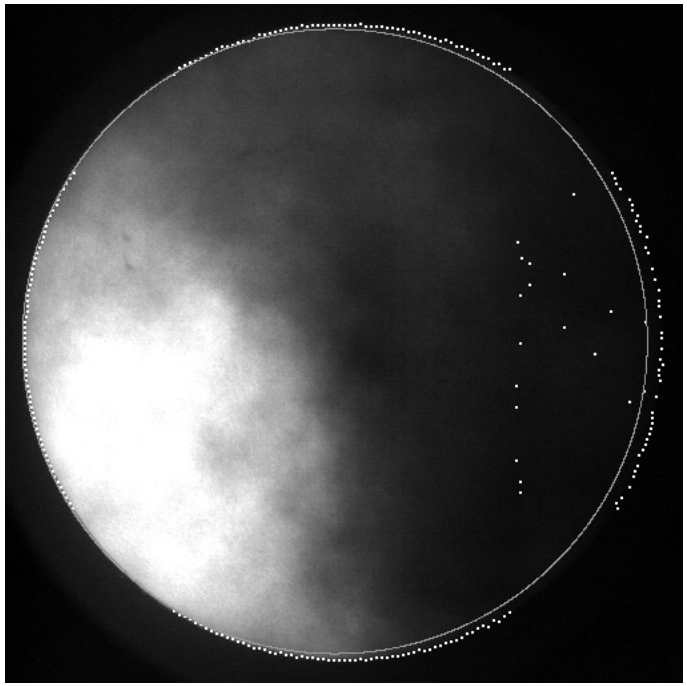
very fast
&
stable results

2 Quality – limb detection

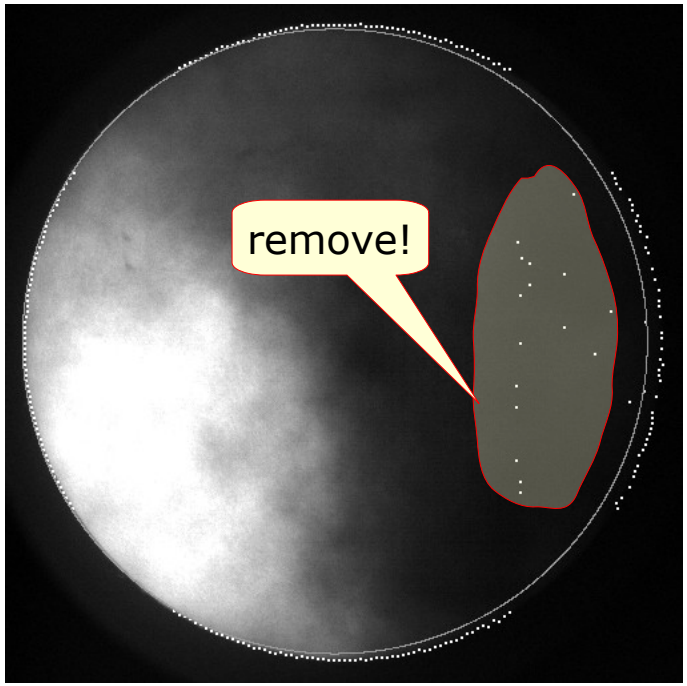
- find inflection points from 4 directions at 64 positions
- fit circle
- iteratively remove bad limb points and fit again



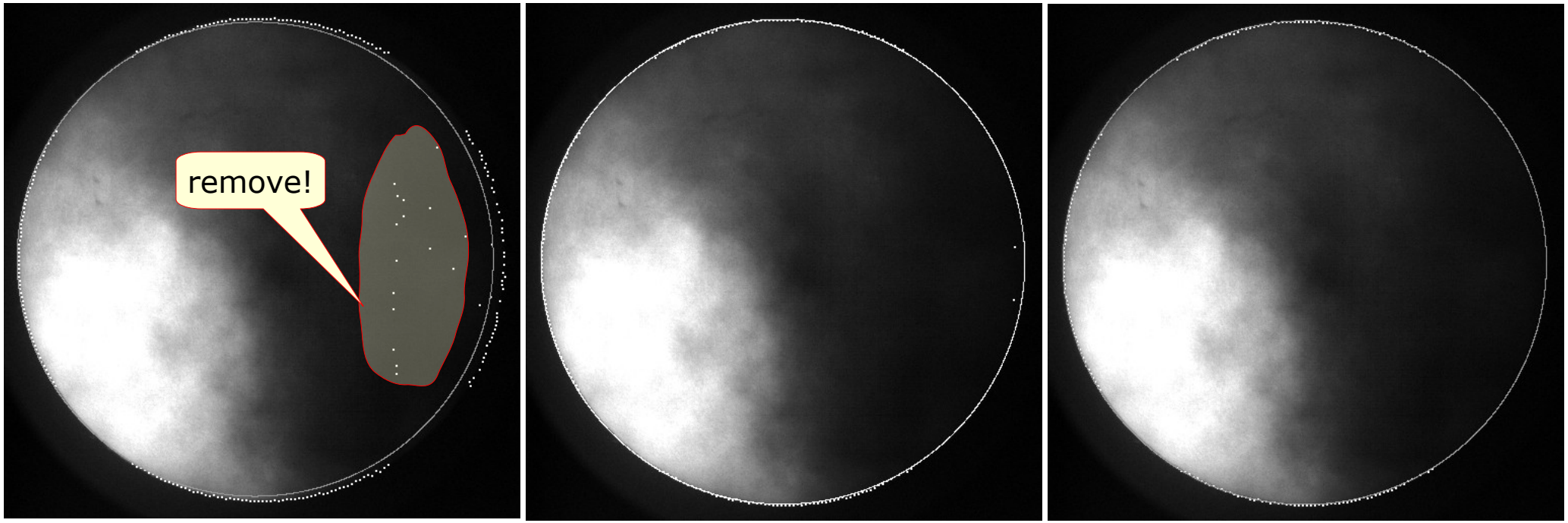
2 Quality – limb detection



2 Quality – limb detection



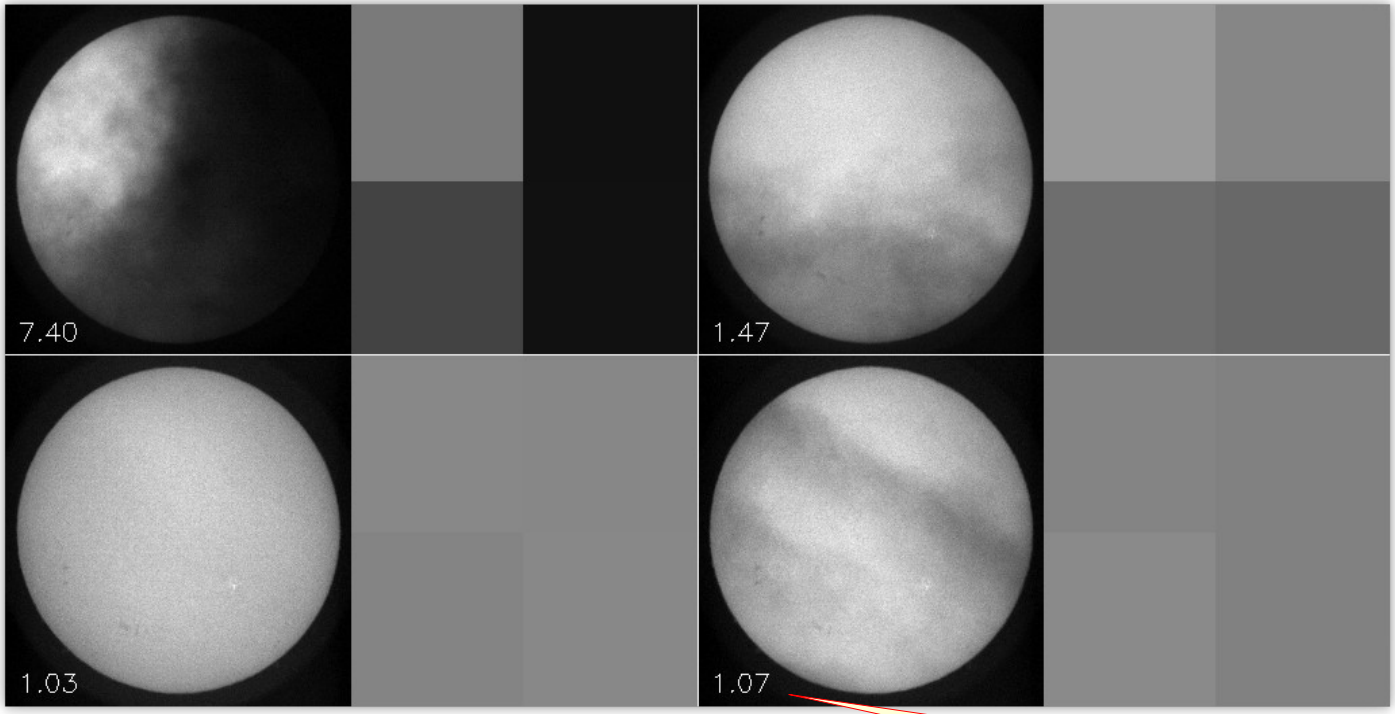
2 Quality – limb detection



2 Quality - inhomogeneities

reduce image to 4 pixel (2x2) and compare brightest to faintest

1.0 = perfect



2 Quality - sharpness

image contrast changes with solar activity (filaments, active regions, spots)
→ cannot be used as an absolute measure

solution:
apply blurring to image and correlate with original image → if image was already unsharp originally, it has a higher correlation

2 Quality – other parameters

Exposure time: high exposure times are a result of clouds

Mean intensity in AOI: should be near the fixed value, if clouds move fast over the solar disc, the intensity can be too high or too low, as the camera cannot be adjusted fast enough

File size: very rarely files are not transmitted or recorded completely, these files are deleted

2 Quality - result

3 classes obtained from a combination of above parameters

bad – not used, only moved to temp archive

fair – good enough for standard processing and visual inspections

good – suitable for full processing (e.g. flare detection & ESA space weather portal)

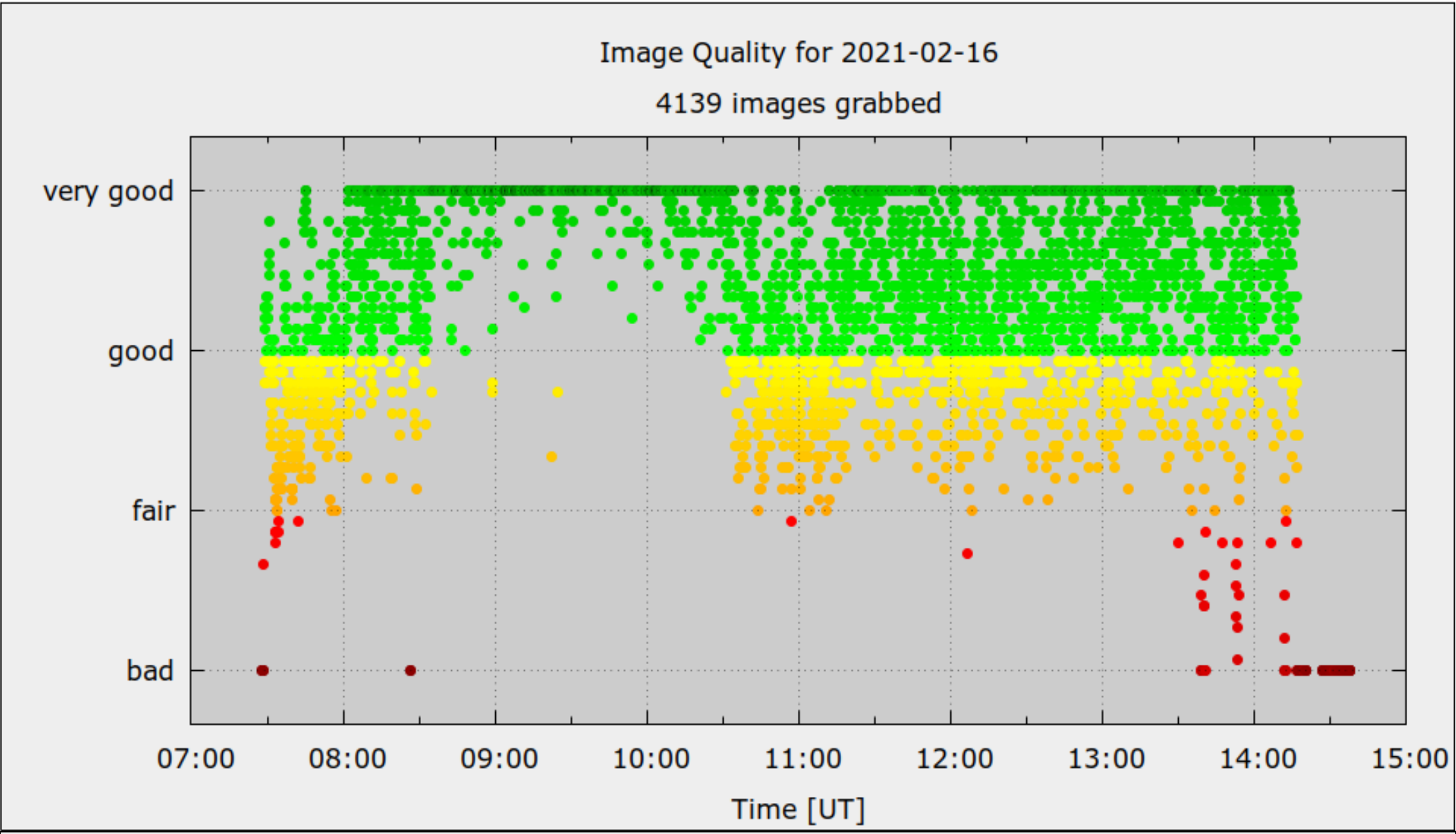
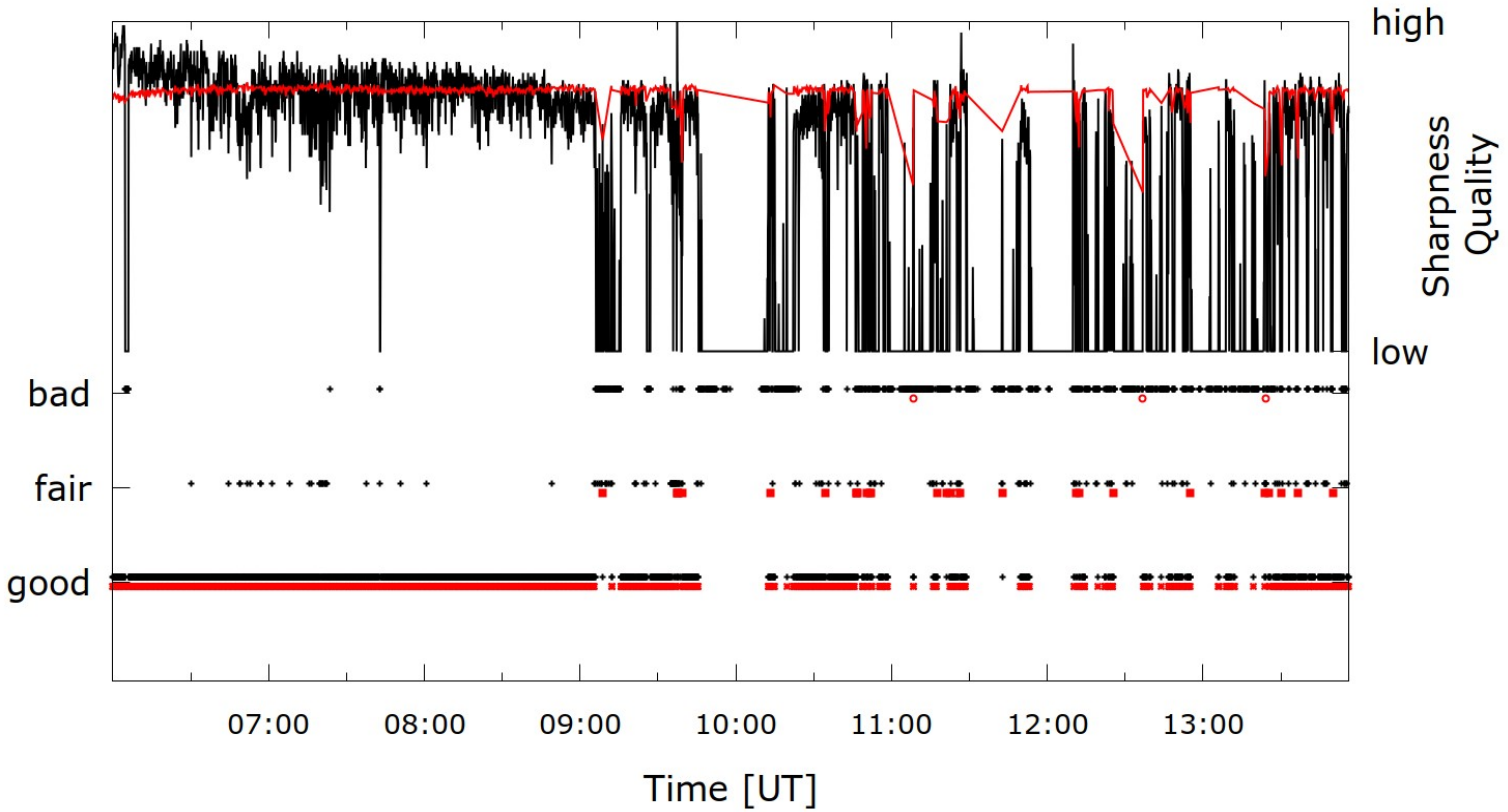


Image Quality for 2021-02-16
4139 images grabbed
very good
good
fair
bad
07:00
08:00
09:00
10:00
11:00
12:00
13:00
14:00
15:00
Time [UT]

2 Quality - comparison



black – KSO quality
(includes all mages)

red – GAN/Jarolim
(no bad images available)

3 Standard processing - FITS

update header information: using keyword from Metadata Definition for Solar Orbiter Science Data (ESA, De Groof, Walsh, and Williams, 2019)

no change in the data block! - raw data is stored

Standard processing - JPEG

1 center solar disc

2 derotate camera tilt angle

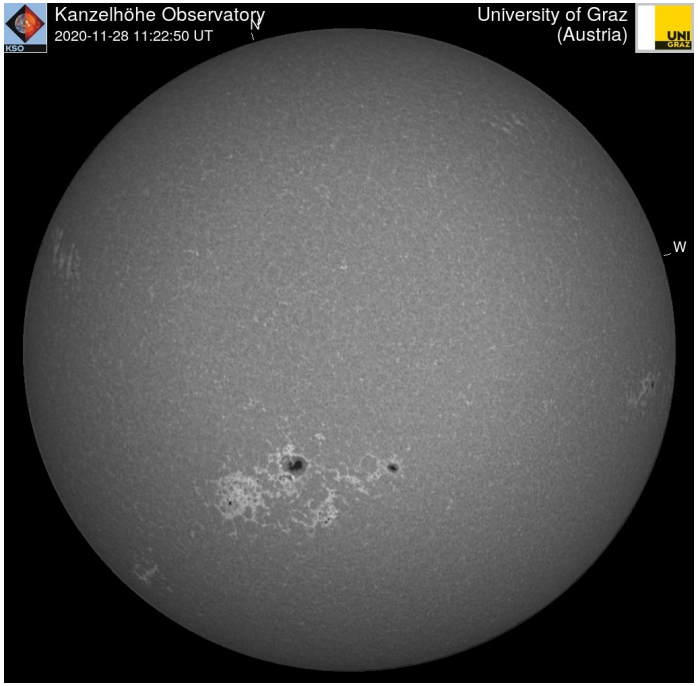
3 intensity adjustment (for H-alpha also above limb)

4 apply unsharp masking (for higher contrast)

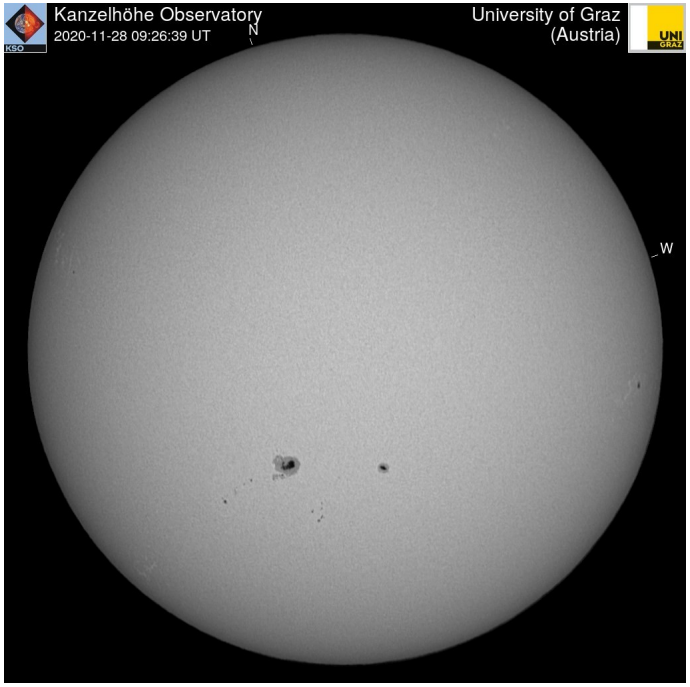
5 add North and West indicator

6 add logos

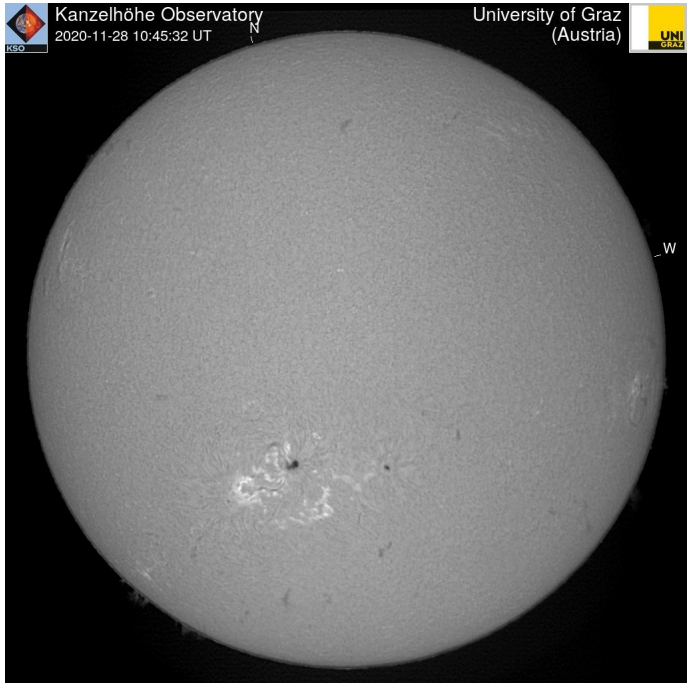
3 Standard processing - JPEG



CaII K



White-light



H-alpha

4 Enhanced processing - JPEG

additionally to standard processing:

colourize images (H-alpha = red)

add heliographic grid

remove center-to-limb variation (+ flatfield)

(*for Ca II K only in live image*)

4 Enhanced processing - CLV

process concentric rings (at each radial position)

apply **running median** filter to rings:
is not sensitive to spots, flares or filaments

disc center: averaging – median filter width too short

computation intensive (1.5sec/8 cores/2048x2048pix)

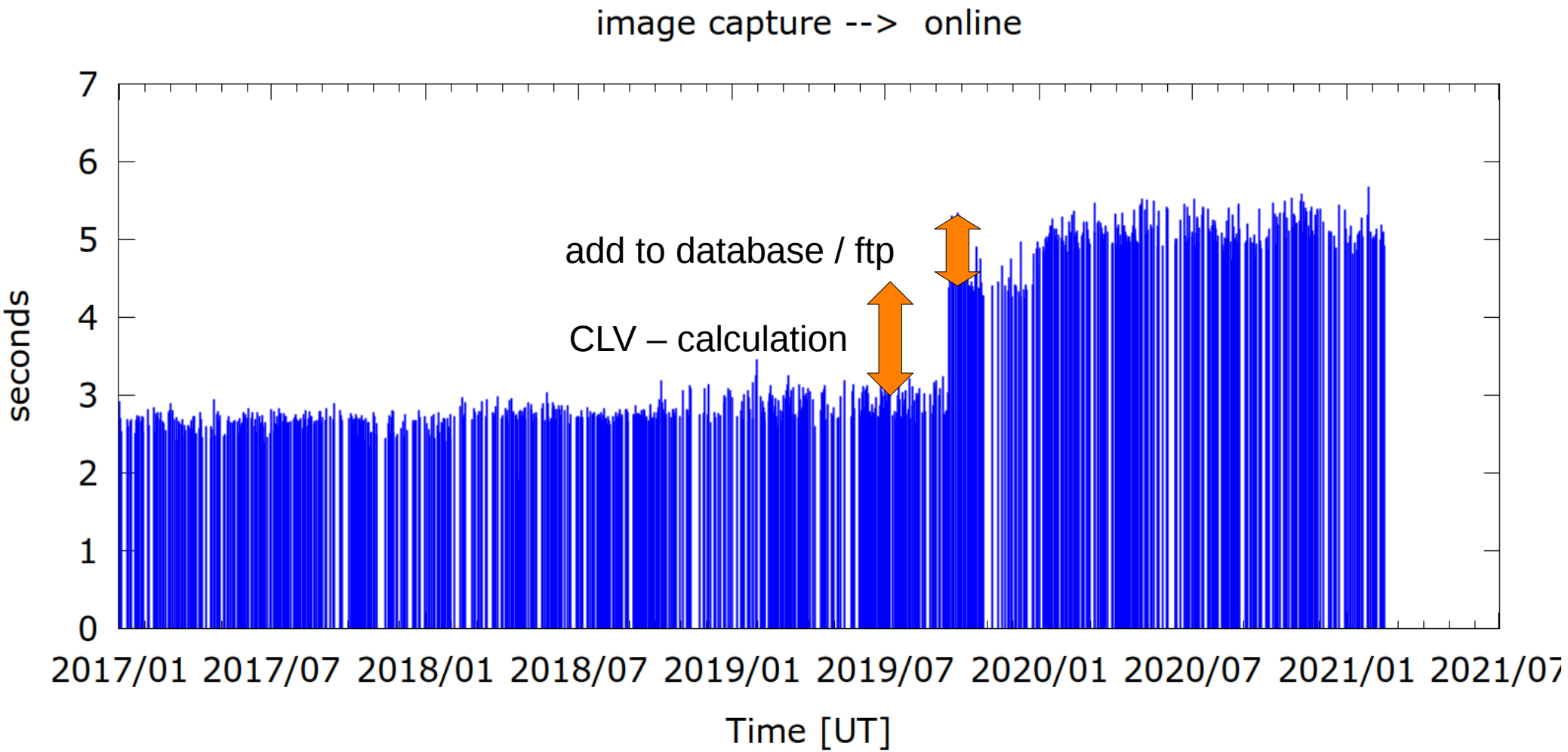
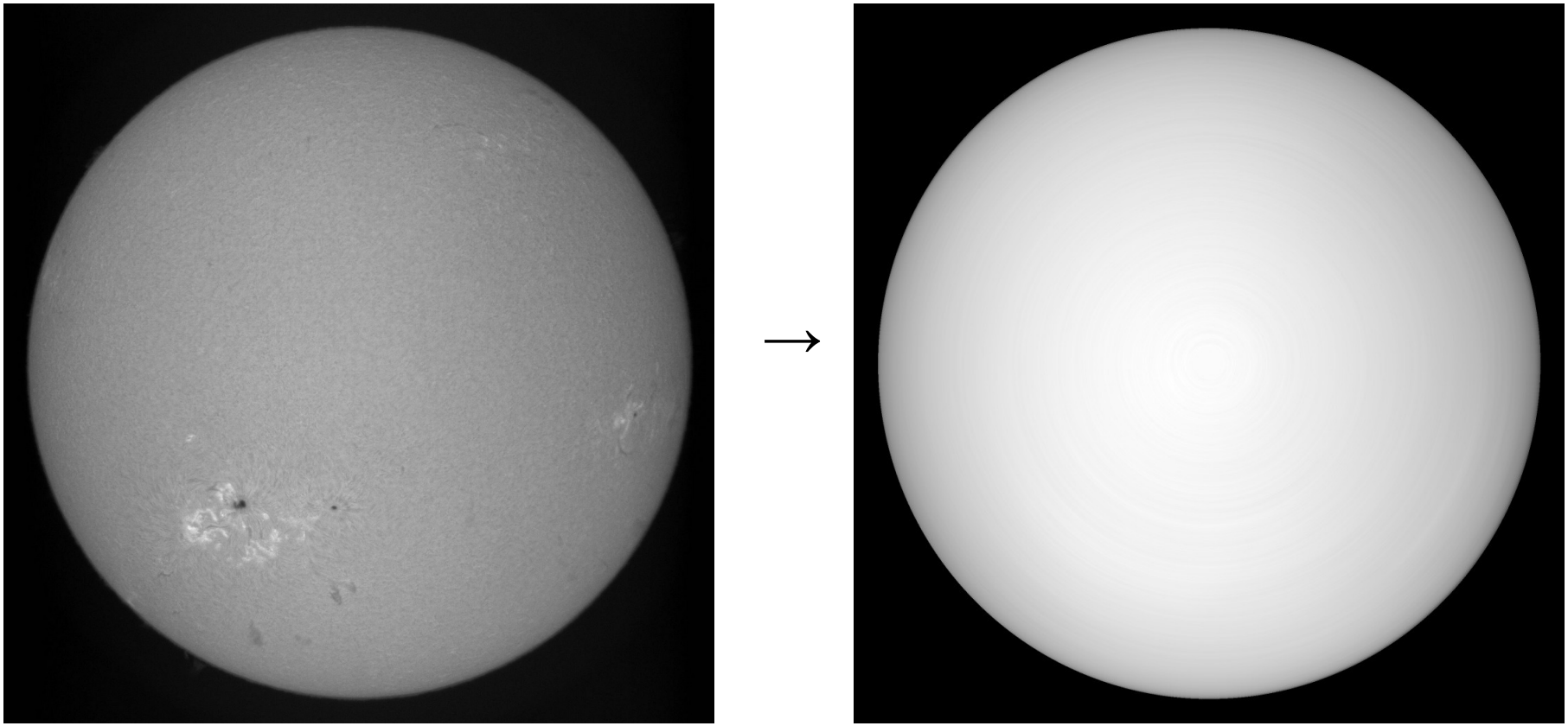
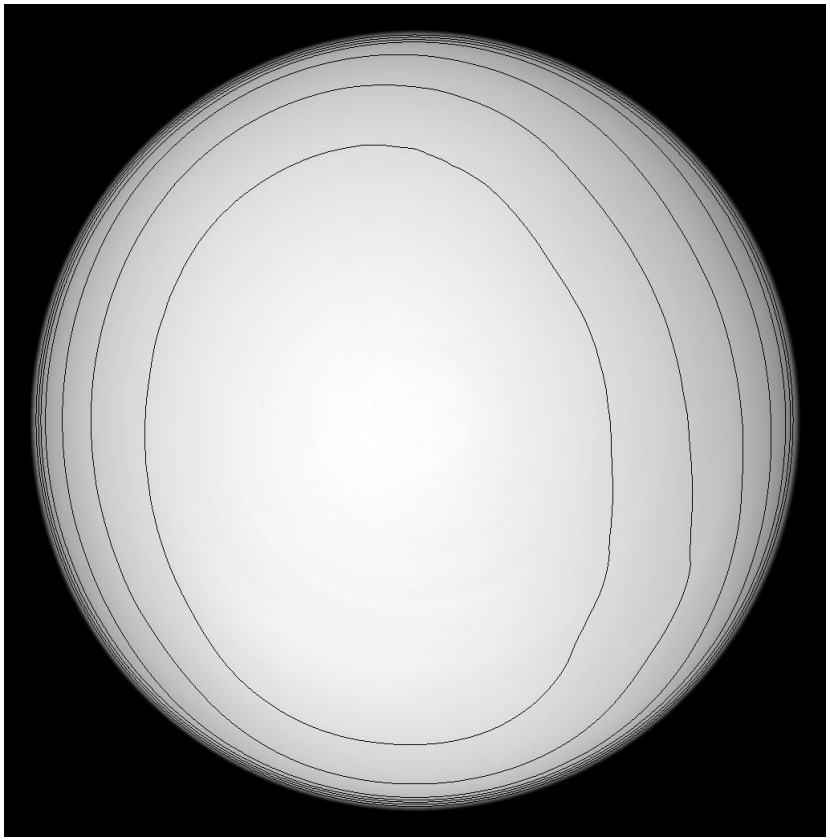


image capture --> online
seconds
0
1
2
3
4
5
6
7
add to database / ftp
CLV – calculation
2017/01
2017/07
2018/01
2018/07
2019/01
2019/07
2020/01
2020/07
2021/01
2021/07
Time [UT]

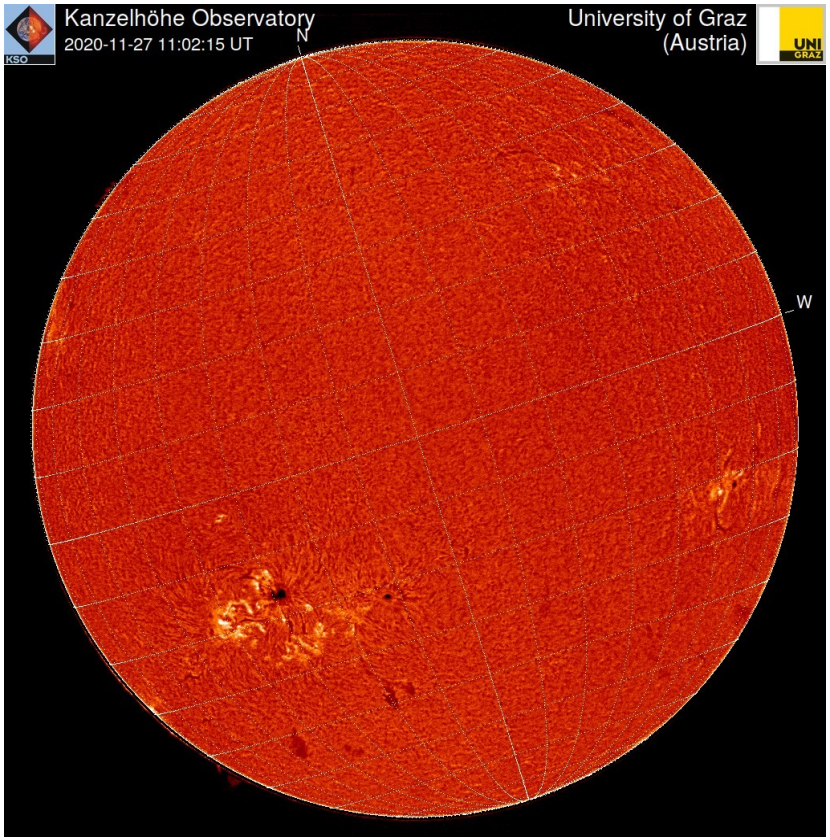
4 Enhanced processing - CLV



4 Enhanced processing - CLV



→



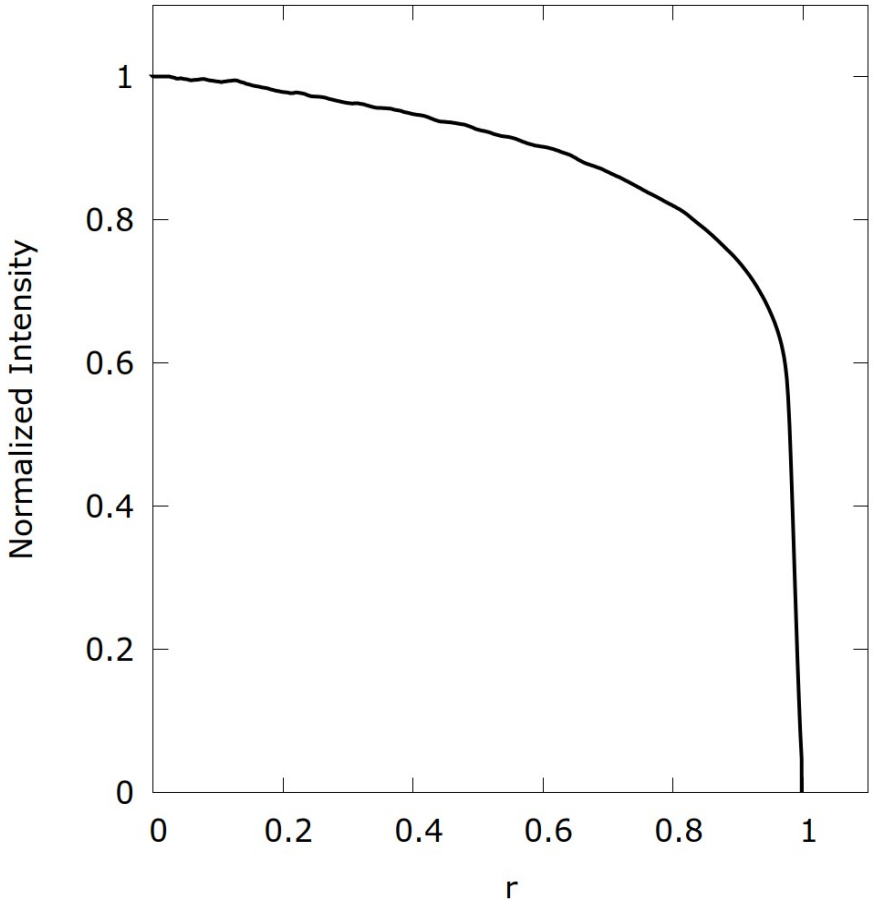
4 Enhanced processing - CLV

CLV – profile

median of complete concentric rings

can be described by a simple formula:

$$y = \frac{1 + b\cos\left(\arcsin\left(a\frac{r}{r_0}\right)\right)}{1+b}$$



4 Enhanced processing - CLV

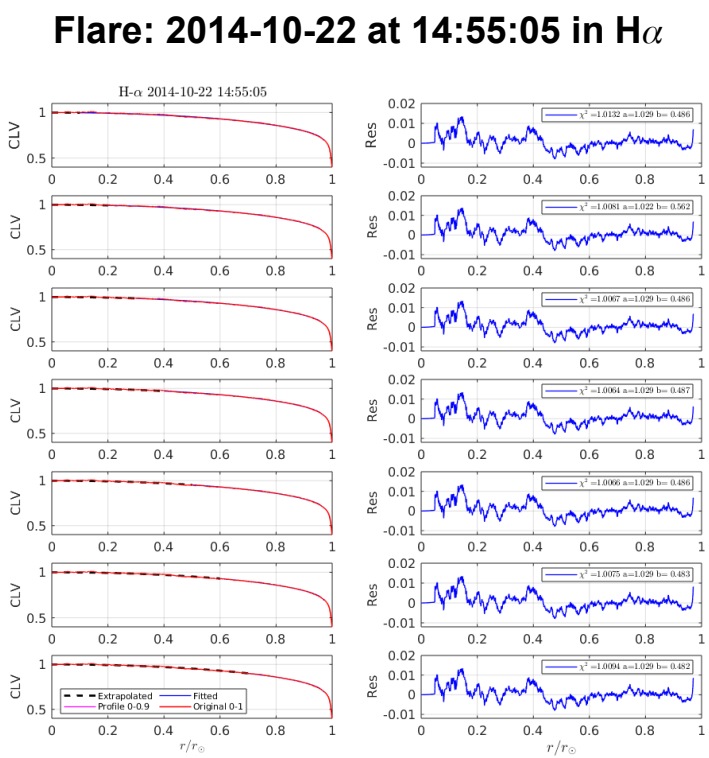


Figure 1. CLV analysis from top to bottom: fitting until 0.97r/r⊙, extrapolated values, CLV profile from 0−0.97r/r⊙ and Original profile from 0−1r/r⊙ (left). Residual values (Res), reduced χ^2 (right).

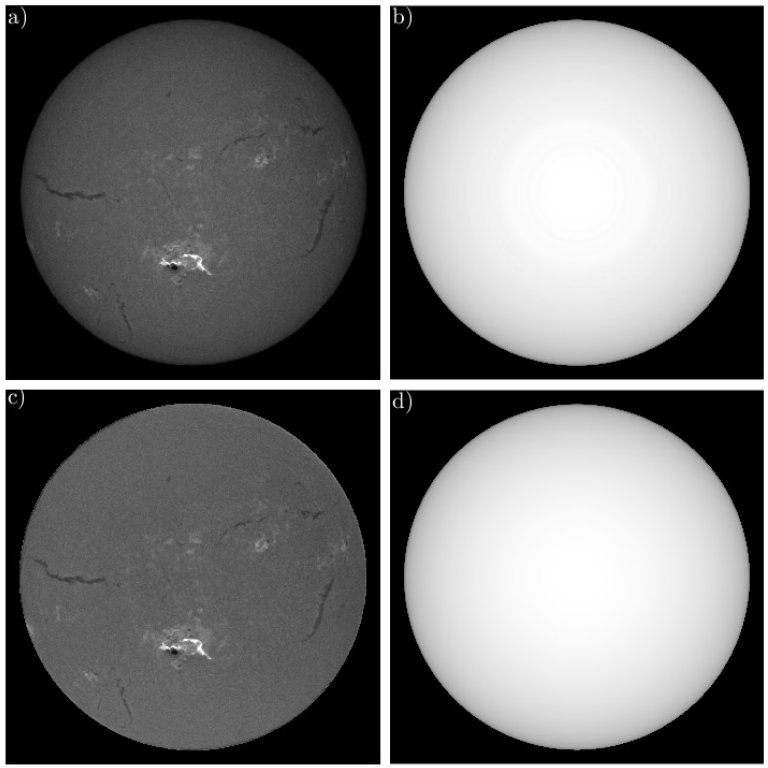
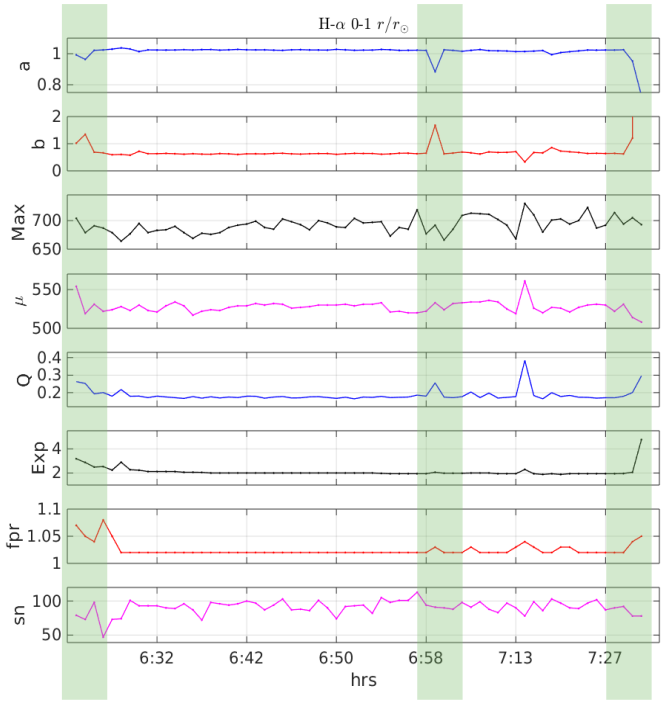


Figure 2. Flare 2014-10-22 at 14:55:05 in H-α. a) Original image, b) CLV raw, c) Image divided by CLV new and d) CLV new.

source: J.M. Rodriguez Gomez

4 Enhanced processing - CLV

Image quality 2020-05-19 Hα



Parameter a
Parameter b
} "quality tracers"

Maximum intensity

Mean intensity (μ)

Quality Q from GAN

Exposure time

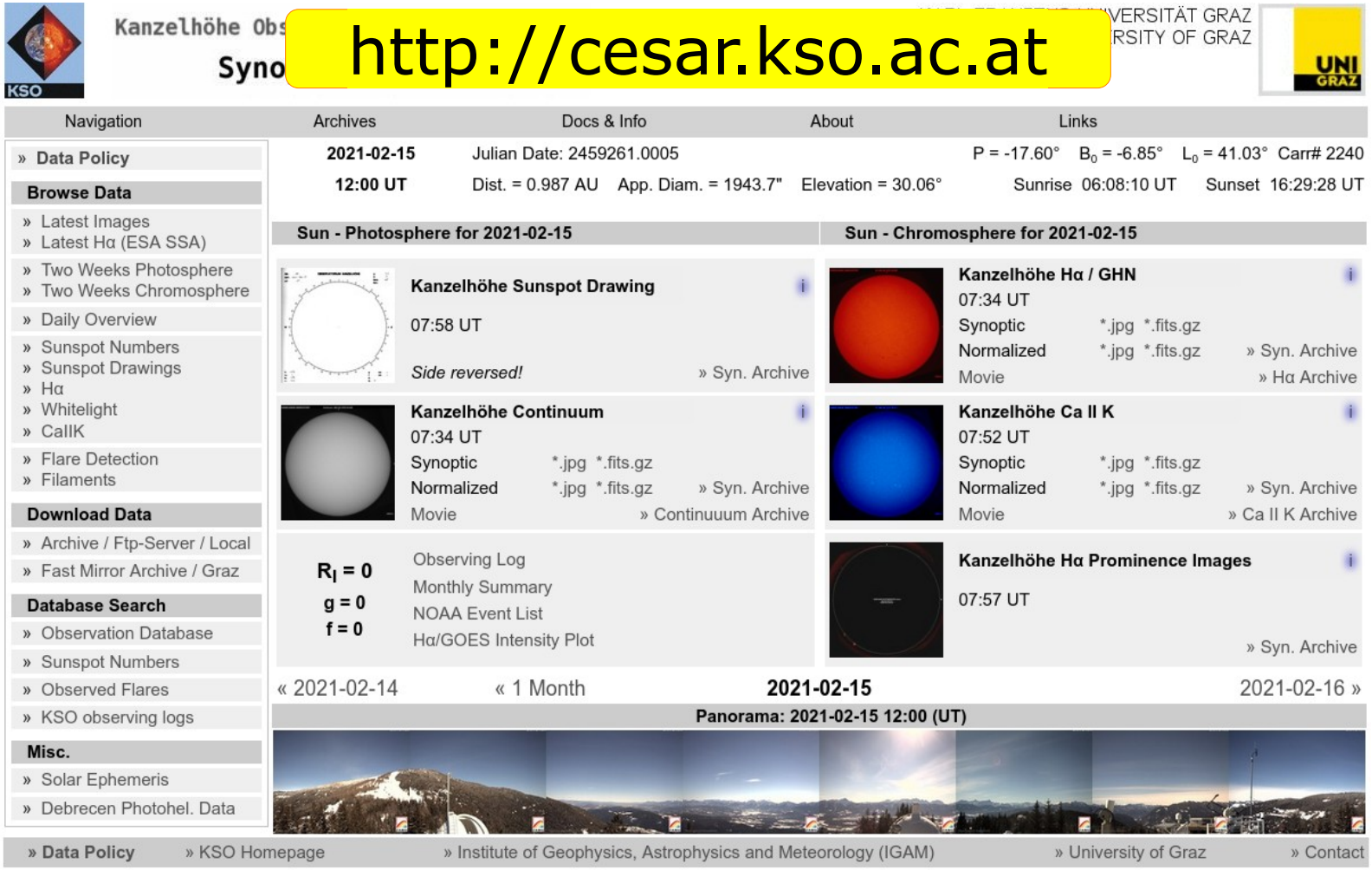
Four pixel ratio

Sharpness

Figure 3. 2020-05-19 time series in H-α. a and b parameter variations, max, mean (μ), quality (Q) and exp, fpr, sn observational parameters.

source: J.M. Rodriguez Gomez

5 Archive


http://cesar.kso.ac.at
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» Debrecen Photohel. Data
2021-02-15
12:00 UT
Julian Date: 2459261.0005
Dist. = 0.987 AU
App. Diam. = 1943.7"
Elevation = 30.06°
P = -17.60°
B0 = -6.85°
L0 = 41.03°
Carr# 2240
Sunrise 06:08:10 UT
Sunset 16:29:28 UT
Sun - Photosphere for 2021-02-15
Kanzelhöhe Sunspot Drawing
07:58 UT
Side reversed!
» Syn. Archive
Kanzelhöhe Continuum
07:34 UT
Synoptic *.jpg *.fits.gz
Normalized *.jpg *.fits.gz
» Syn. Archive
Movie
» Continuum Archive
RI = 0
g = 0
f = 0
Observing Log
Monthly Summary
NOAA Event List
Hα/GOES Intensity Plot
Sun - Chromosphere for 2021-02-15
Kanzelhöhe Hα / GHN
07:34 UT
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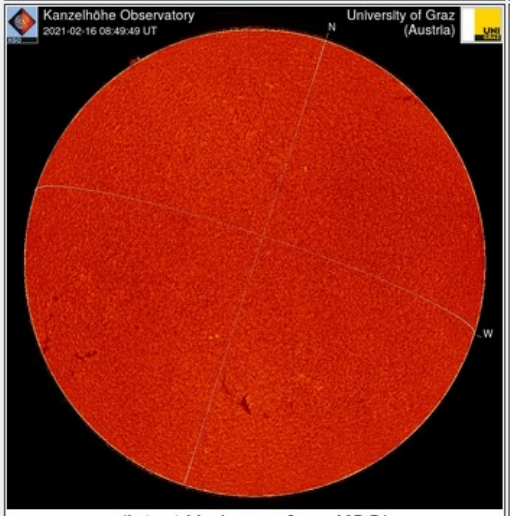
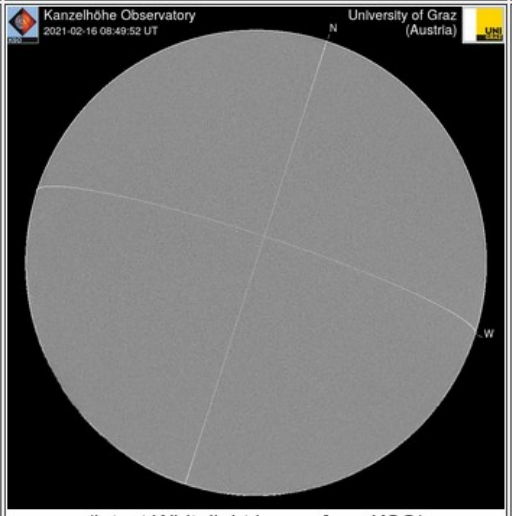
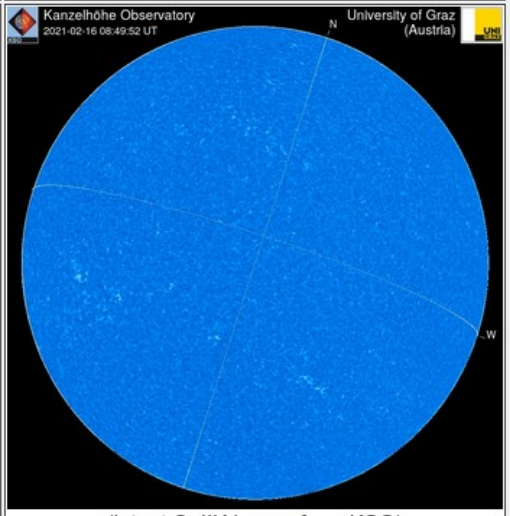
Normalized *.jpg *.fits.gz
» Syn. Archive
Movie
» Hα Archive
Kanzelhöhe Ca II K
07:52 UT
Synoptic *.jpg *.fits.gz
Normalized *.jpg *.fits.gz
» Syn. Archive
Movie
» Ca II K Archive
Kanzelhöhe Hα Prominence Images
07:57 UT
» Syn. Archive
« 2021-02-14
« 1 Month
2021-02-15
2021-02-16 »
Panorama: 2021-02-15 12:00 (UT)
» Data Policy
» KSO Homepage
» Institute of Geophysics, Astrophysics and Meteorology (IGAM)
» University of Graz
» Contact

5 Archive - Mirror

http://kanzelhohe.uni-graz.at

SOLAR-TERRESTRIAL INVESTIGATIONS AND ARCHIVES

Kanzelhöhe Hα, Whitelight and CaIIK Data Archive

Hα Archive	Whitelight Archive	CaIIK Archive
		
(latest Hα image from KSO)	(latest Whitelight image from KSO)	(latest CaIIK image from KSO)
» Archive...	» Archive...	» Archive...

Start Page | Kanzelhöhe Archive | Kanzelhöhe Homepage | ESA SSA KSO | Data Policy

5 Archive - ftp

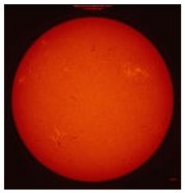
ftp.kso.ac.at
user: download
pass: 9521treffen

Navigation

Data Download

Raw FITS data (only header processed) - JPEG quicklook images - daily movies - flare movies
There are two possibilities to download data from our archive:
1) You can use the links listed below to get directly to the data directories or
2) you can also access our ftp-server.
If you go directly to the directories you will need some download manager for a more convenient download.

H-Alpha Chromospheric Data



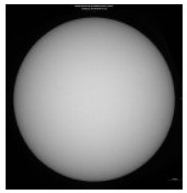
» 4MPix 12bit CCD
Image Format: jpg, fits
Data since 2008/06/01

» 1MPix 10bit CCD
Image Format: jpg, fits
Data since 2005/07/13

» 1MPix 8bit CCD
Image Format: jpg, fits
Data since 1998/09/24

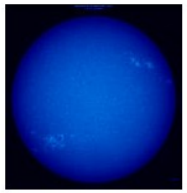
» 1MPix 8bit scanned
Image Format: jpg, fits
Data since 1973/05/05

Broadband Photospheric Data



» 4MPix 10/12bit CCD
Image Format: jpg, fits
Data since 2007/07/02

CaII-K Chromospheric Data



» 4MPix 12bit CCD
Image Format: jpg, fits
Data since 2010/07/31

Access to our ftp-server for download

- address: **» ftp.kso.ac.at**
- username: **download**
- password: **9521treffen**

» Data Policy !!

Contact: Werner Pötzi

» Data Policy » KSO Homepage » Institute of Geophysics, Astrophysics and Meteorology (IGAM) » University of Graz » Contact

5 Archive – Database access

- http://cesar.kso.ac.at/database/get_halpha.php?
  from=datetime&to=datetime
- http://cesar.kso.ac.at/database/get_wl.php?...
- http://cesar.kso.ac.at/database/get_caii.php?...

from and **to** start/end date and time: yyyy-mm-dd HH:MM:SS
ftype (optional) one of: all / jpeg / fits
html (optional) = 1 html output, default is csv list
qual (optional) the lowest quality level to select
filesize (optional) filesize of FITS

also used by Virtual Solar Observatory (VSO)