

Atlas of emission lines from gases discharge tubes

**Version 1.3
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Description

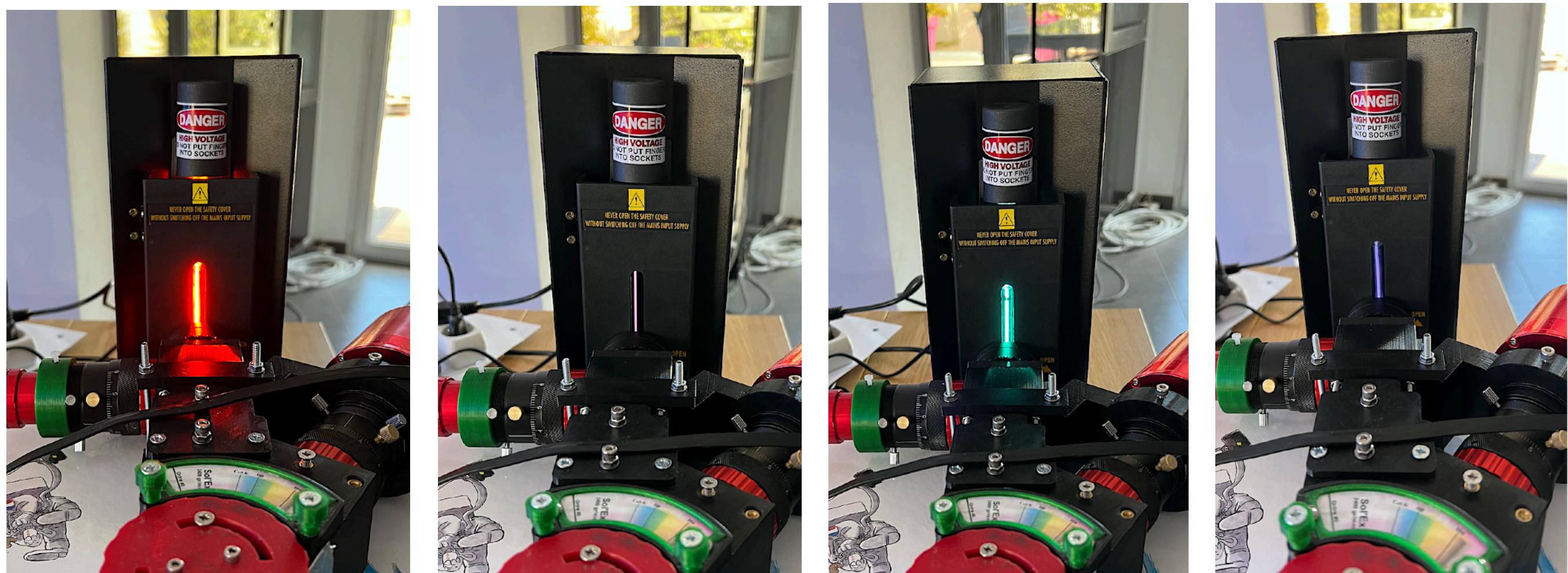
Atlas of emission lines from spectral tube that can be used to calibrate astronomical spectrograph (UVEX, Star'Ex, Lowspec, Alpy600, Lhires III, and more).

The light emitted by various low pressure spectral tubes (see opposite) is analyzed with a Star'Ex spectrograph used in various configurations (low resolution, medium resolution, high resolution).

Origin of spectral tubes + HT alimentation :

Sordalab : <https://www.sordalab.com>

3D Scientific : <https://www.3bscientific.com>



Neon

Argon

Xenon

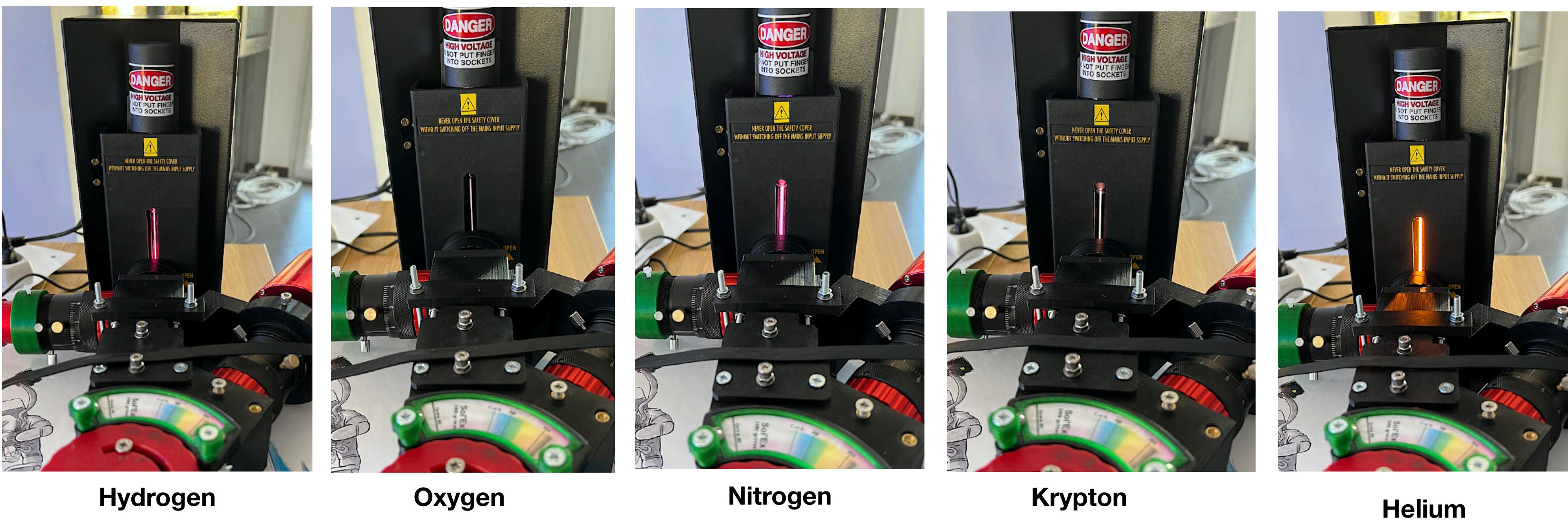
Mercury

Wavelength values for the Atlas are from the NIST database (air wavelength) : https://physics.nist.gov/PhysRefData/ASD/lines_form.html

Spectra are recorded by spectrograph Star'Ex (the « Star Explorer »). It is a 3D printing spectrograph designed for astronomical observation on small and moderate telescopes. It is a part of the Sol'Ex project (the « Sun Explorer ») : <http://www.astrosurf.com/solex/>

specINTI is used for data processing : <http://www.astrosurf.com/solex/specinti.html>

The atlas is organized according to some possible Star'Ex configurations (classical for usual spectrograph models).



Hydrogen

Oxygen

Nitrogen

Krypton

Helium



Configuration #1

Spectral coverage : 3850 Å - 7000 Å (visible range)

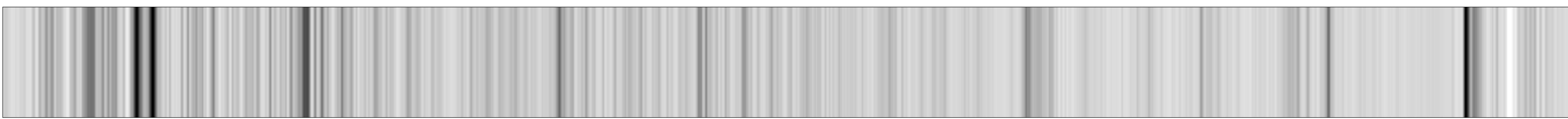
Star'Ex - 80 mm x 80 mm

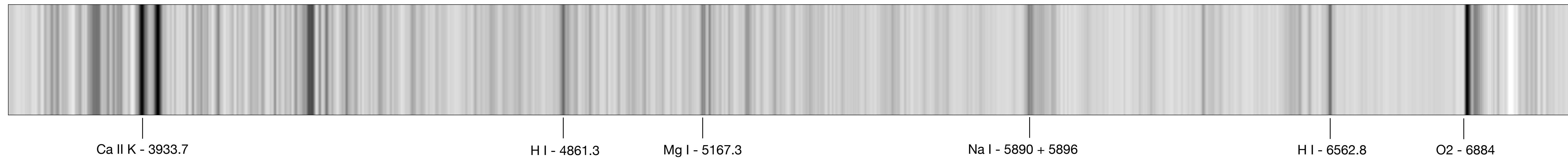
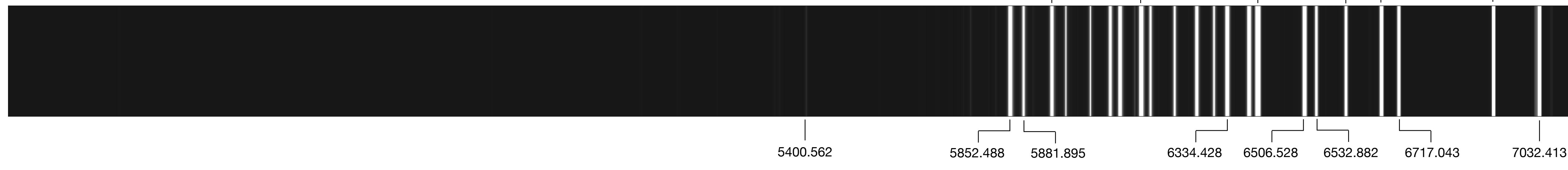
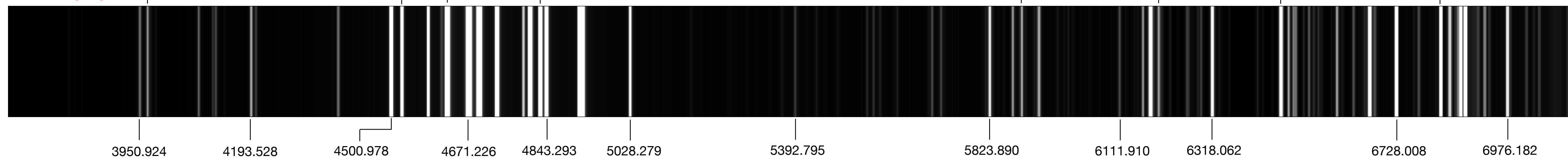
Grating : 300 lines/mm - blaze 500 nm

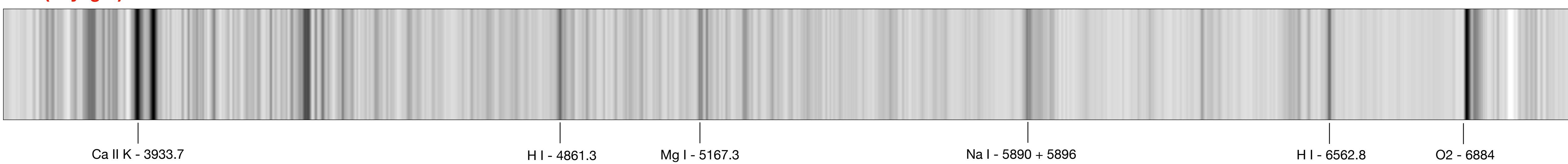
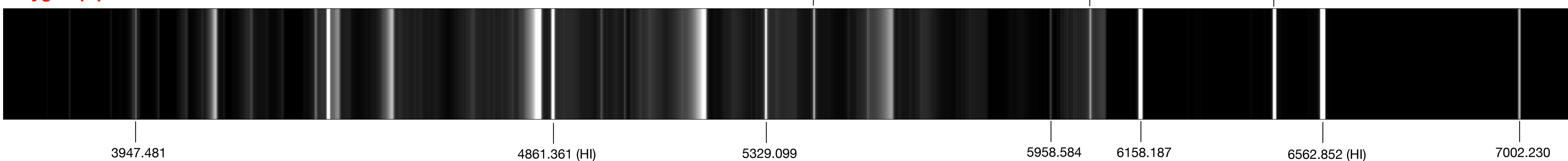
Slit : 19 microns

Optical beam : f/9

Camera : ASI183MM (0.973 Å/pixel)

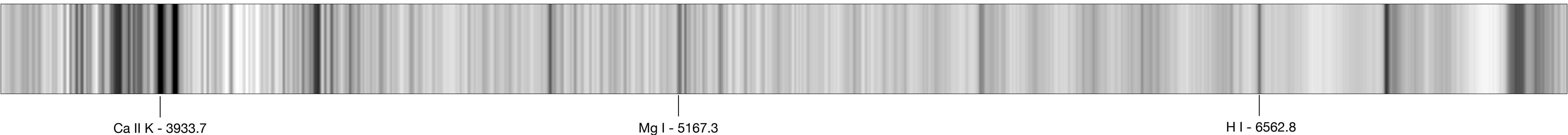
Sun (daylight)**Mercury (Hg)****Argon (Ar)****Kryton (Kr)**

Sun (daylight)**Neon (Ne)****Xenon (Xe)****Hydrogen (H)**

Sun (daylight)**Helium (He)****Nitrogen (N)****Oxygen (O)**

Low cost composite gases discharge lamps (neon + argon)

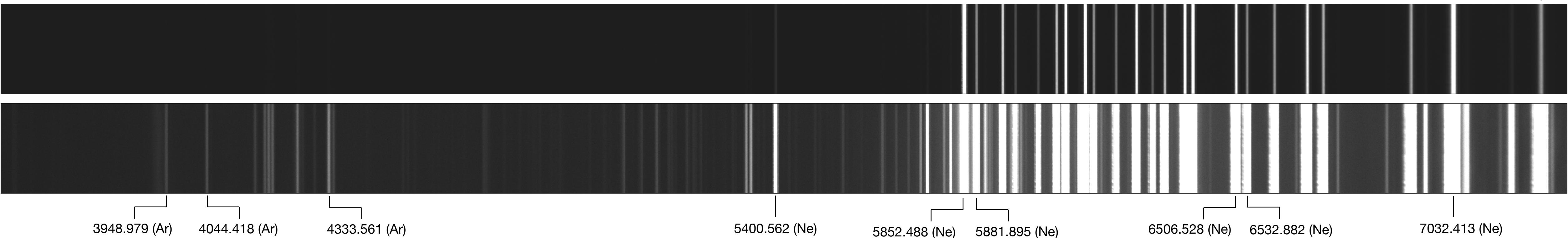
Sun (daylight)



Red miniature lamp - Conrad : Barthelme 00012340 Luciole 230 V 0.30 W E10 (2.90 €)

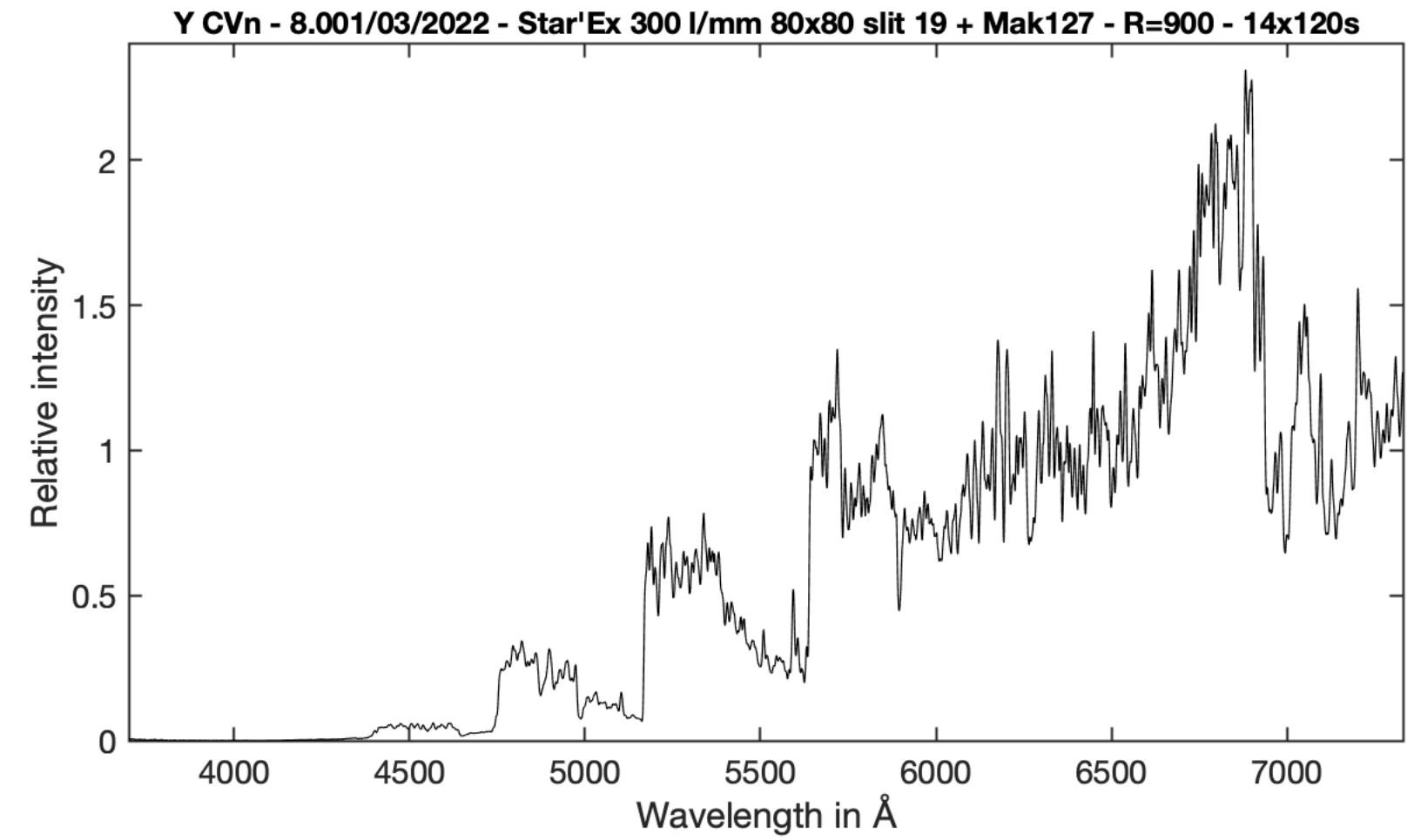
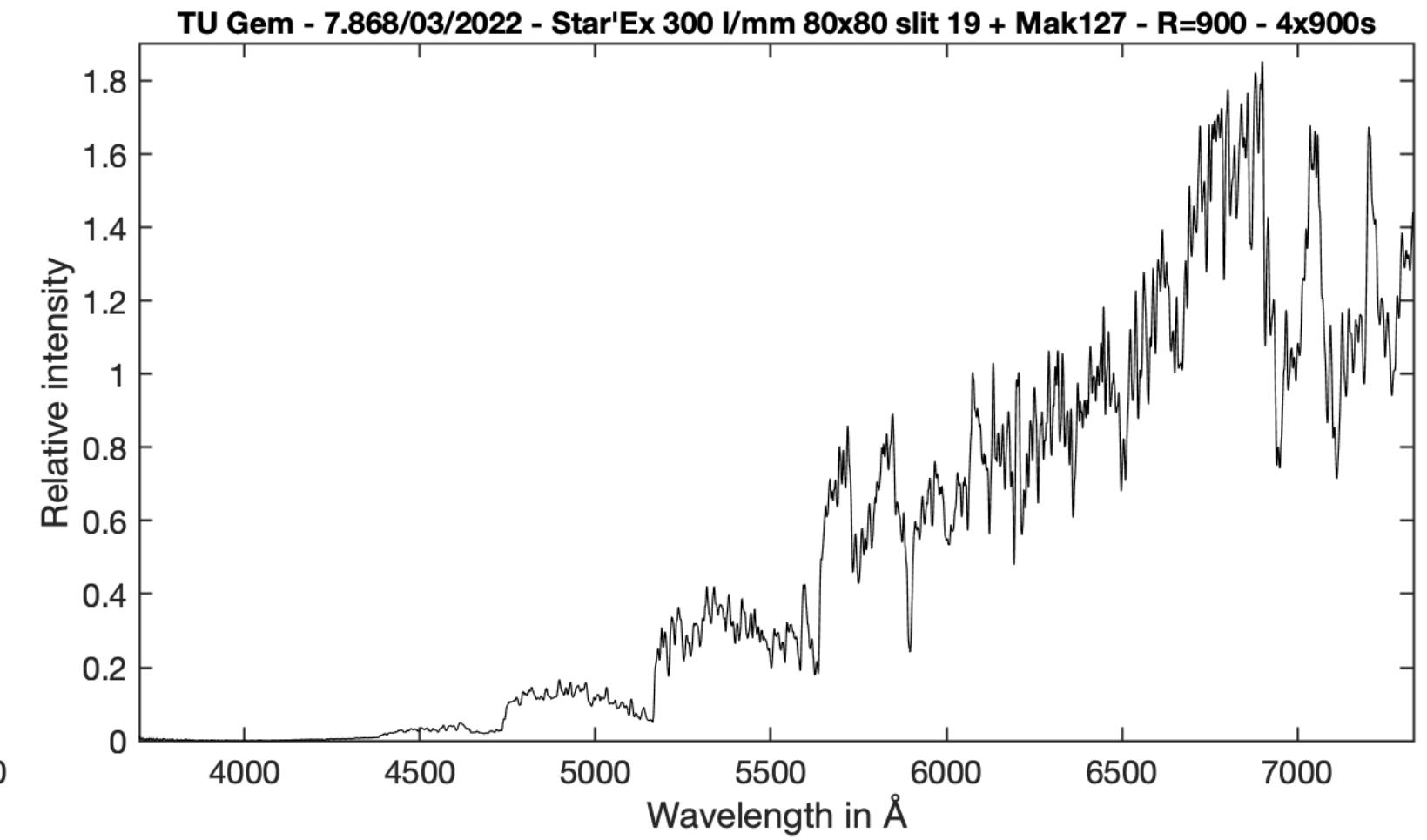
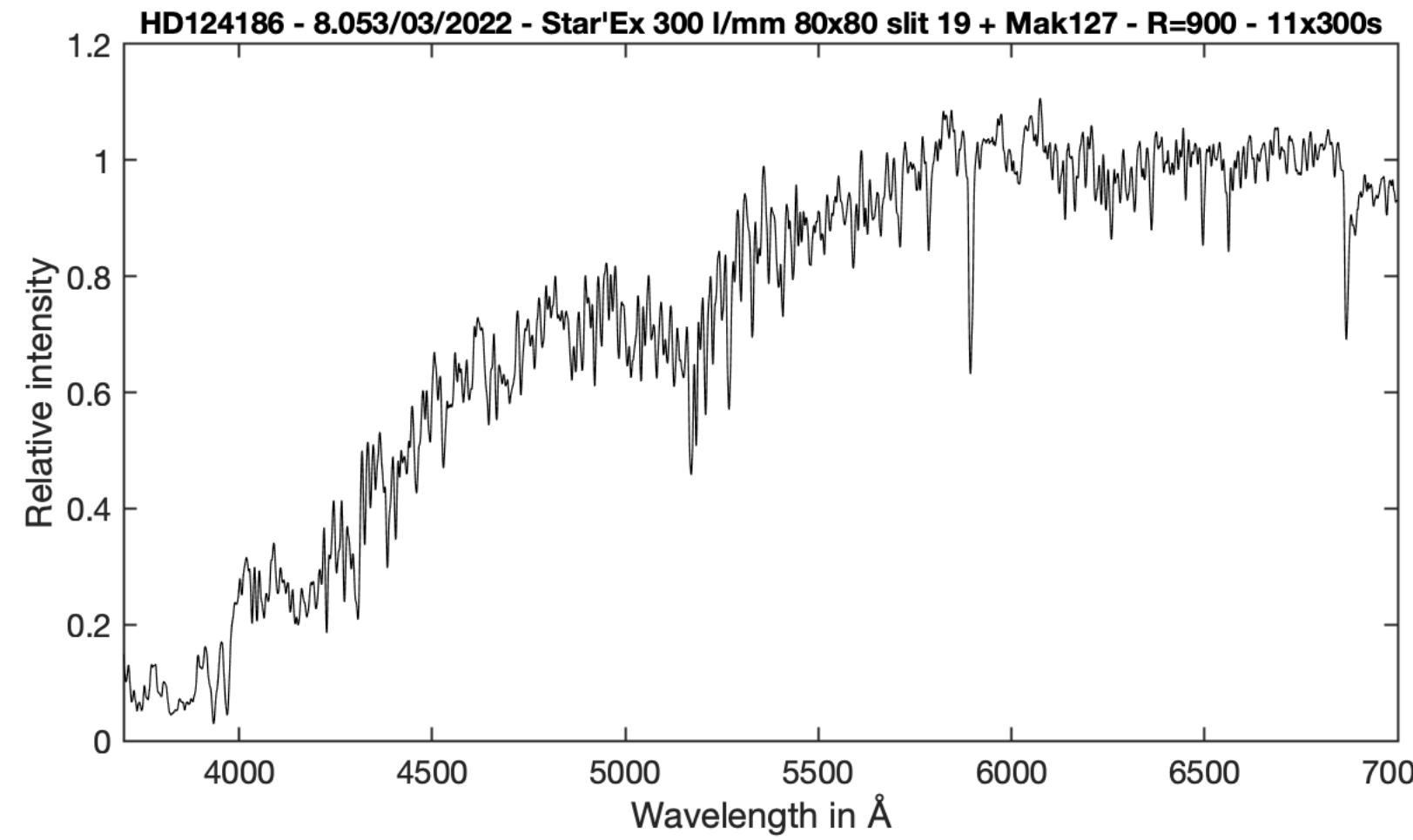
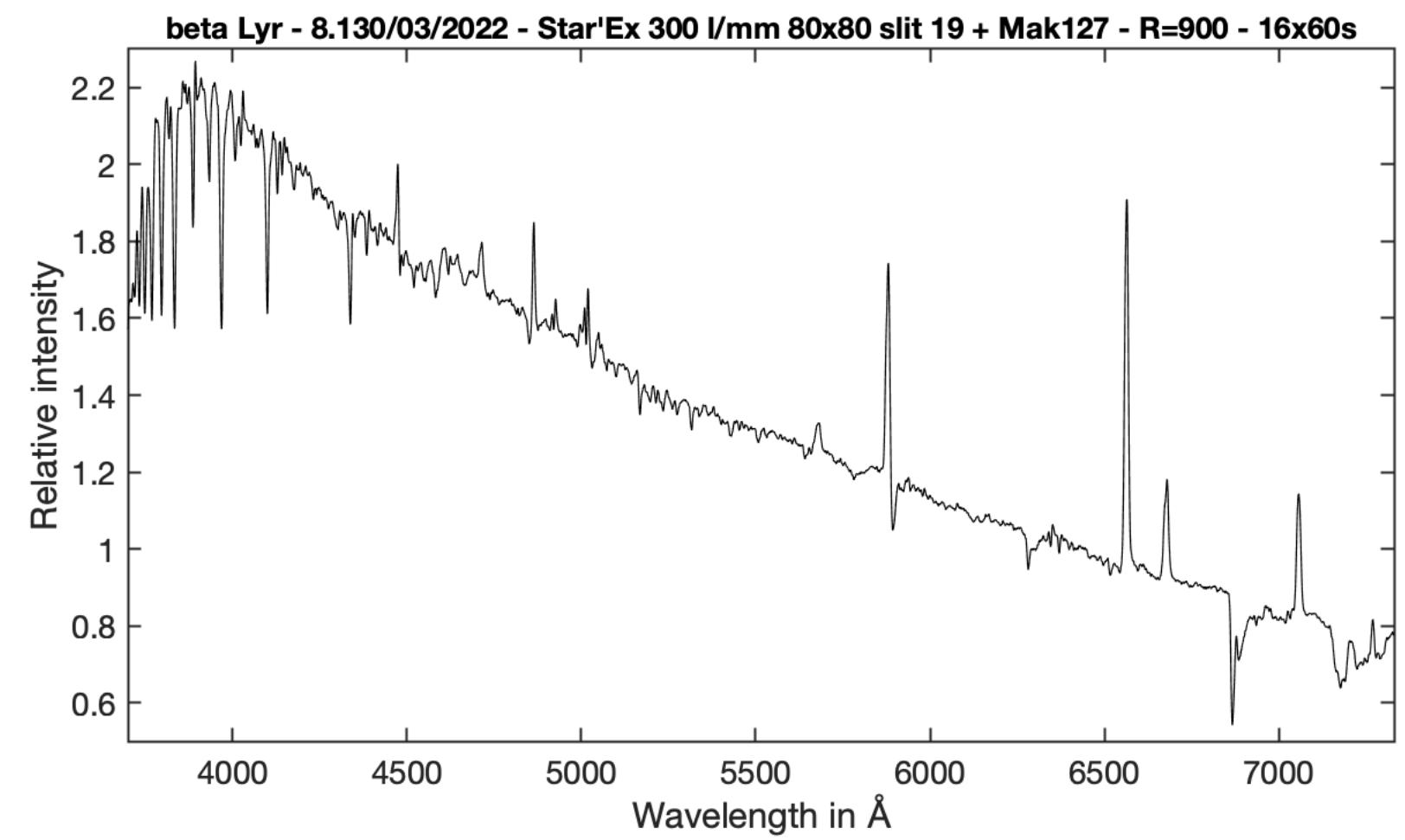
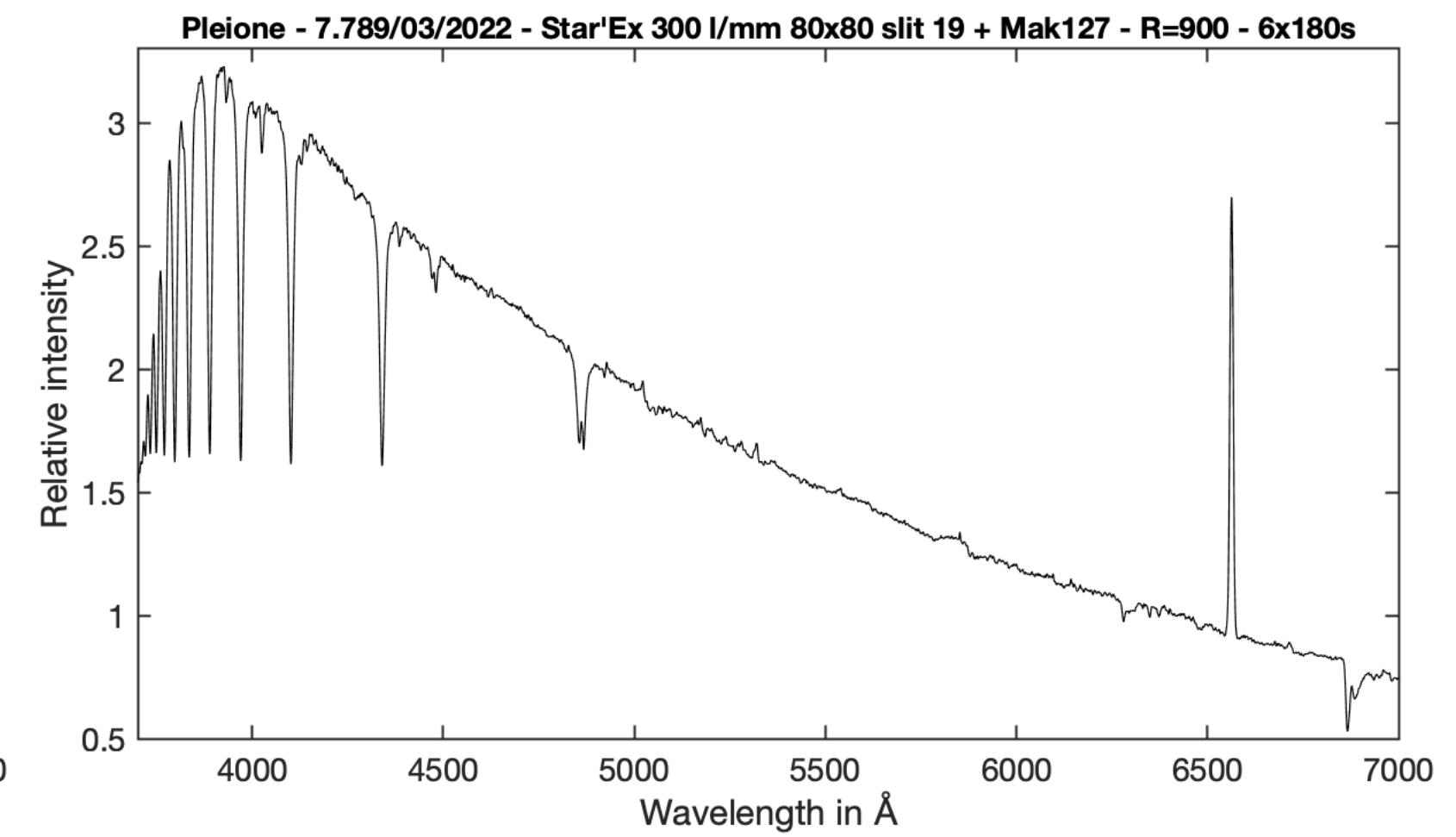
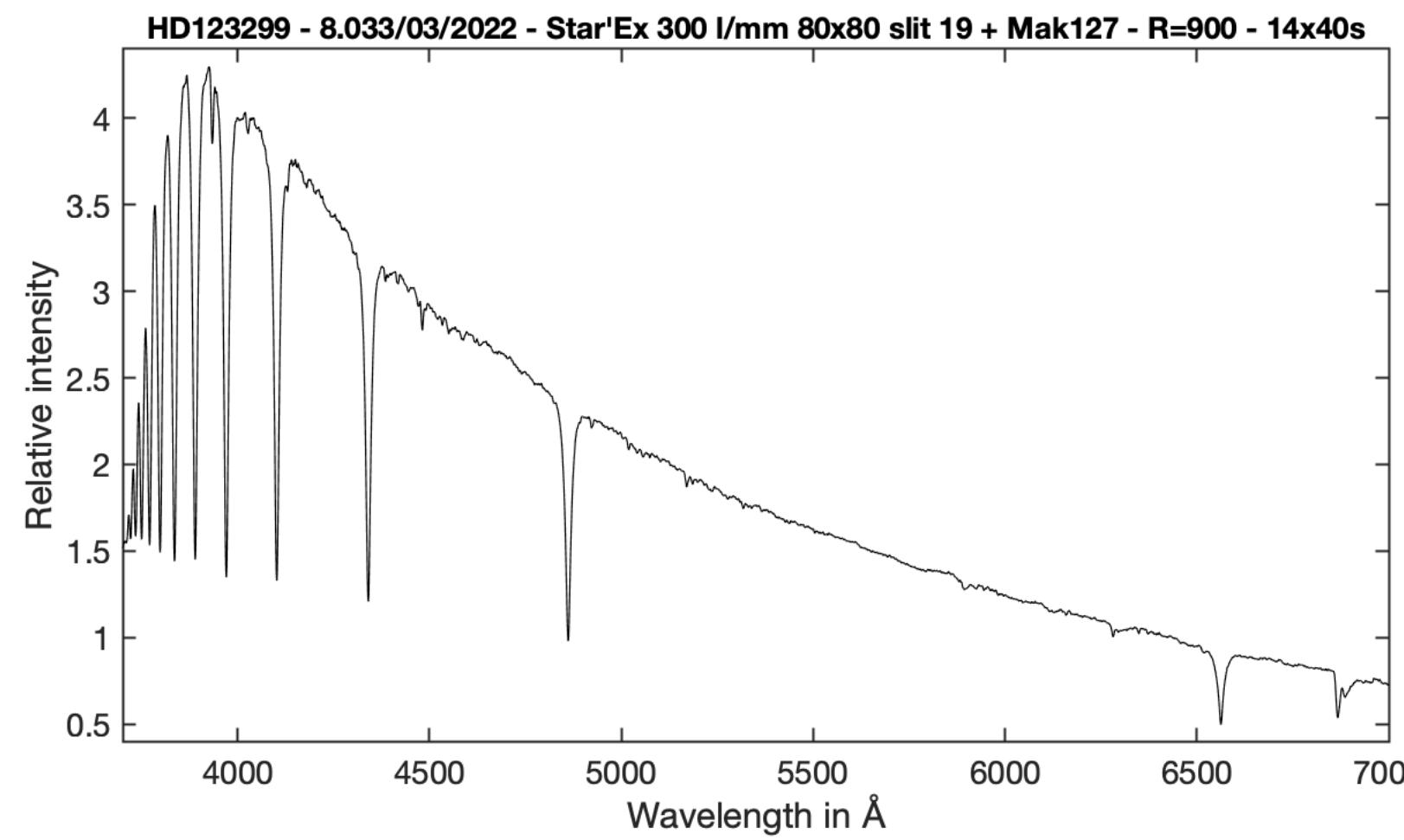
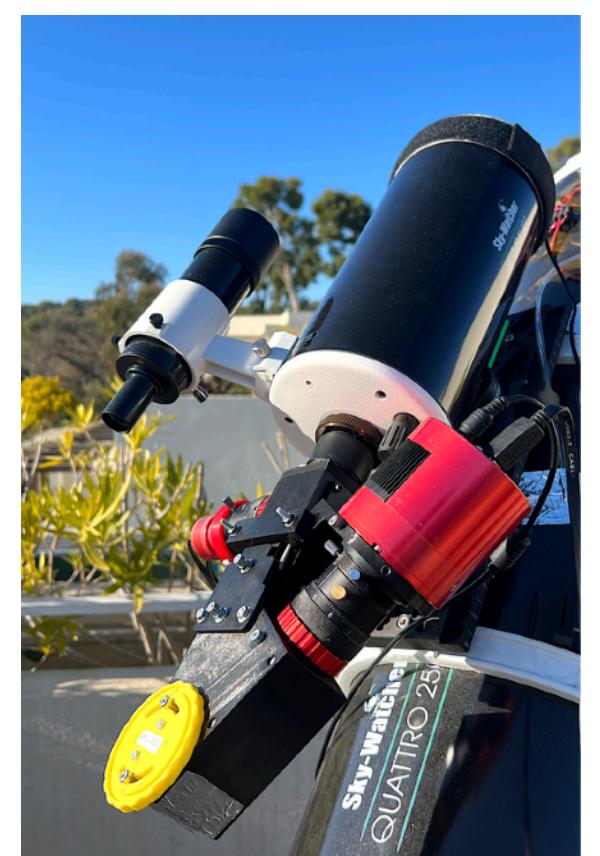


7245.166 (Ne)



Stellar spectra sample

Star'Ex 300 lines/mm on a Maksutov 127 mm telescope (VIS region)



Configuration #2

Spectral coverage : 3650 Å - 5500 Å (UV + blue range)

Star'Ex - 80 mm x 80 mm

Grating : 600 lines/mm - blaze 500 nm

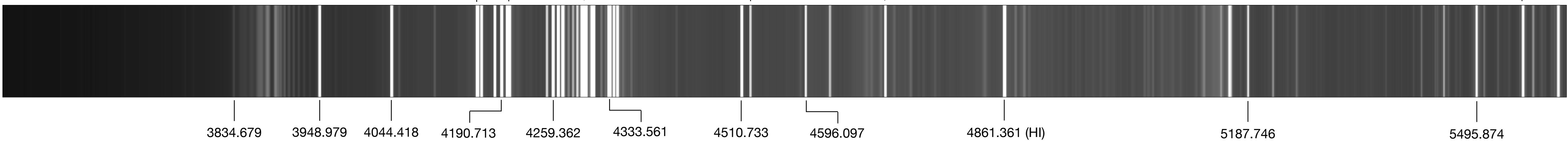
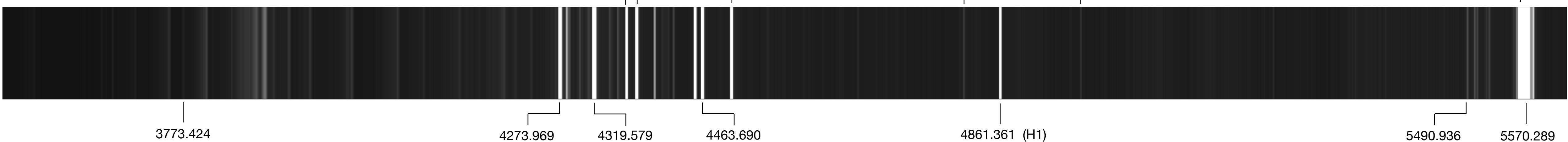
Slit : 19 microns

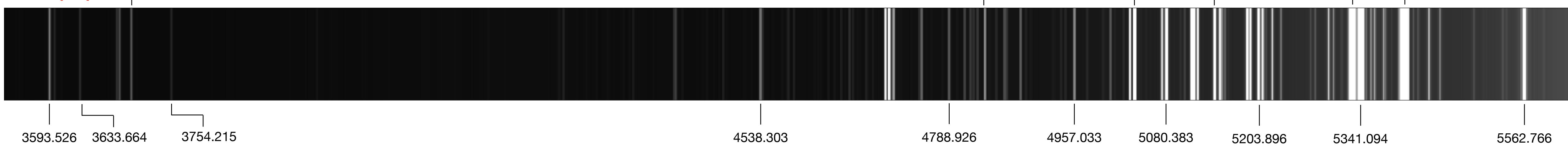
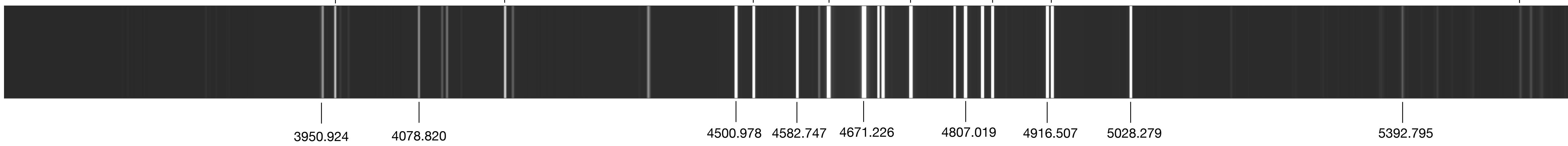
Optical beam : f/9

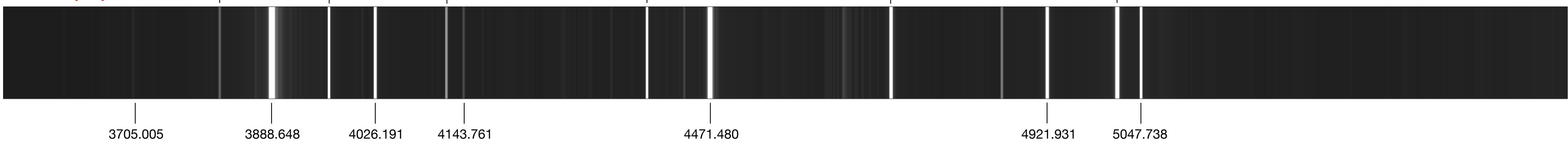
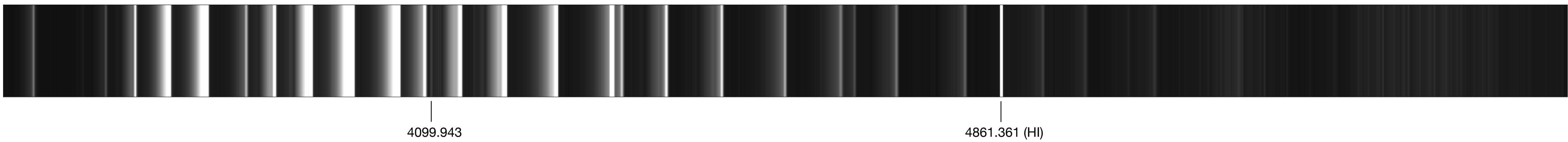
Camera : ASI183MM (0.495 Å/pixel)

Sun (daylight)

3654.842

Mercury (Hg)**Argon (Ar)****Krypton (Kr)**

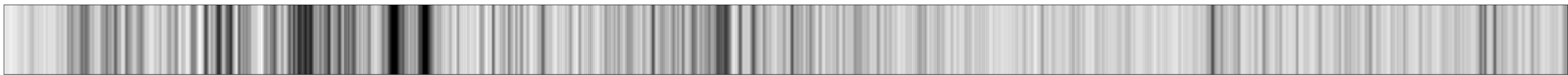
Sun (daylight)**Neon (Ne)****Xenon (Xe)****Hydrogen (H)**

Sun (daylight)**Helium (He)****Nitrogen (N)****Oxygen (O)**

Low cost composite gases discharge lamps (neon + argon)

UV+ blue - 600 l/mm

Sun - Daylight



Ca II K - 3933.68 Ca II H - 3968.49

HI - 4861.34

Mg I - 5167.33



Neon tube - Eisco Scientific



3593.526 (Ne)

3701.225 (Ne)

4538.303 (Ne)

4704.395 (Ne)

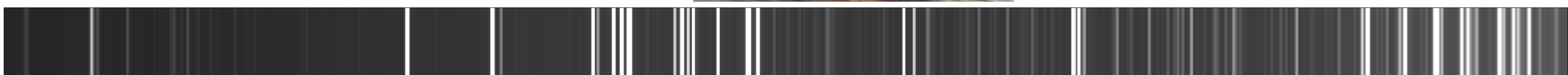
4837.314 (Ne)

4957.033 (Ne)

5203.896 (Ne)



Red miniature lamp - Conrad : Barthelme 00012340 Luciole 230 V 0.30 W E10 (2.90 €)



3593.526 (Ne)

3701.225 (Ne)

3948.979 (Ar)

4044.418 (Ar)

4200.674 (Ar)

4333.561 (Ar)

4510.733 (Ar)

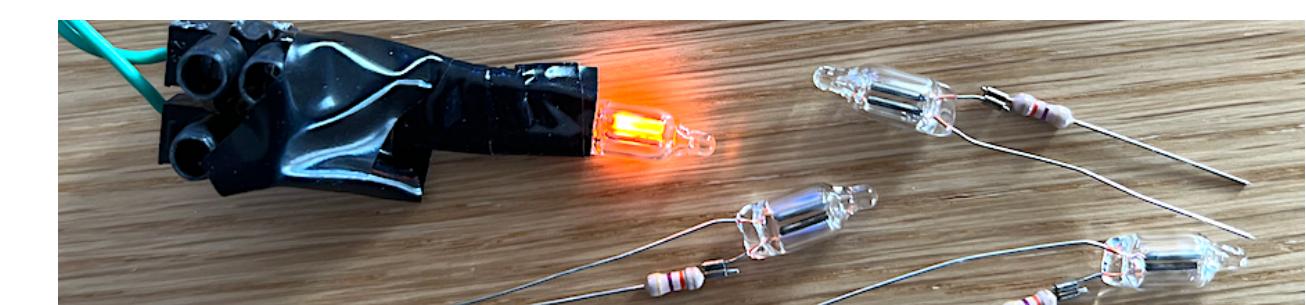
4538.303 (Ne)

4704.395 (Ne)

4837.314 (Ne)

4957.033 (Ne)

5203.896 (Ne)



Red miniature lamp - Conrad : TRU COMPONENTS 1590293 Glim Lamp 230 V 0.33 W (0.60 €)



3593.526 (Ne)

3701.225 (Ne)

3948.979 (Ar)

4044.418 (Ar)

4200.674 (Ar)

4333.561 (Ar)

4510.733 (Ar)

4538.303 (Ne)

4704.395 (Ne)

4837.314 (Ne)

4957.033 (Ne)

5203.896 (Ne)

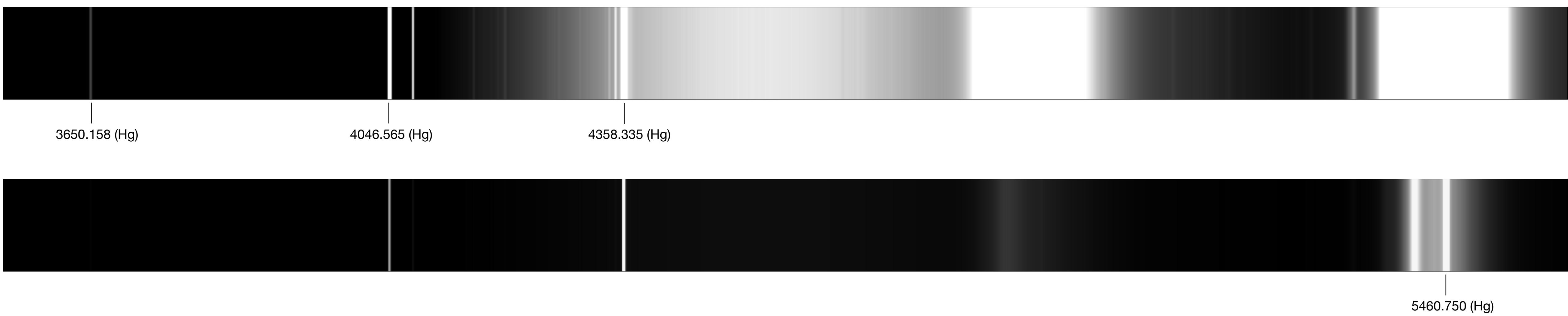
Fluo-compact lamp (mercury excitation gas)

UV+ blue - 600 l/mm

Sun (daylight)

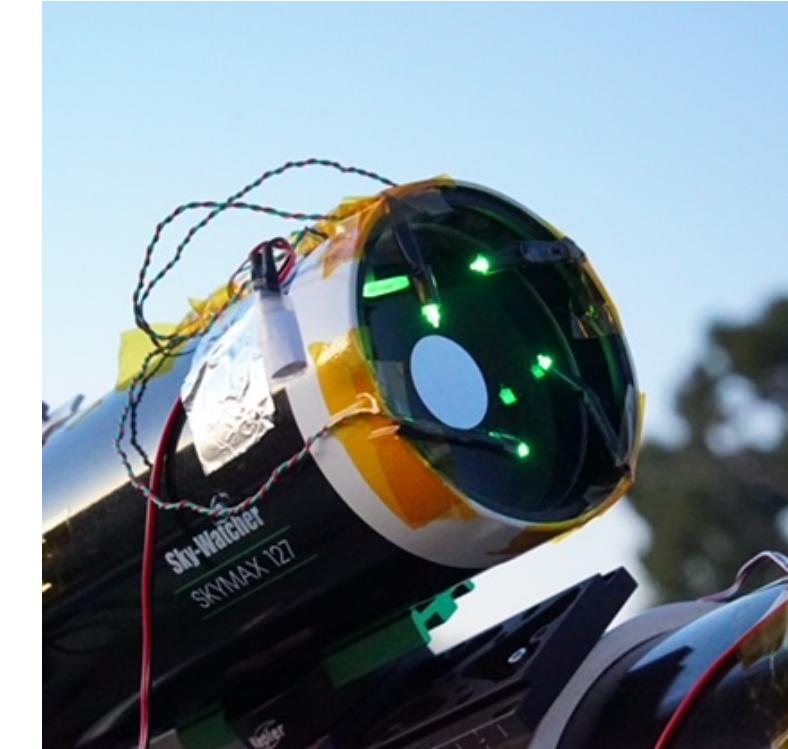
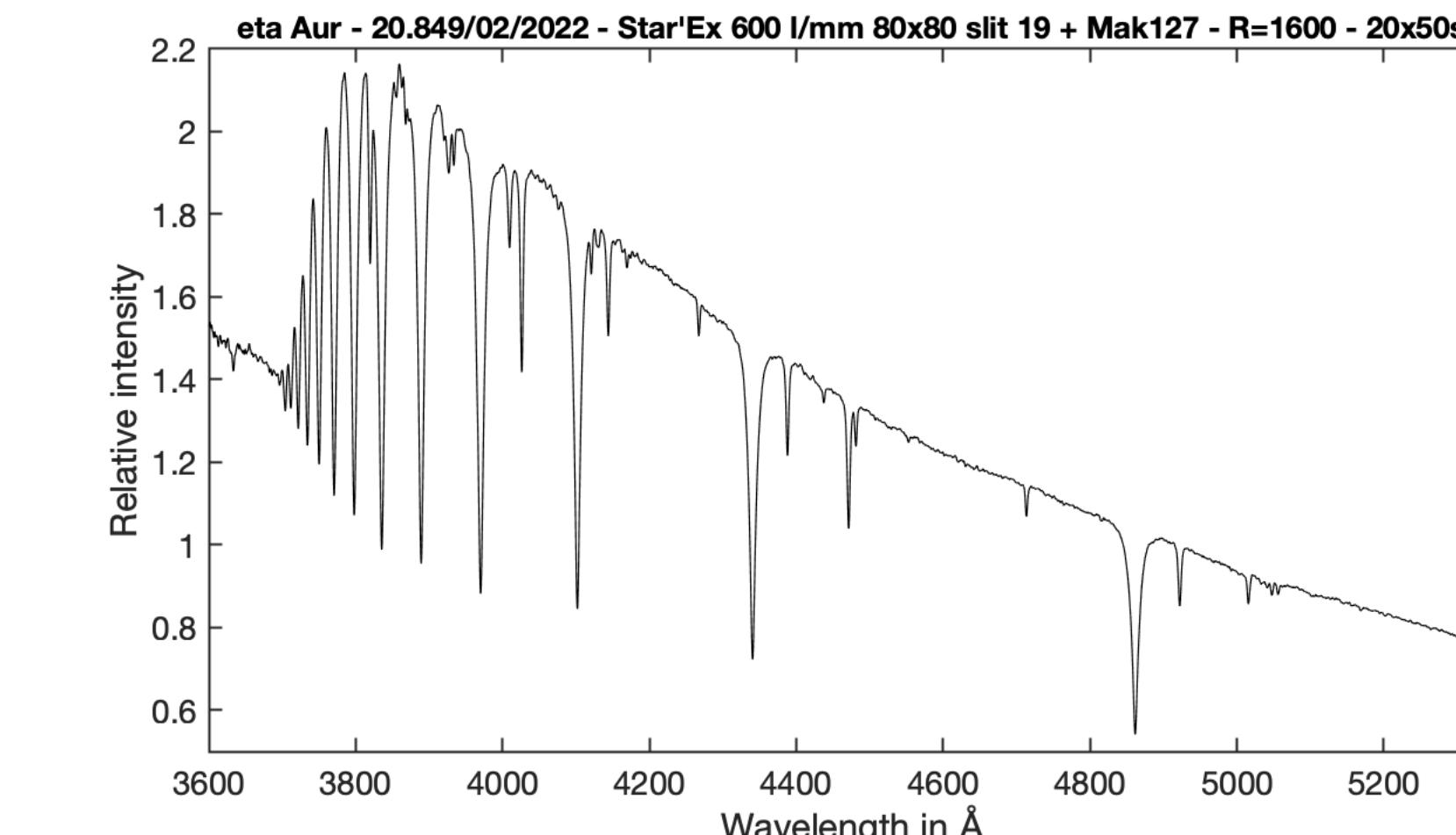
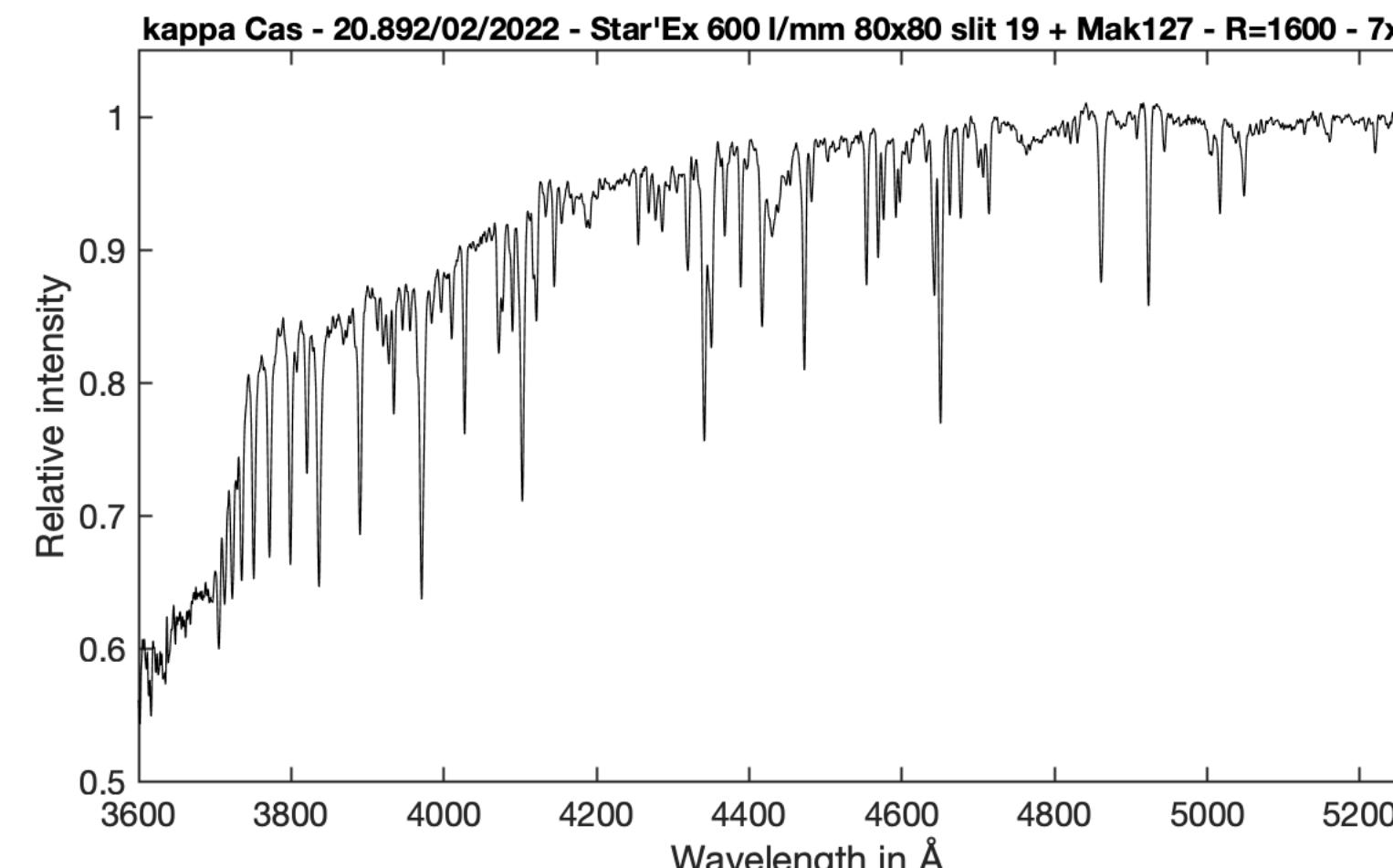
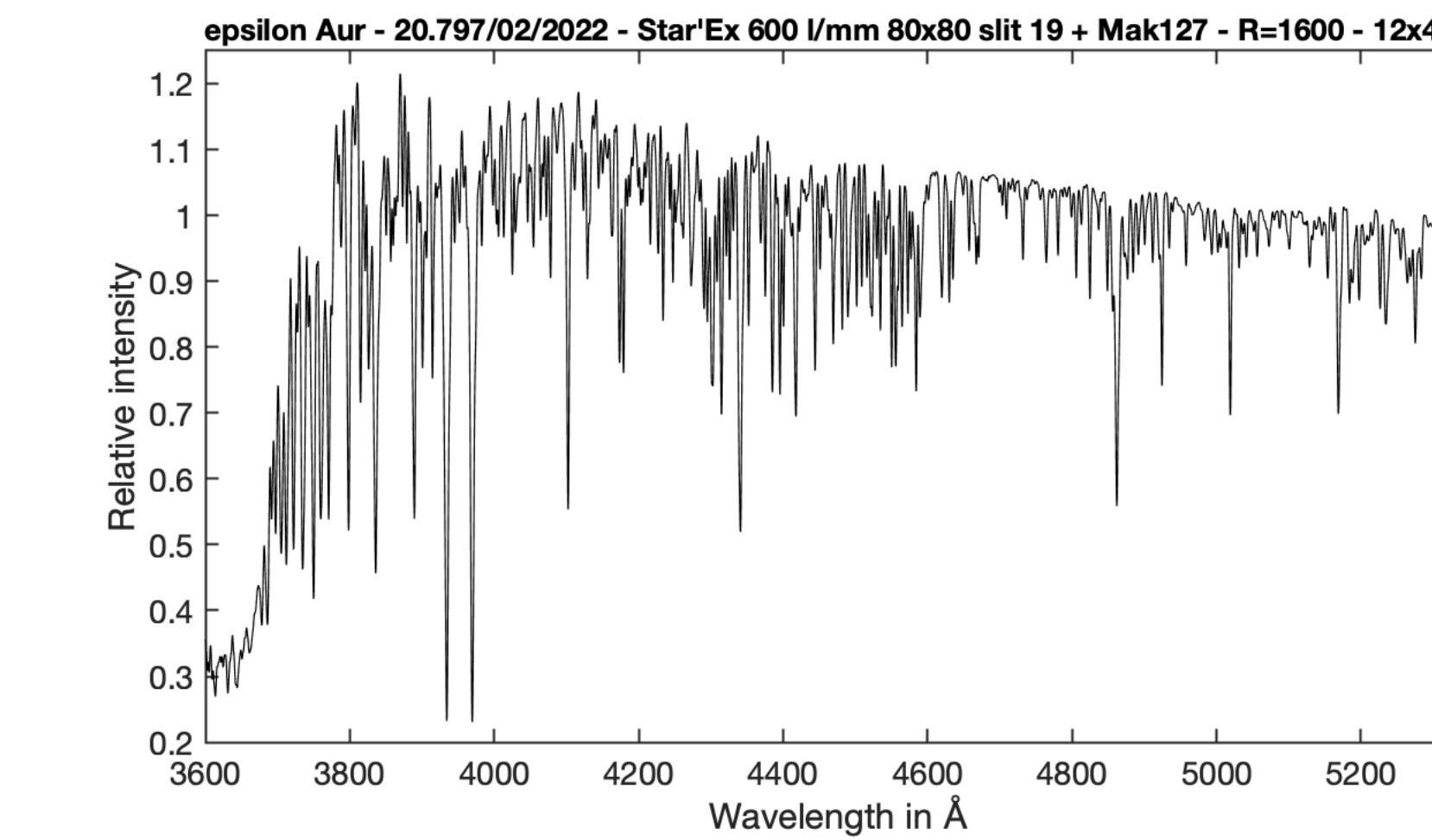
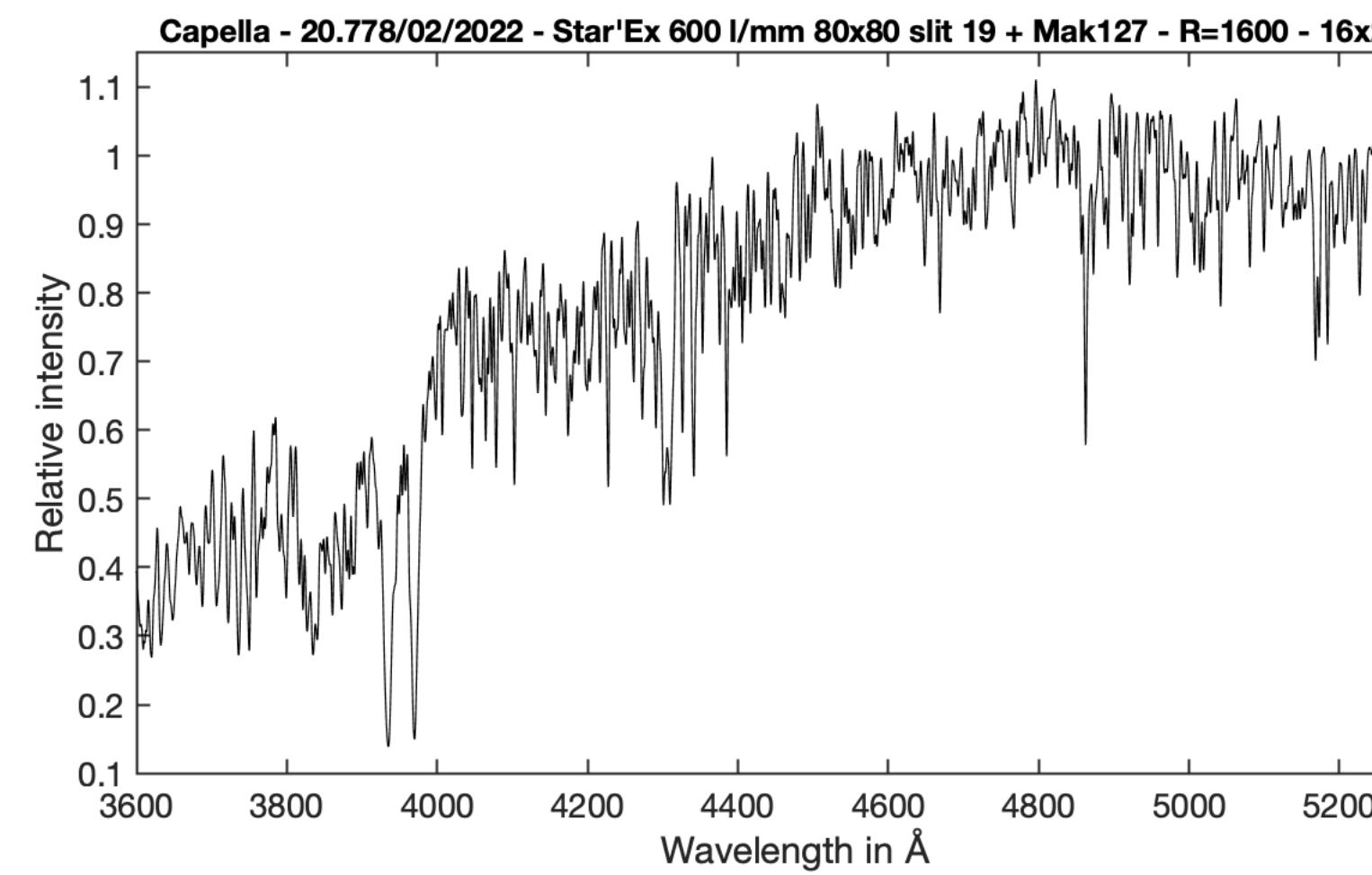


Fluo lamp



Stellar spectra sample

Star'Ex 600 lines/mm on a Maksutov 127 mm telescope (UV + blue region)



Example of spectral calibration setup on the pupil

Configuration #3

Spectral coverage : 6500 Å - 6700 Å (H-alpha line)

Configuration

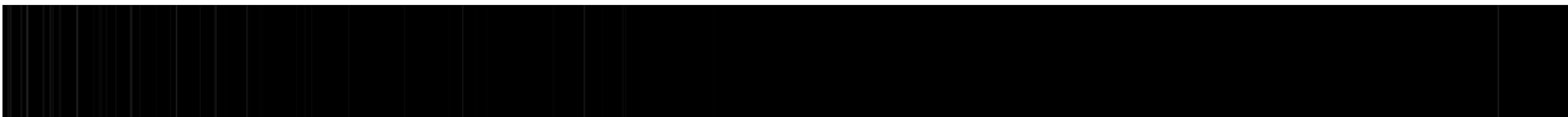
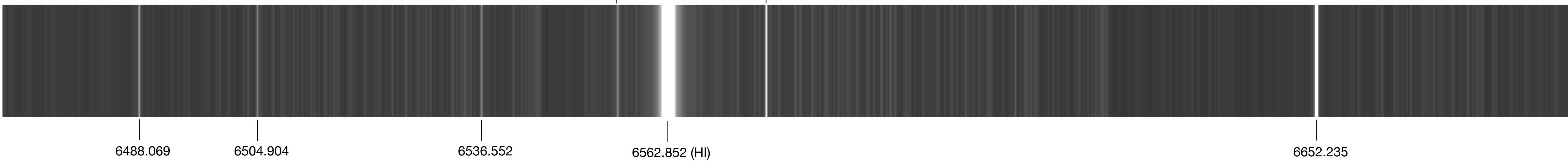
Star'Ex - 80 mm x 125 mm

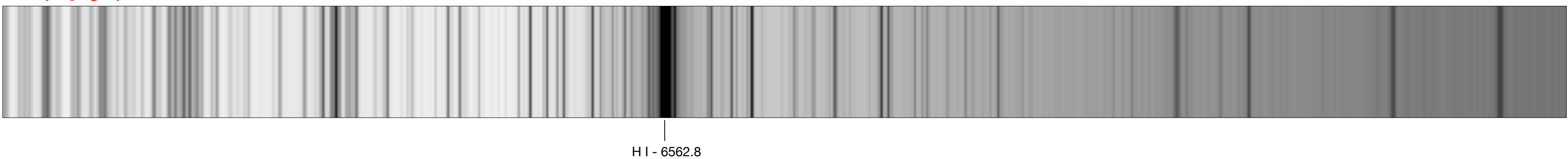
Grating : 2400 lines/mm - holographic

Slit : 19 microns

Optical beam : f/9

Camera : ASI183MM (0.062 Å/pixel)

Sun (daylight)**Mercury (Hg)****Argon (Ar)****Kryton (Kr)**

Sun (daylight)

H I - 6562.8

Neon (Ne)

6506.528

6532.882

6598.953

6678.278

6472.841

Xenon (Xe)

6504.180

6533.159

6554.196

6583.270

6607.410

6666.965

6678.972



6469.705

6487.765

6498.717

6521.508

6543.360

6595.561

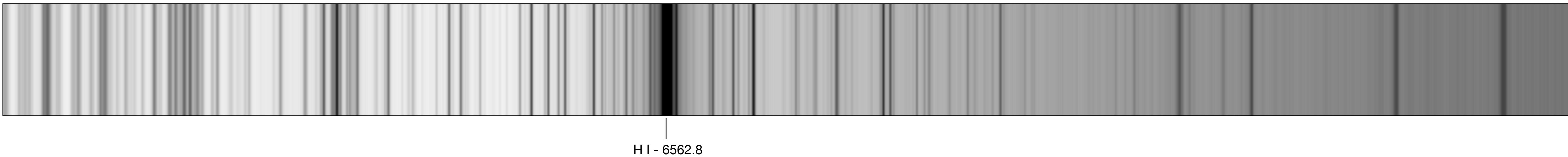
6632.464

6668.920

6681.036

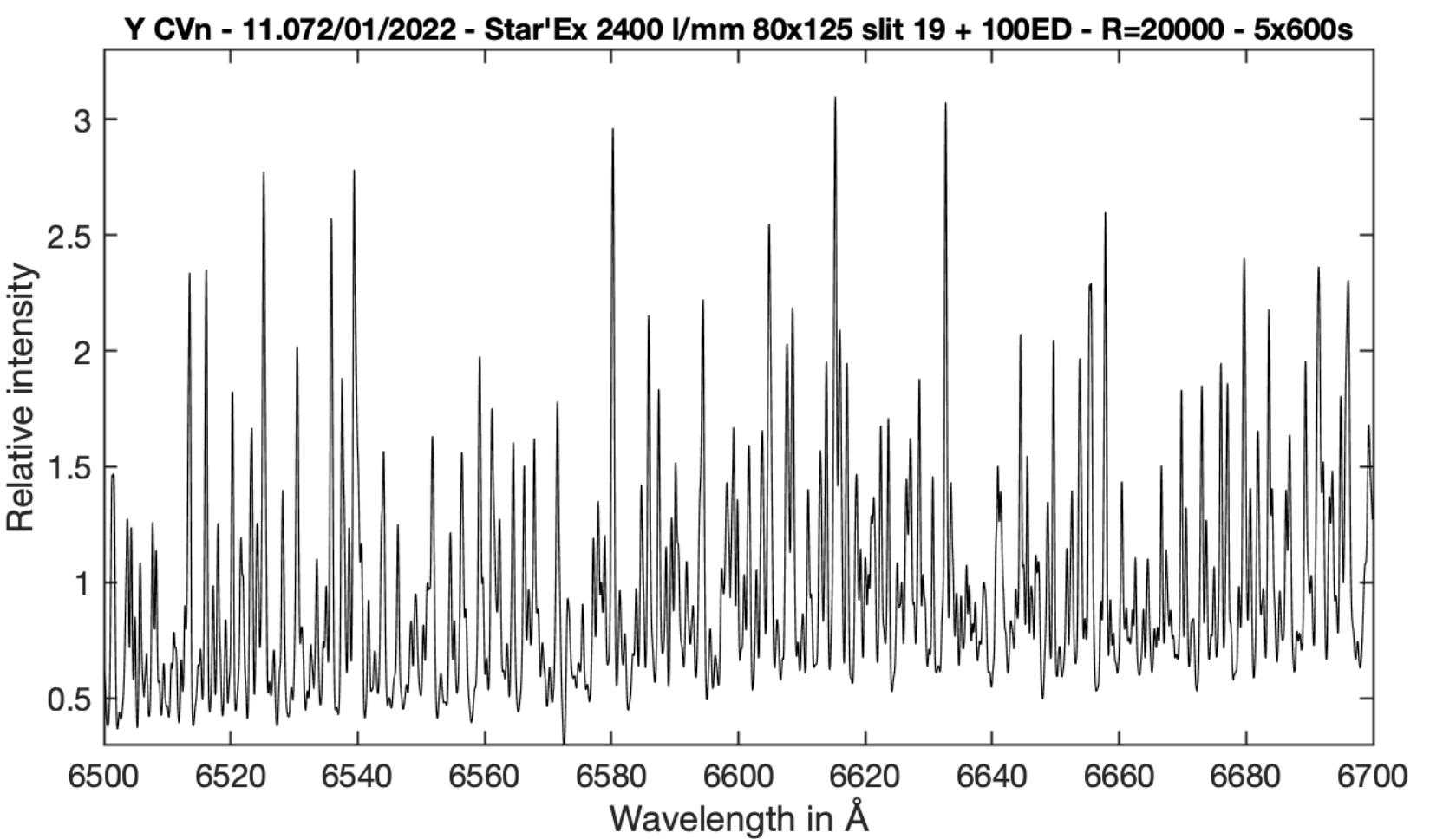
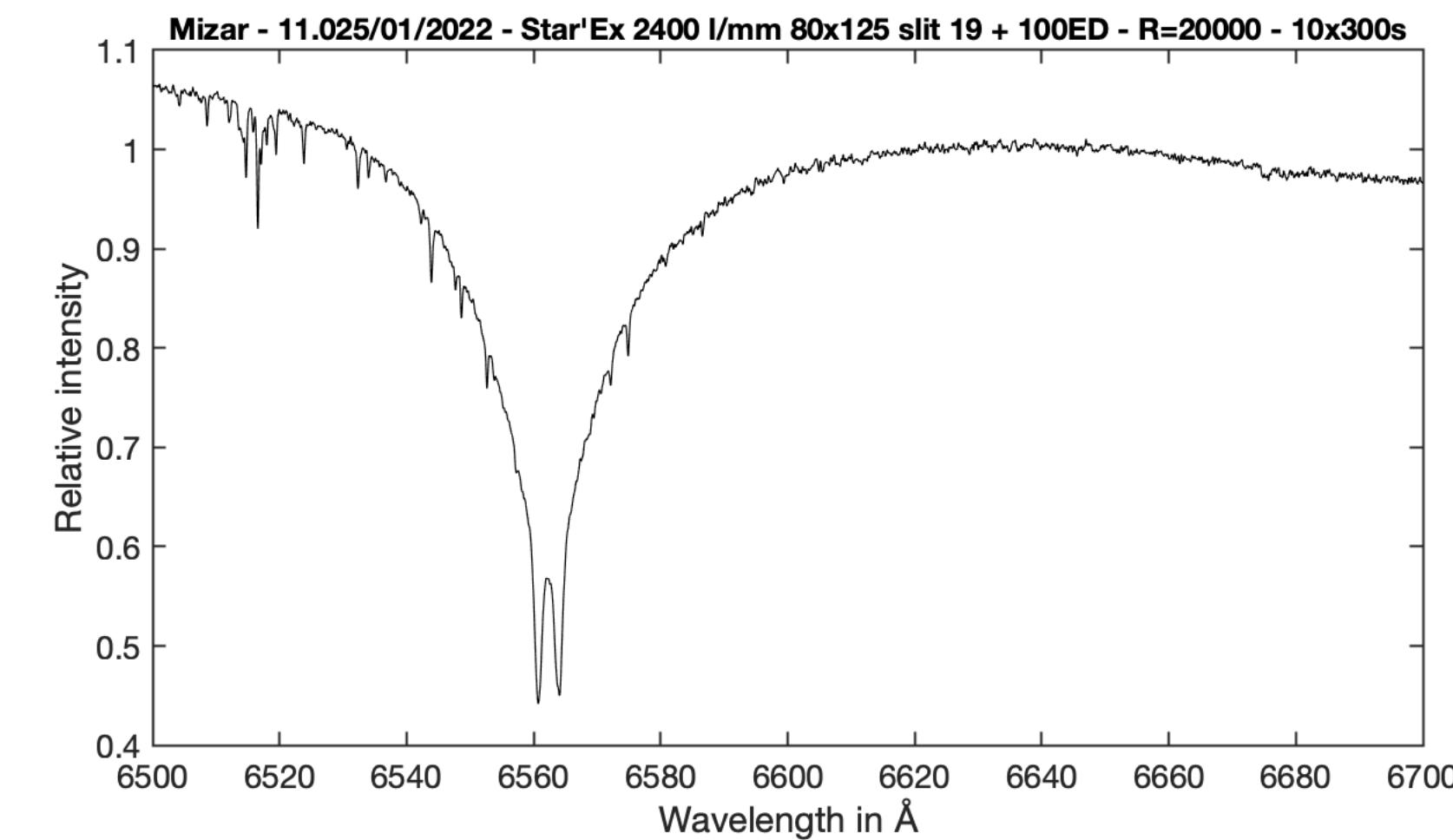
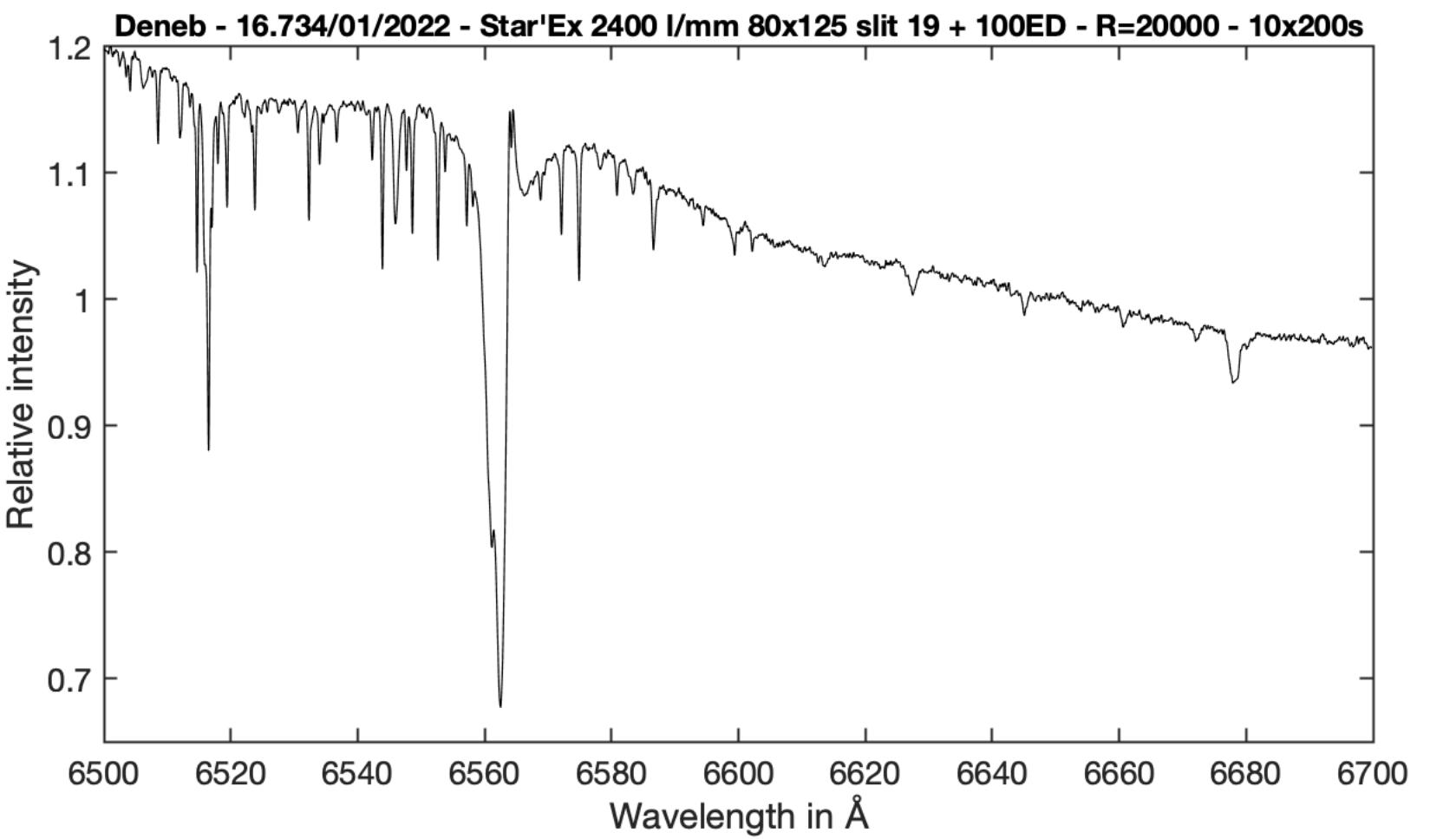
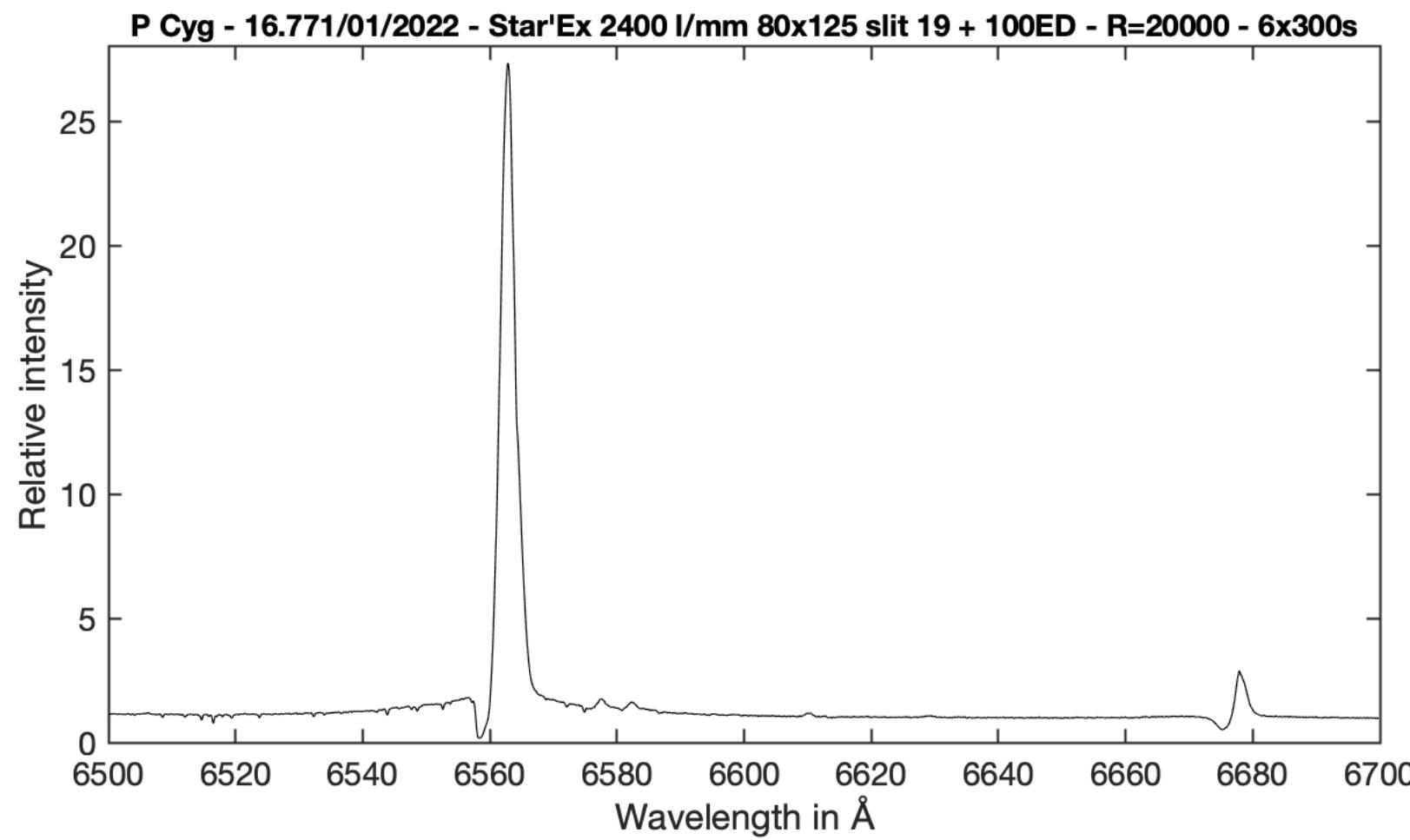
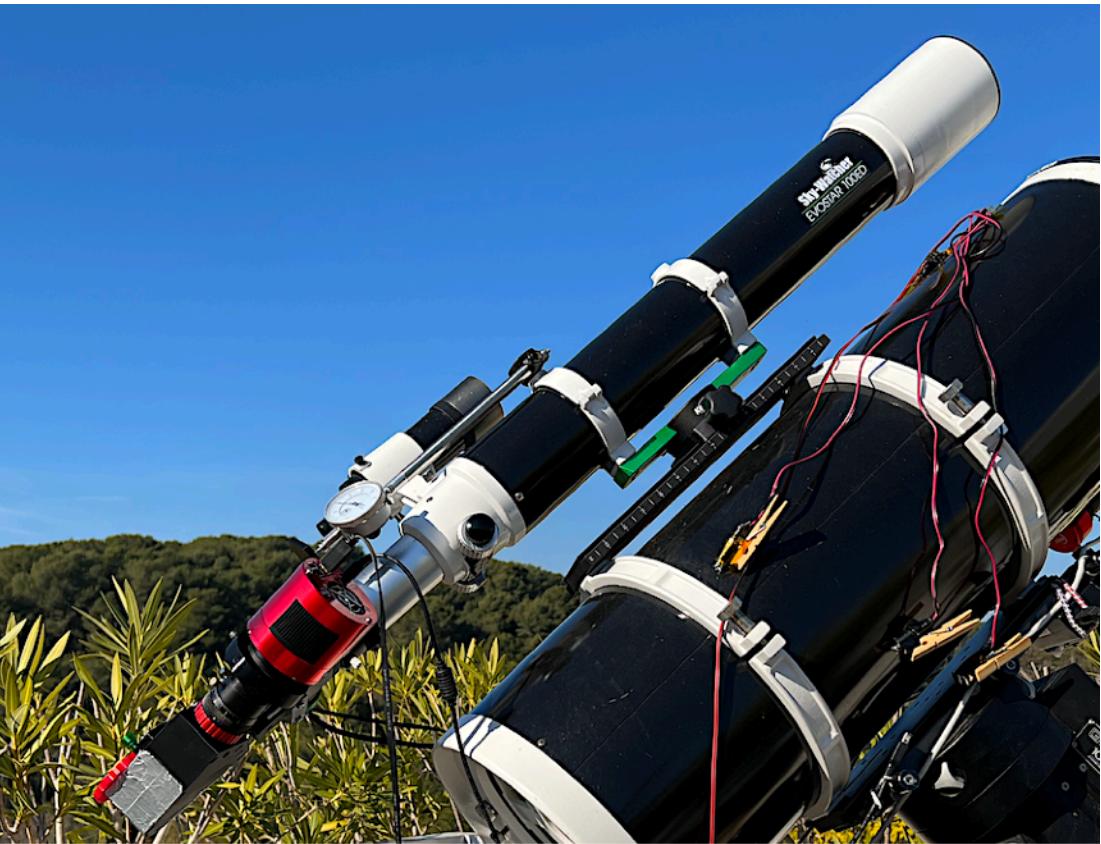
Hydrogen (H)

6562.852

Sun (daylight)**Helium (He)****Nitrogen (N)****Oxygen (O)**

Stellar spectra sample

Star'Ex 2400 lines/mm on a EVOSTAR 100ED refractor (H-alpha region)



Use of economical optical fibers (plastic) for precision spectral calibration at the entrance pupil.

Configuration #4

Spectral coverage : 4600 Å - 4950 Å (H-beta line)

Configuration

Star'Ex - 80 mm x 125 mm

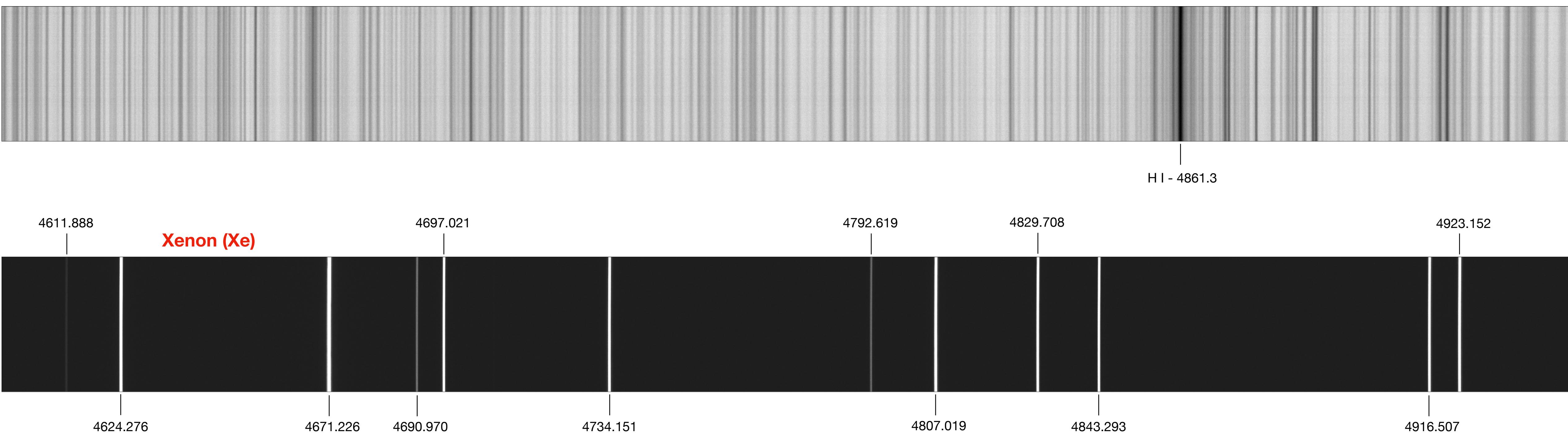
Grating : 2400 lines/mm - holographic

Slit : 19 microns

Optical beam : f/9

Camera : ASI183MM (0.075 Å/pixel)

Sun (daylight)



This part of the spectrum is tested because:

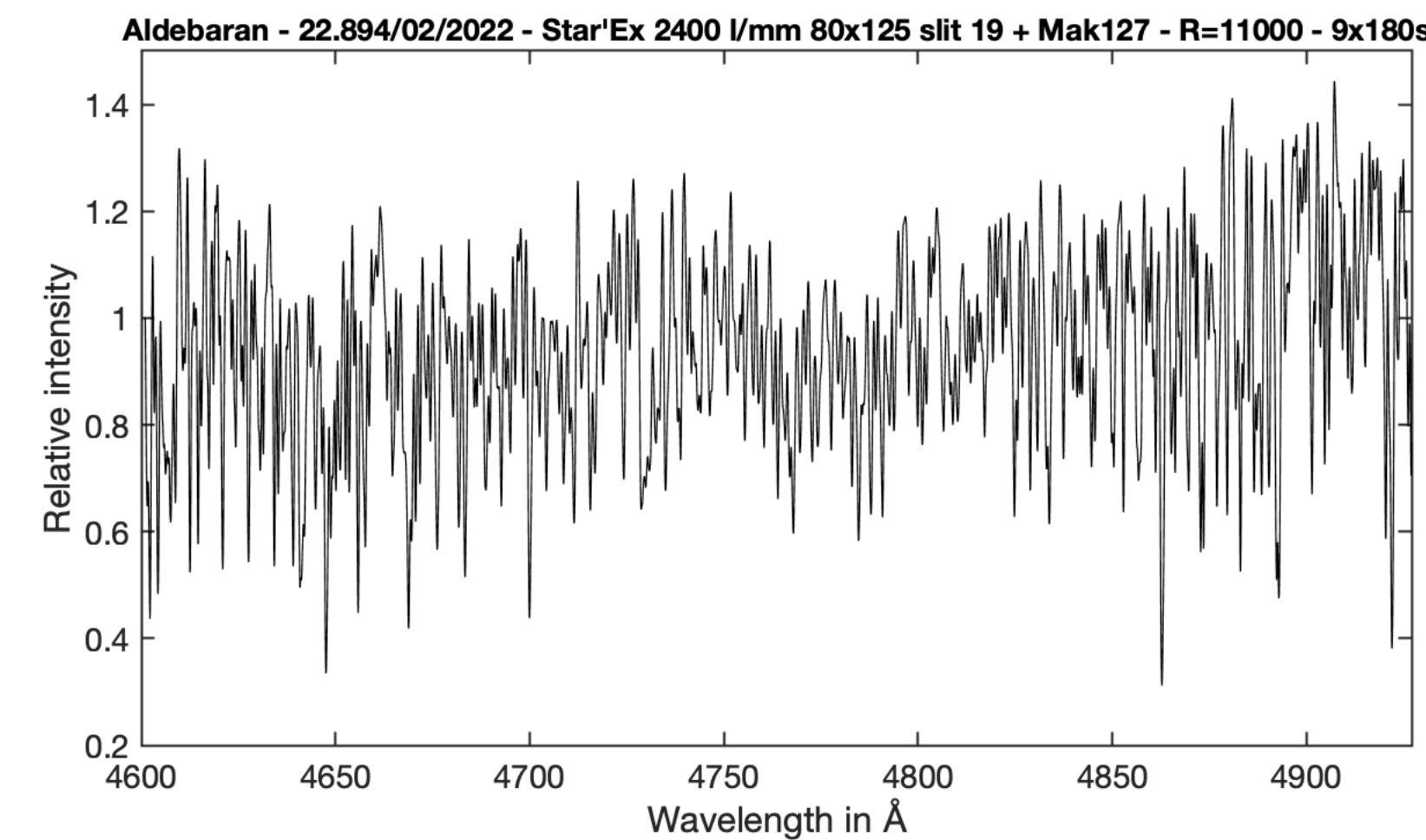
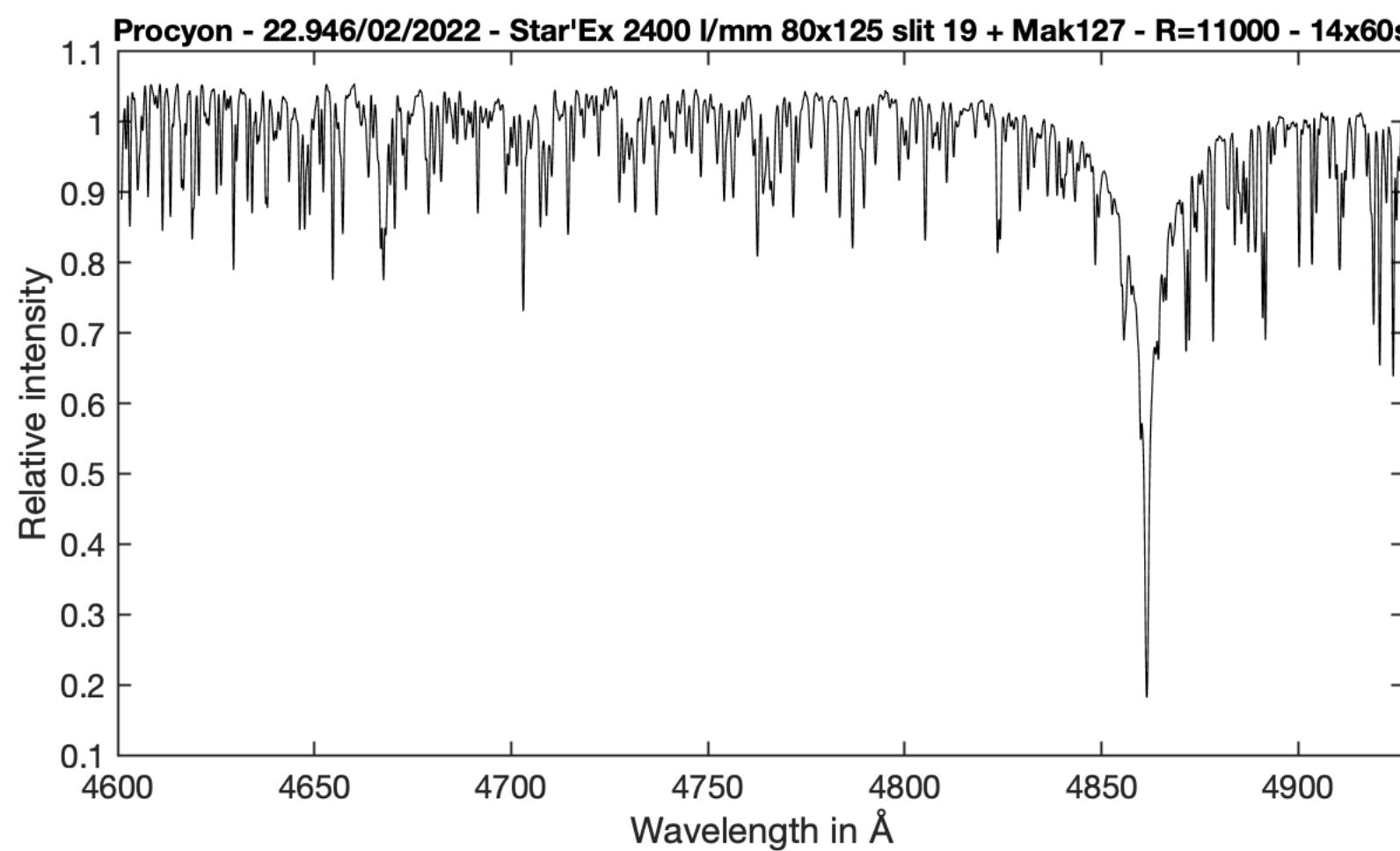
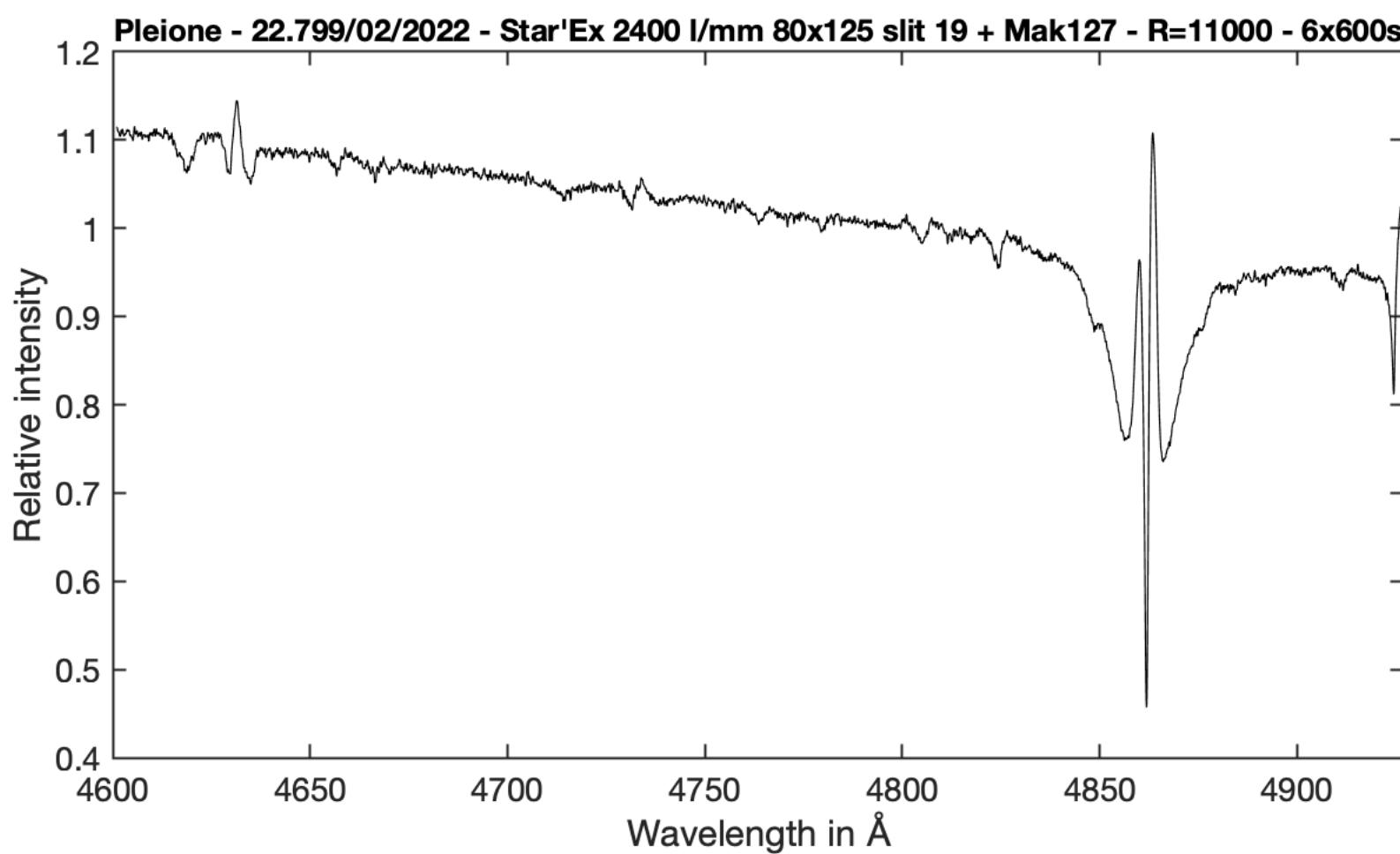
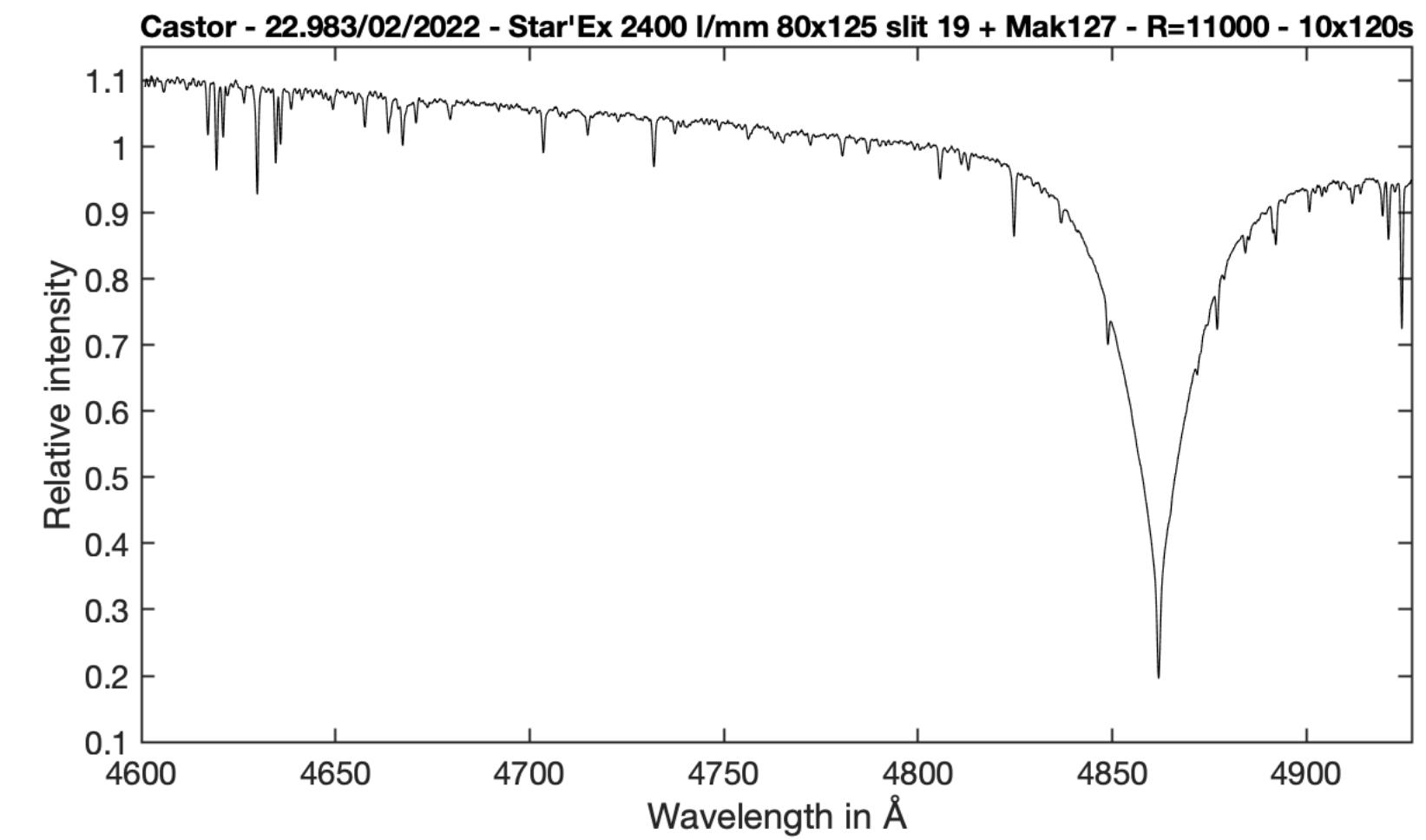
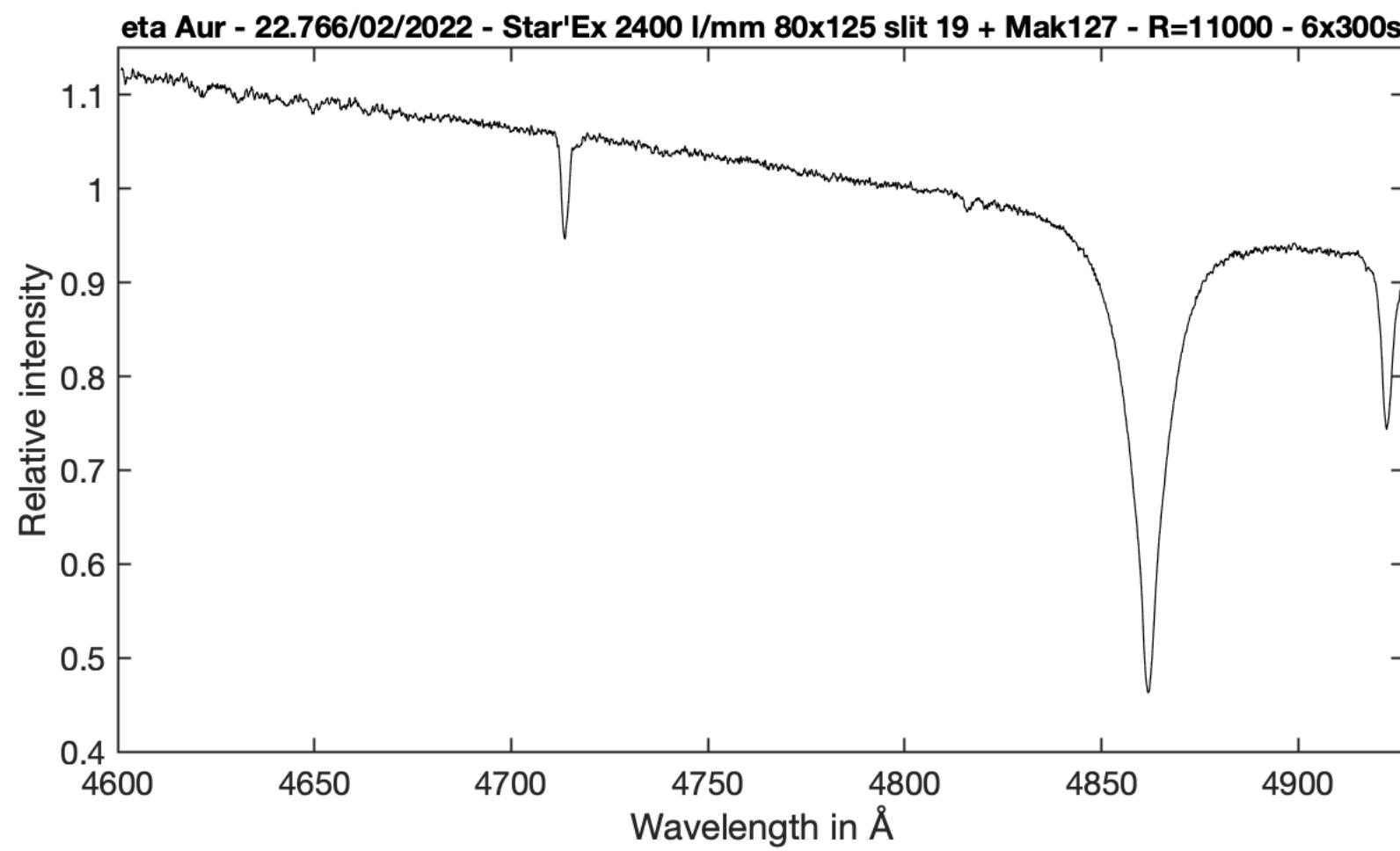
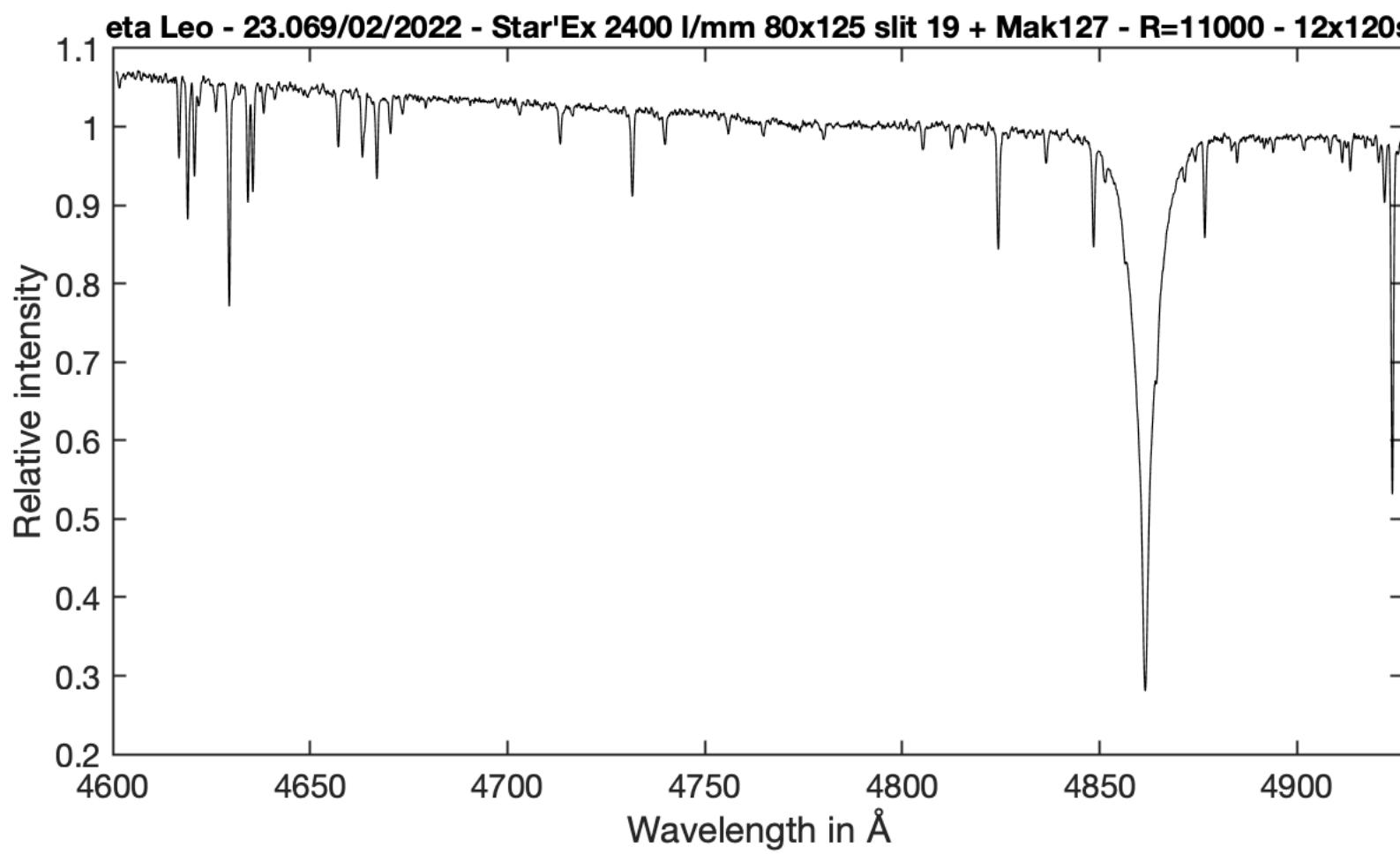
- Presence of the hydrogen H-beta line.
- Relatively high density of xenon lines (for a high spectral resolution spectrum and a non-échelle spectrograph). Spectral calibration accuracy is estimated better to +/- 2 km/s.
- High density of metallic lines for high precision radial velocity measurements (cross-correlation method). Spectral resolution power near 15000.
- Spectral domain free of atmospheric telluric lines.
- The chromatic aberration of most refractors is moderate in this spectral range.
- Good detector quantum efficiency (CMOS) and grating efficiency (holographic 2400 lines/mm).

On the left, some light sources producing xenon emission lines: miniature discharge lamp (pen-ray type), glimm glow lamp (Conrad Electronic, 720215), large discharge tube. However, the intensity of the lines is weak, it will be necessary to adapt the calibration procedure accordingly.



Stellar spectra sample

Star'Ex 2400 lines/mm on a Maksutov 127 mm telescope (H-beta region)



Configuration #5

Spectral coverage : 6800 A - 9900 A (infrared)

Configuration

Star'Ex - 80 mm x 80 mm

Grating : 300 lines/mm - blazed at 10000 A

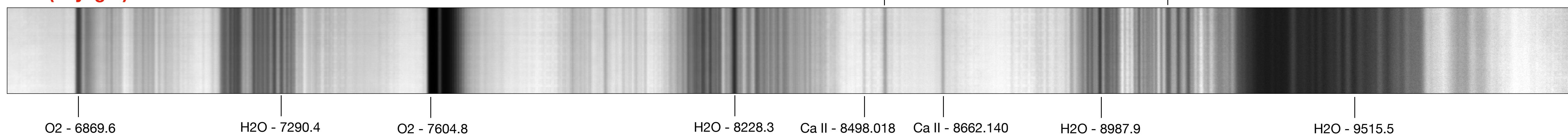
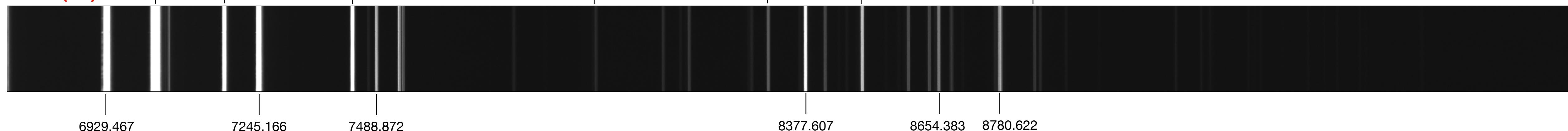
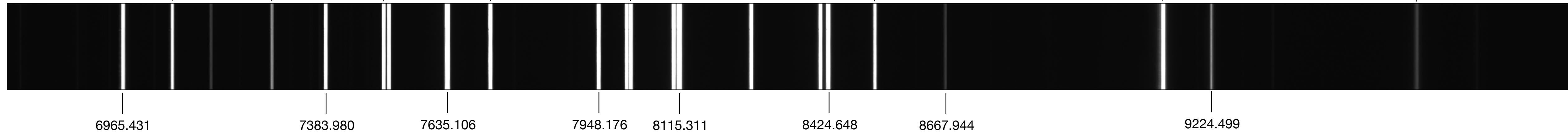
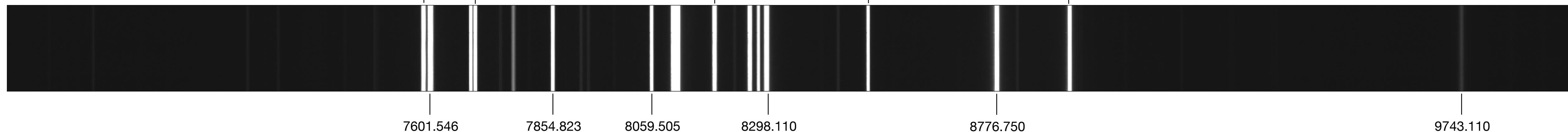
Slit : 19 microns

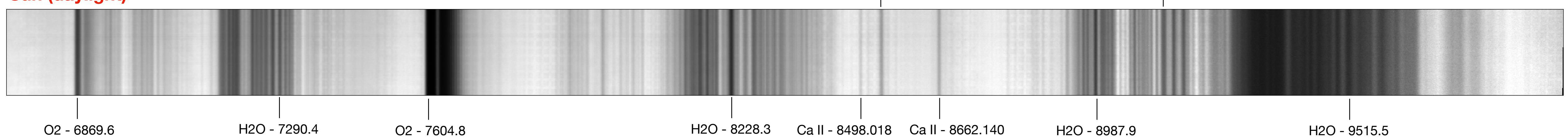
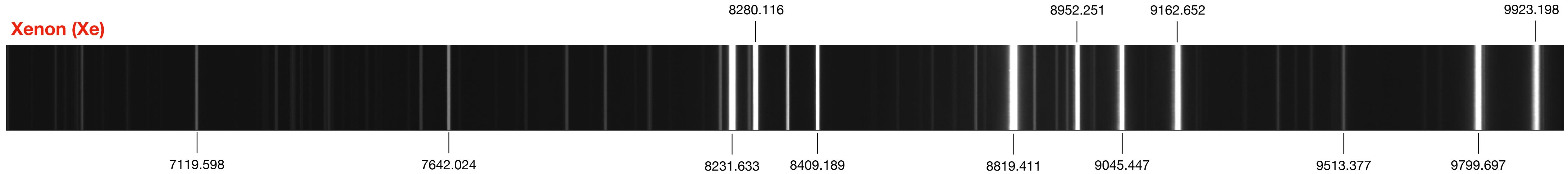
Optical beam : f/9

Camera : ASI183MM (0.986 A/pixel)



An important point: add an order filter to observe infrared (here a RG650)

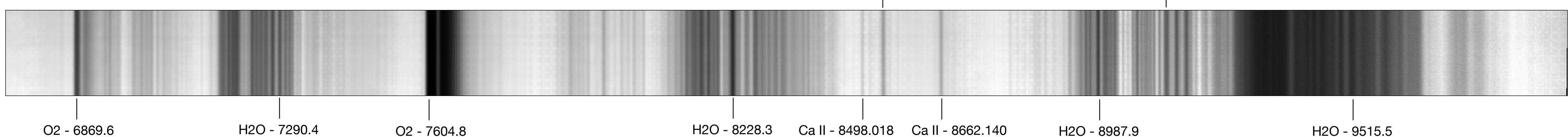
Sun (daylight)**Neon (Ne)****Argon (Ar)****Krypton (Kr)**

Sun (daylight)**Xenon (Xe)****Helium (He)****Nitrogen (N)**

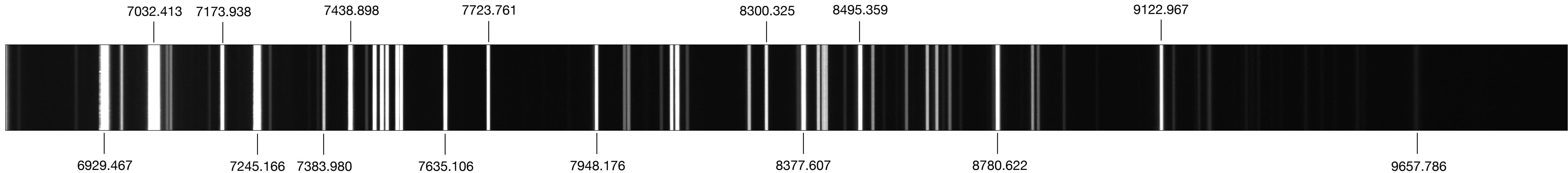
Low cost composite gases discharge lamps (neon + argon)

Infrared - 300 l/mm

Sun (daylight)

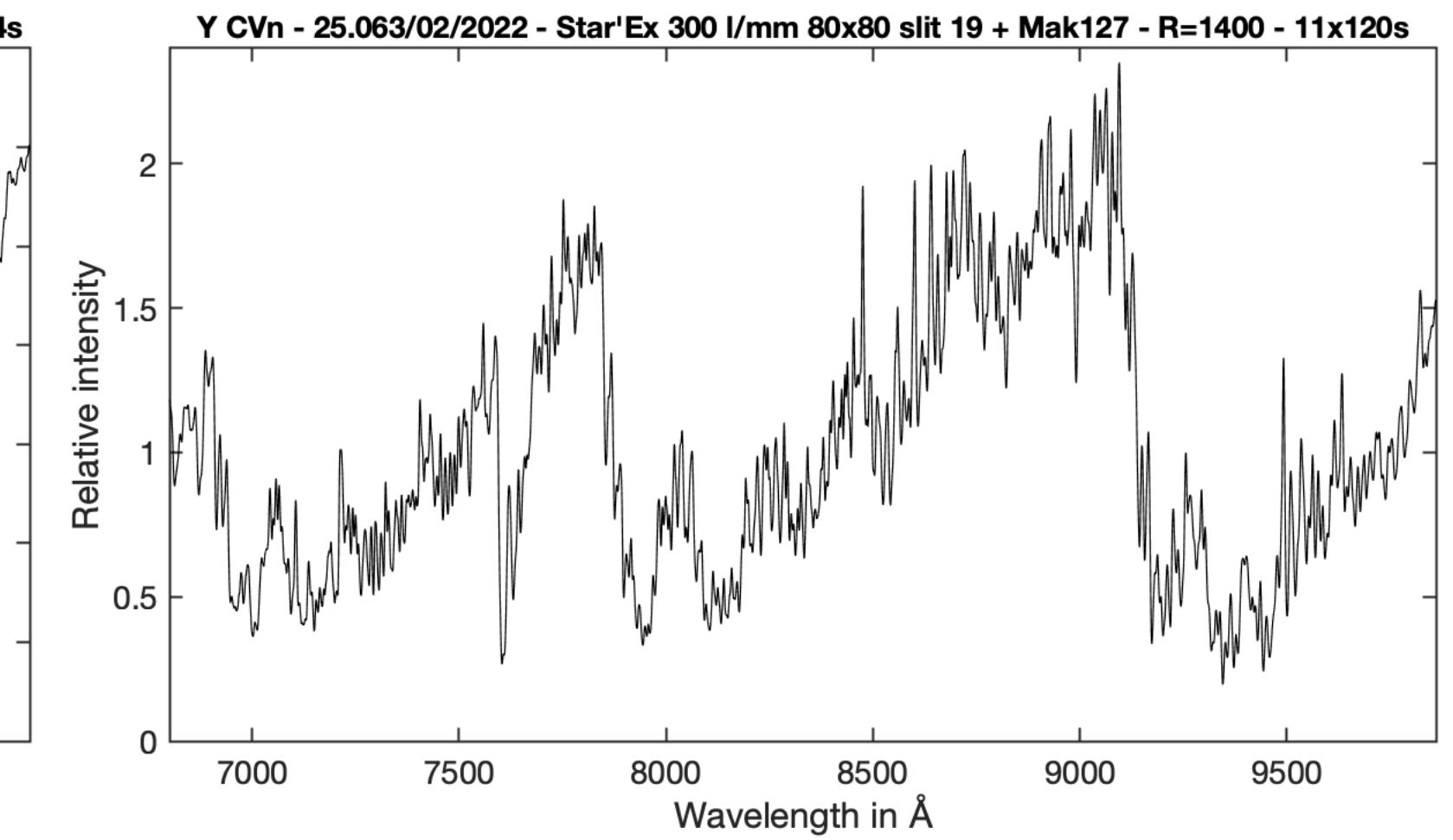
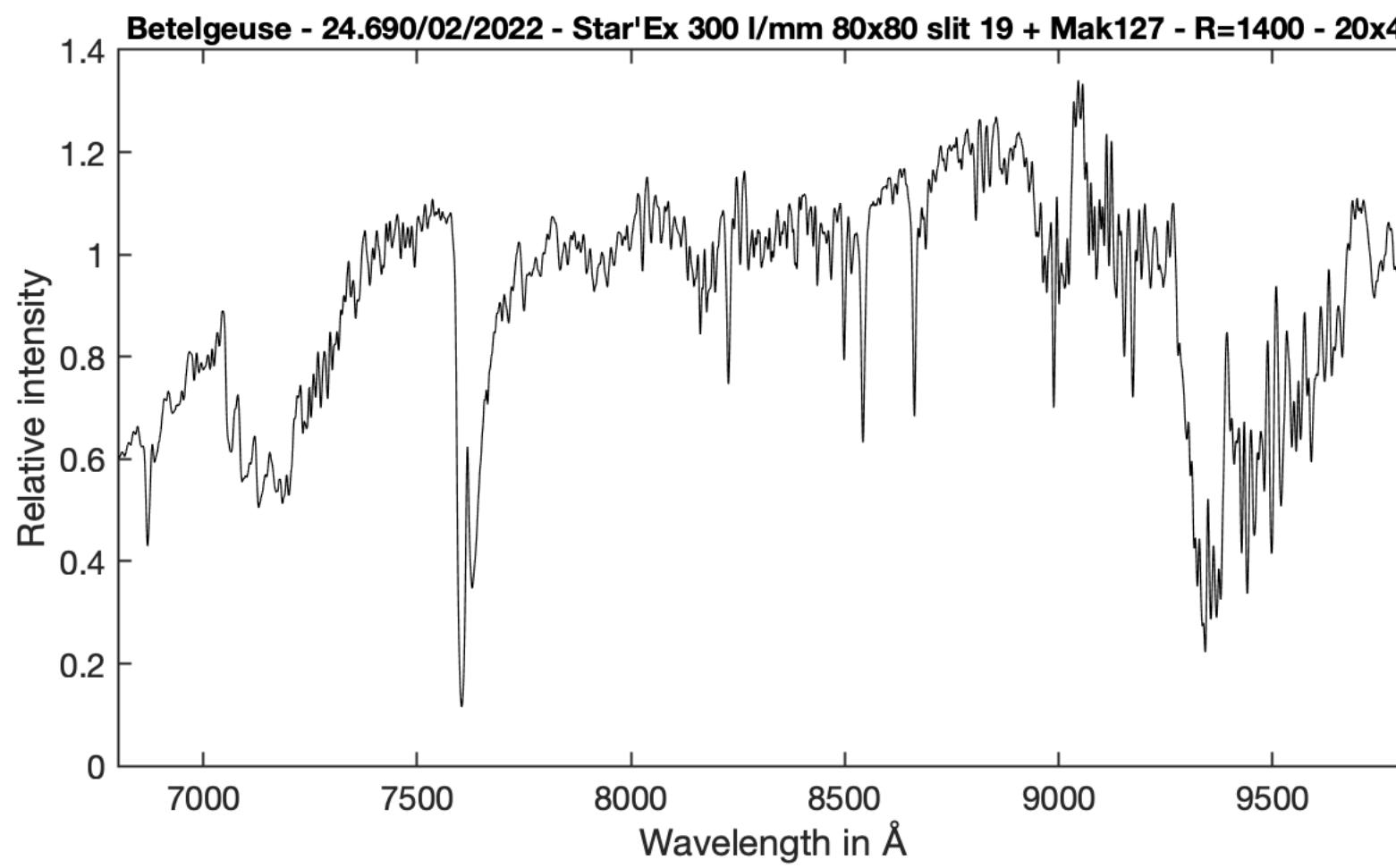
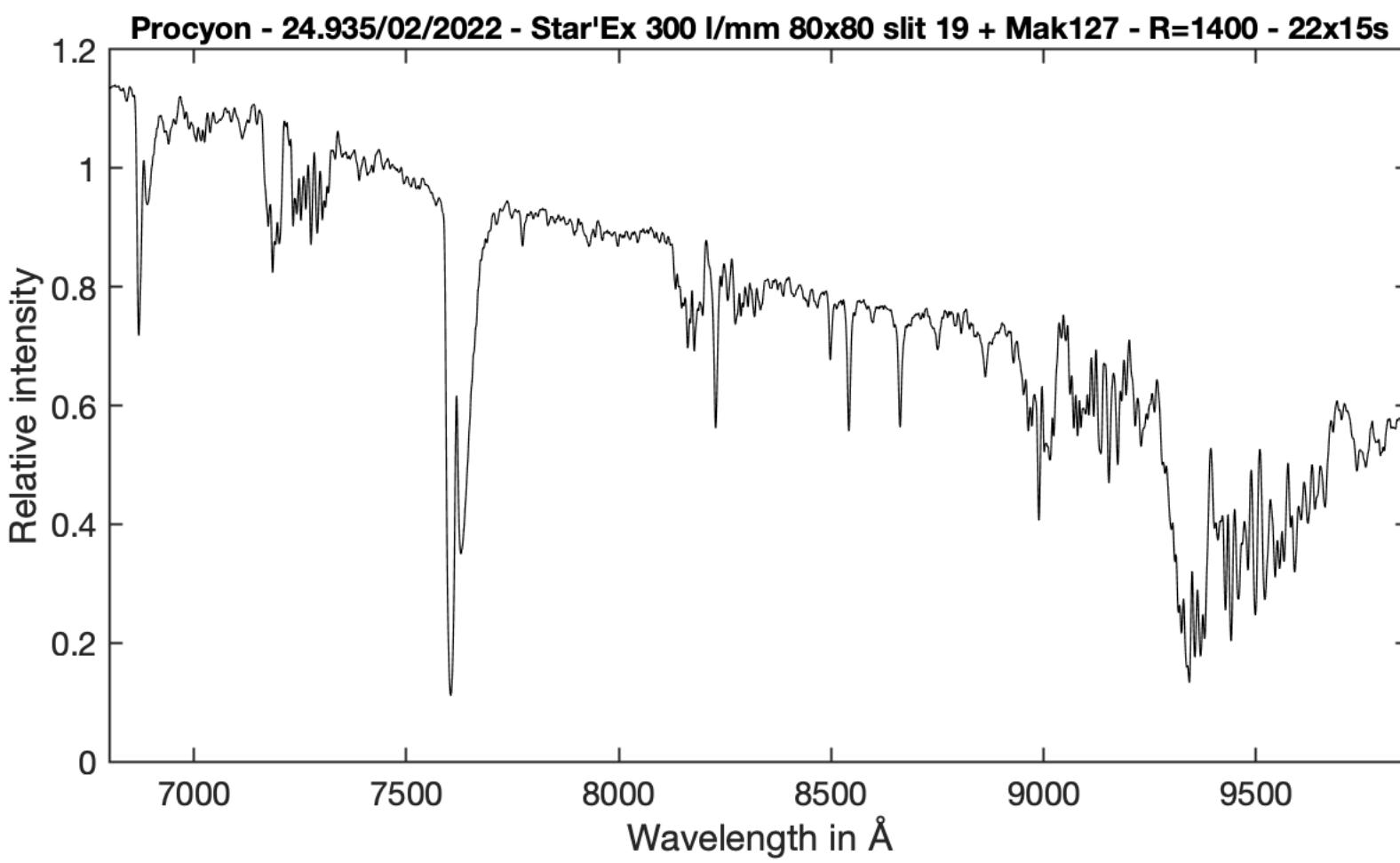
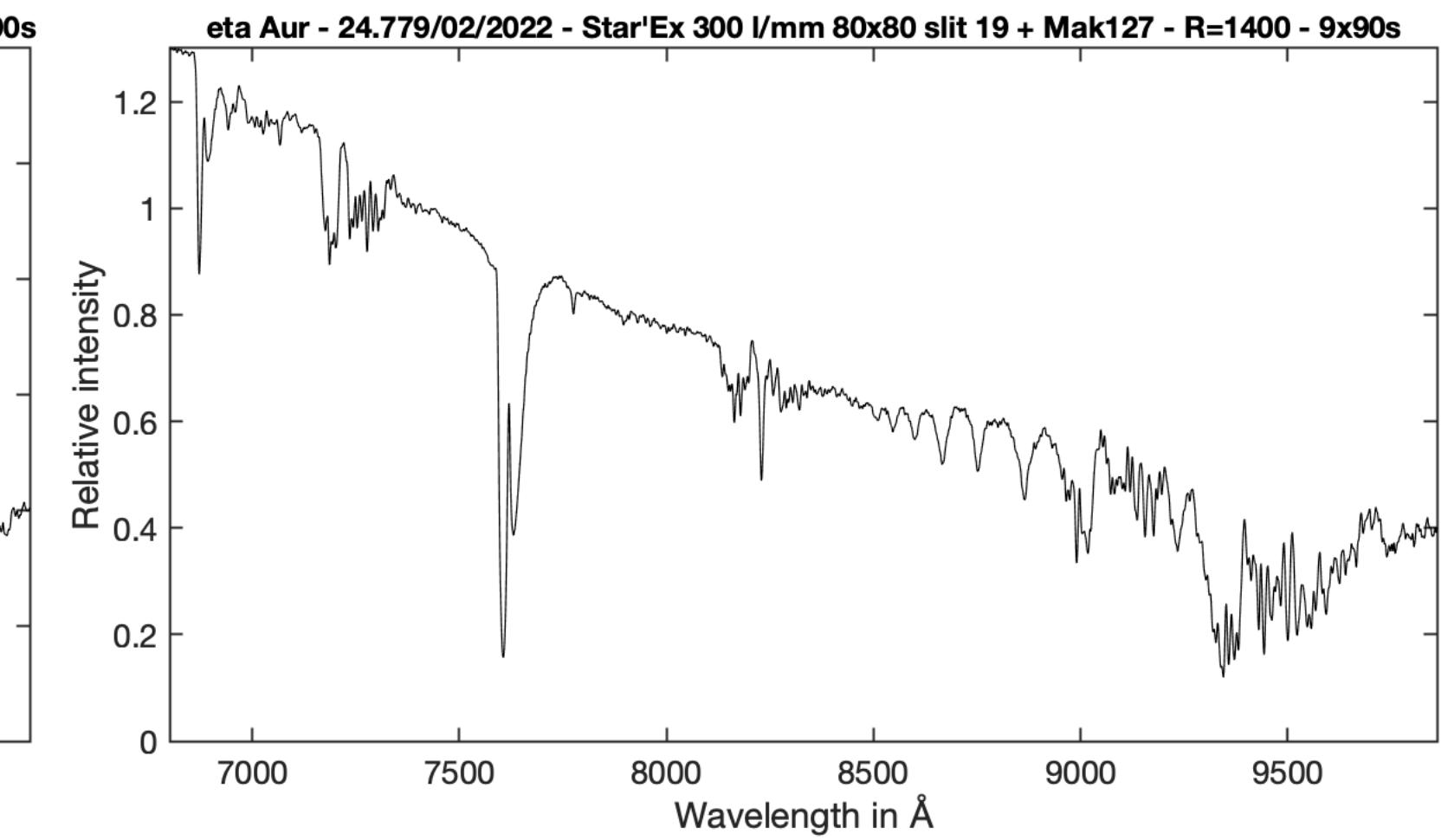
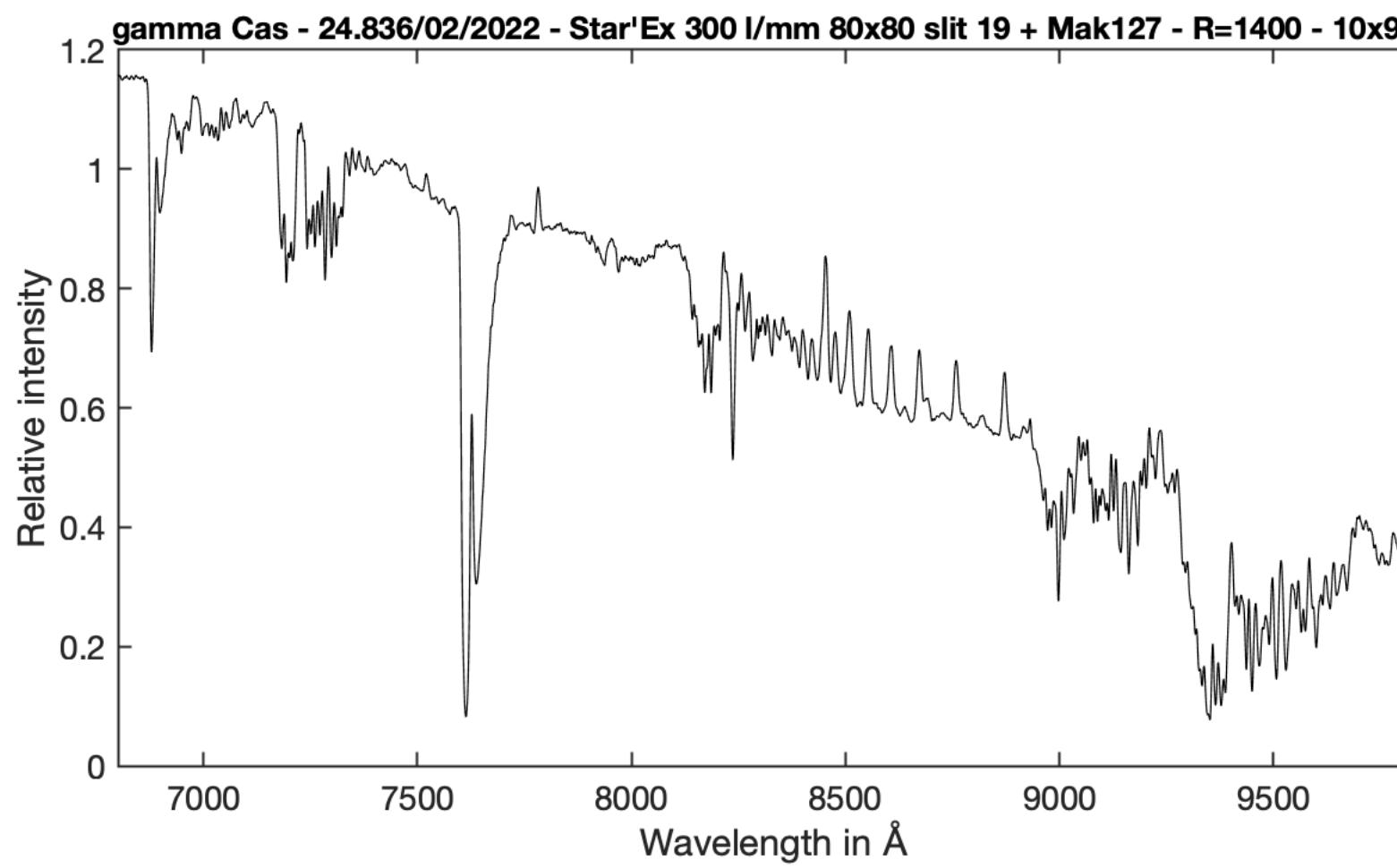
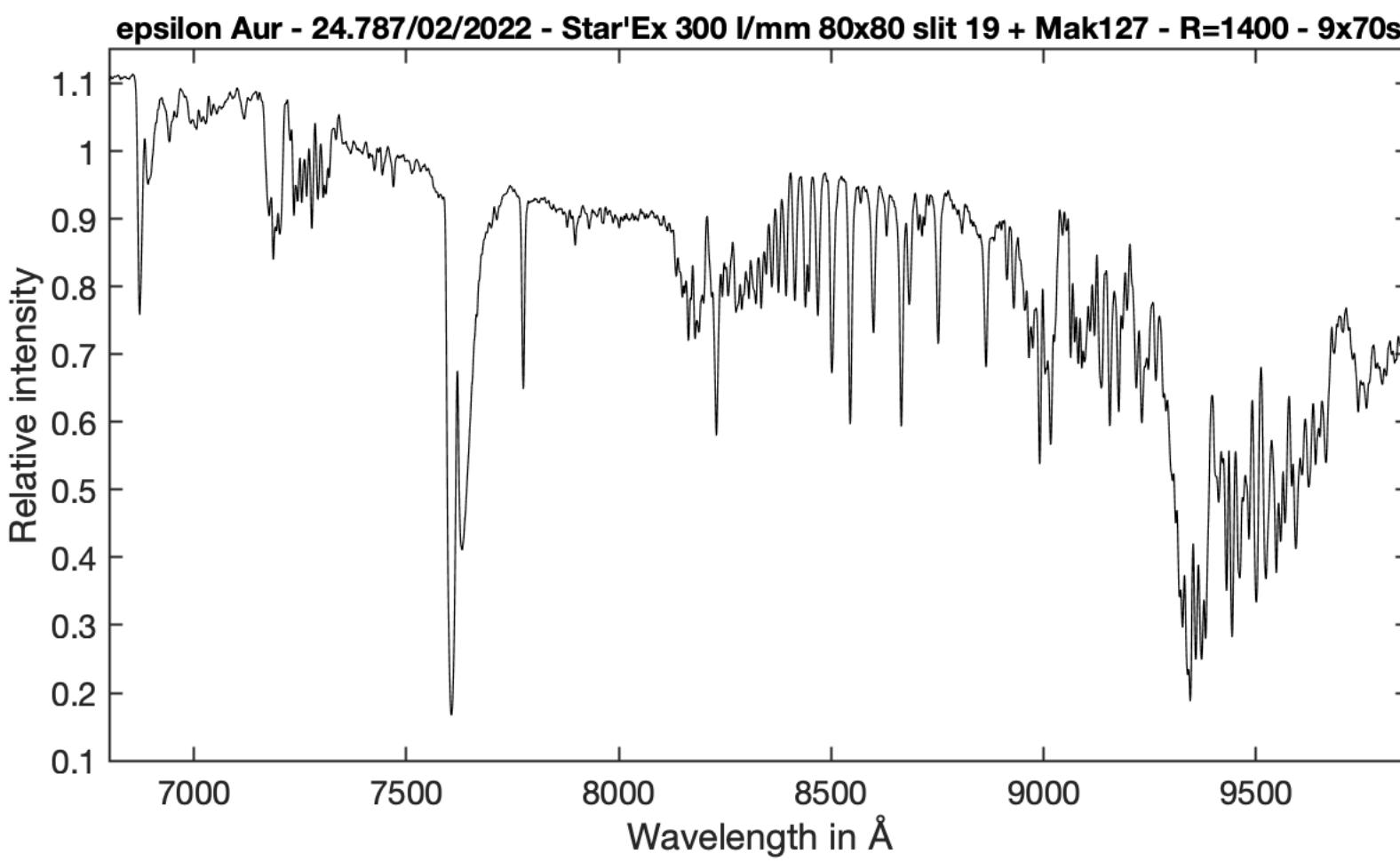


Red miniature lamp - Conrad : Barthelme 00012340 Luciole 230 V 0.30 W E10 (2.90 €)



Stellar spectra sample

Star'Ex 300 lines/mm blaze 10 000 Å on a Maksutov 127 mm telescope (infrared region)



End.