

UltraVioletEXplorer

Version 3

By

Christian Buil, Pierre Dubreuil, Stéphane Ubaud,
Alain Lopez, Jean-Luc Martin, Pierre Thierry

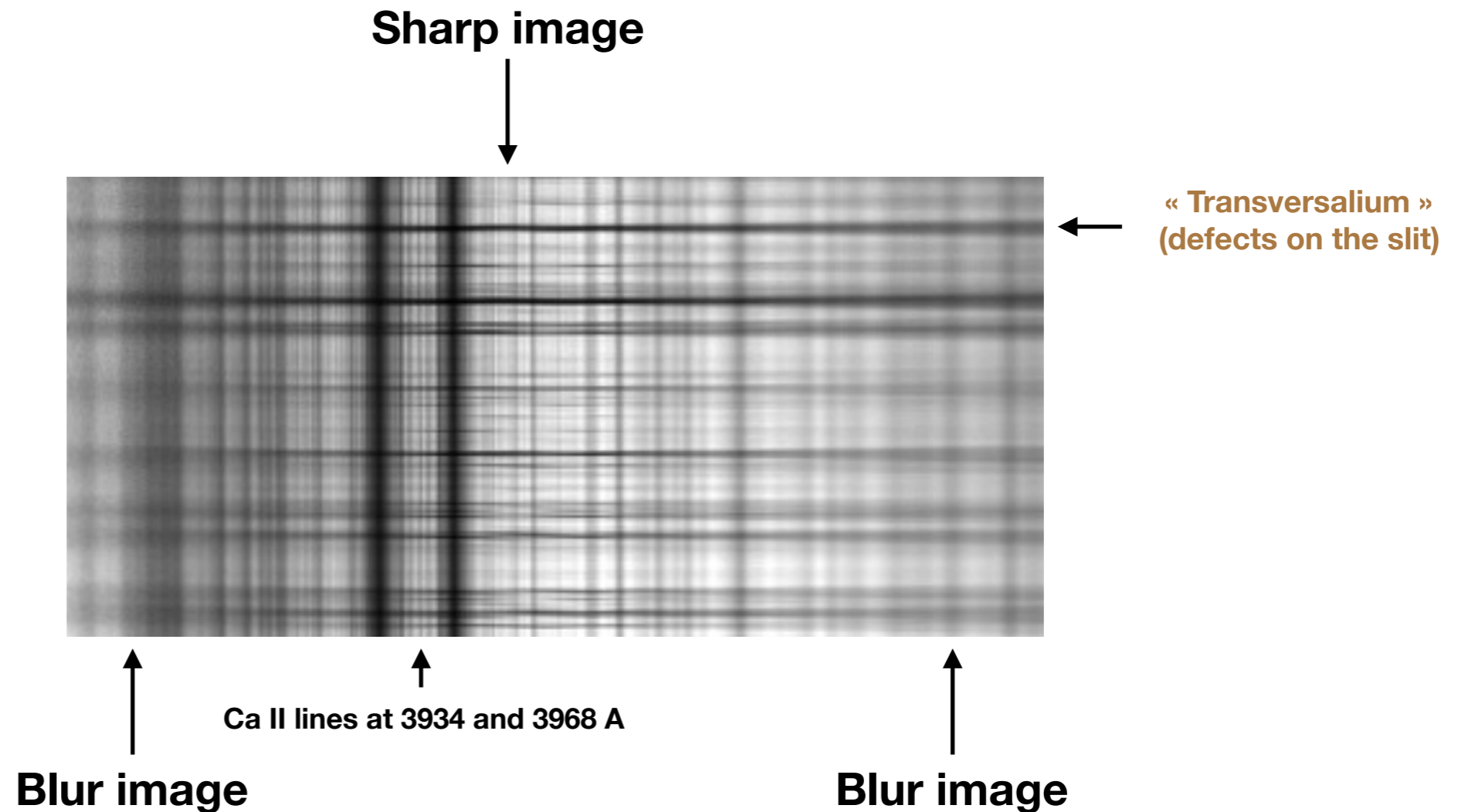


Why UVEX ?

A classical problem in spectroscopy : chromatic aberration of the optic

Optical rays are not focused at the same location in function of wavelength

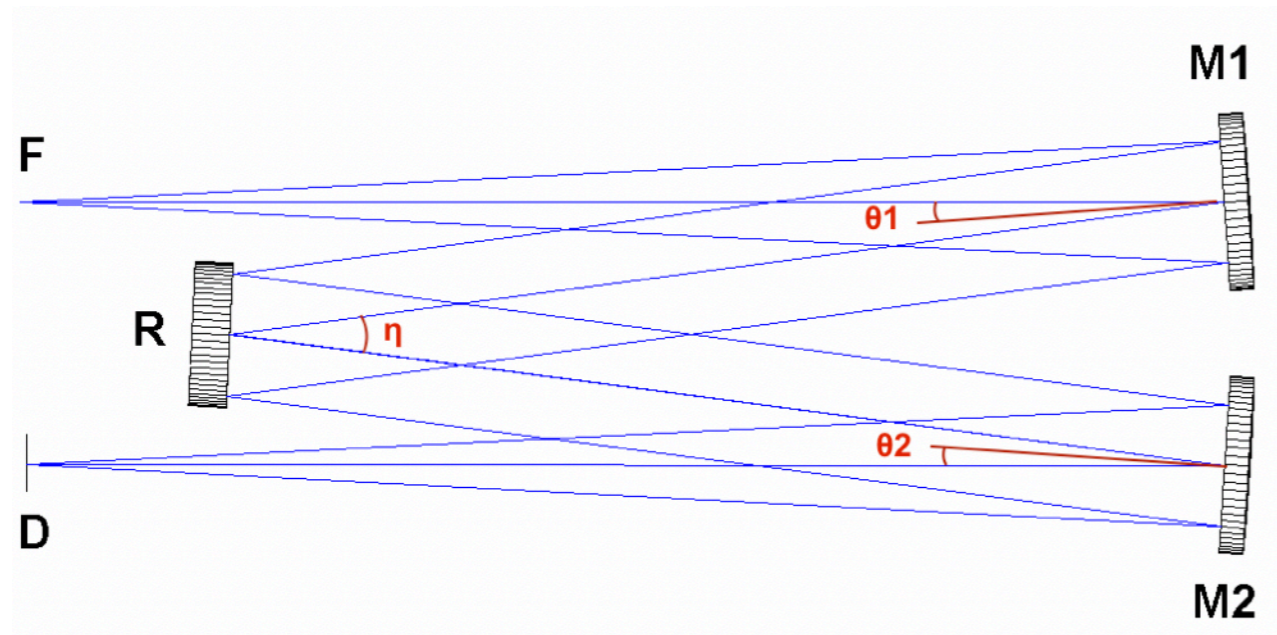
Image given by a classical amateur spectrograph in the near UV :



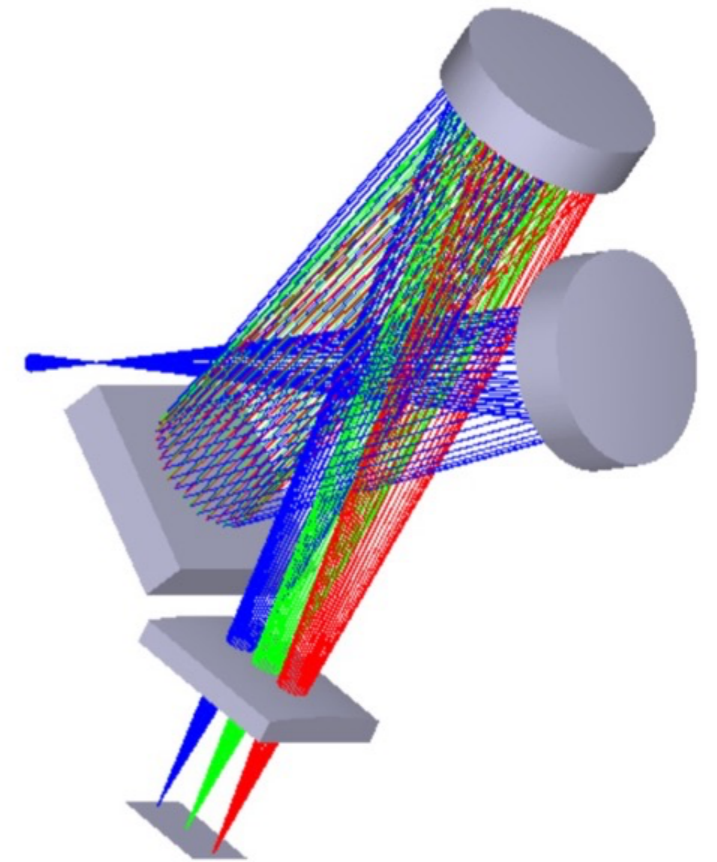
The goal of UVEX : obtain sharp spectra from ultraviolet to infrared

UVEX is the acronym of **UltraViolet EXplorer**

UVEX is a spectrograph based on a simple optical concept: a slit, two spherical mirrors (Czerny-Turner disposition), a grating, and of course, a detector :



Basic optical drawing

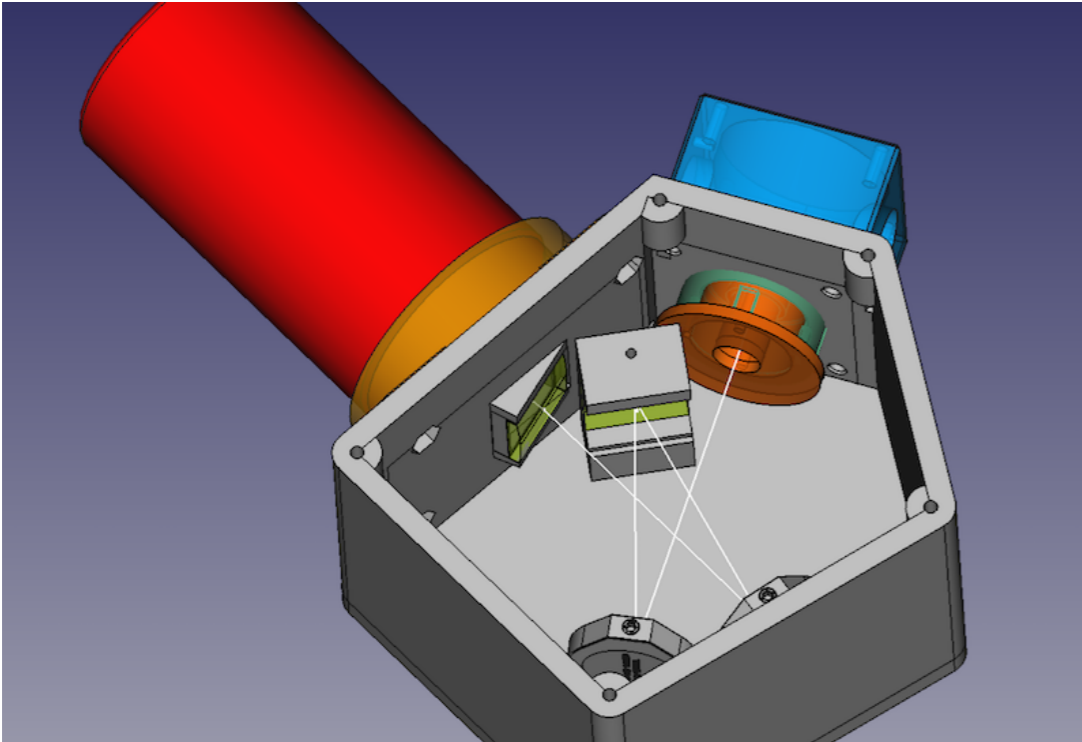


UVEX crossed version of Czerny-Turner

The adopted version of the Czerny-Turner for UVEX is crossed and add a cylindrical lens for correct astigmatism aberration.

The great interest of this setup : nearly fully achromatic (no chromatic aberration). For this reason, it is possible to observe parts of the spectrum rarely (never) explored by amateurs - towards the ultraviolet (and towards the infrared).

Made yourself the spectrograph

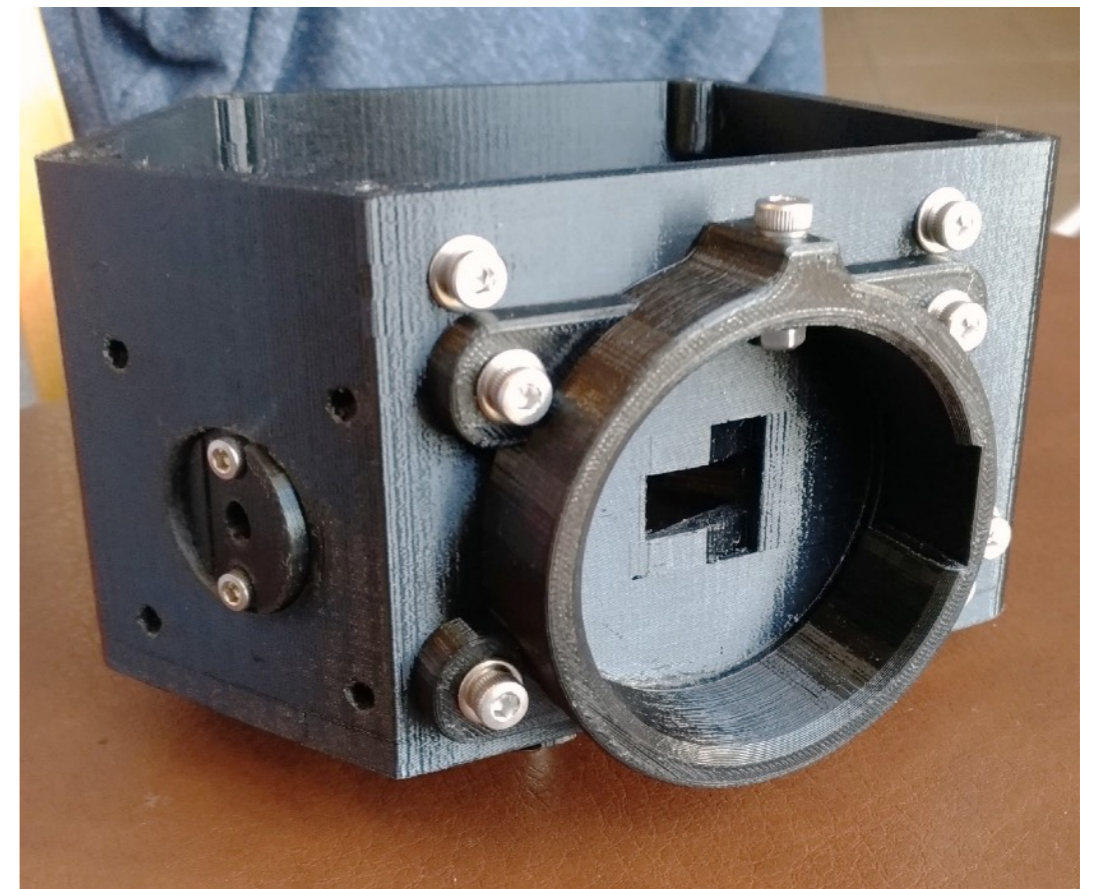
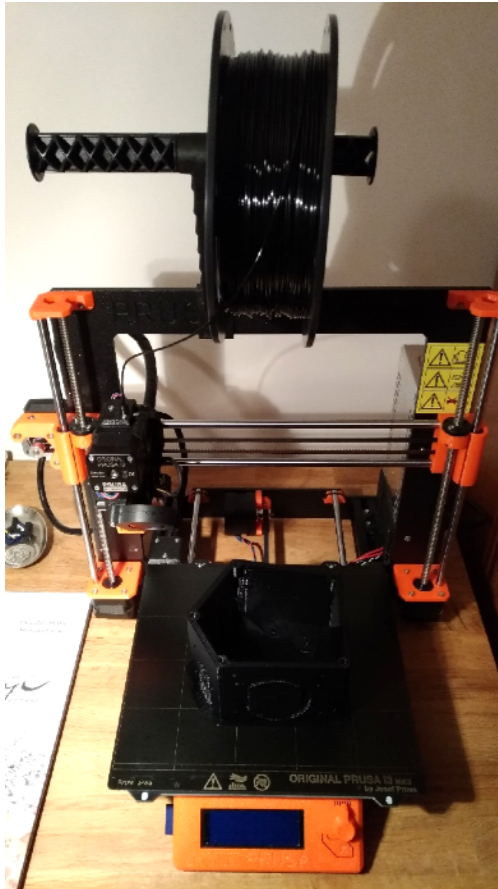


The key idea of the current version (V3): offer the possibility to realize the spectrograph by yourself at low cost using 3D printing technology.

See also the example of LOWSPEC project.

But, each spectrograph is a prototype, a unique adventure!

This philosophy is very different from buying a spectrograph off the shelf!



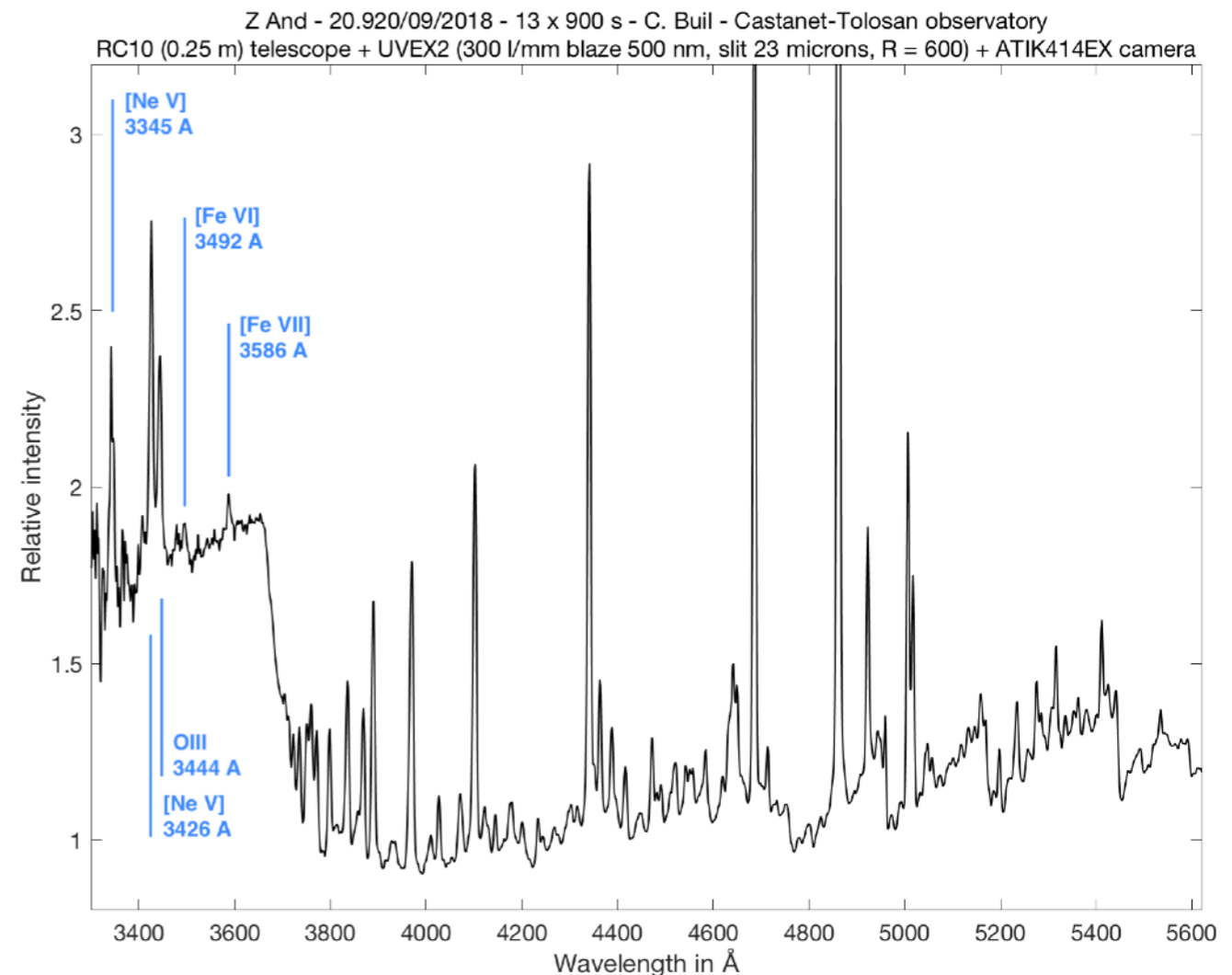
UVEX(3), a low cost projet, but with some limitations...

- Optimized only for small telescopes ($10 \text{ cm} < D < 40 \text{ cm}$).
- Ideal f-ratio between f/8 and f/10 (The target telescopes are f/10 Schmidt-Cassegrain (SC) and f/8 Ritchey-Chretien (RC)). Newton telescope are not recommended, but possible (less spectral resolution).
- Because you build the spectrograph, you also have the responsibility to adjust the optics (a not so simple task on a Czerny-Turner...).
- The mechanical rigidity is far from a metallic industrial model.

UVEX(3) is primarily an **experimental project**. Ideal for understanding how a spectrograph works (excellent end-to-end project for clubs, schools and universities).

UVEX is a spectrograph for **education**, OK, but also for **sciences and astrophysics...**

At right, the spectrum of symbiotic star Z And taken by using UVEX(2) on a RC10 spectrograph. Note the detection of [Ne IV] line at 3345 angströms. A first for amateurs!



UVEX versus other spectrograph

UVEX: Better spectral resolution (R=1000 to 3000)

Alpy 600: More compact and more easy to use



Alpy 600



UVEX

UVEX: More polyvalent

LISA : Compatible with large telescope, more luminous on extended object.



LISA

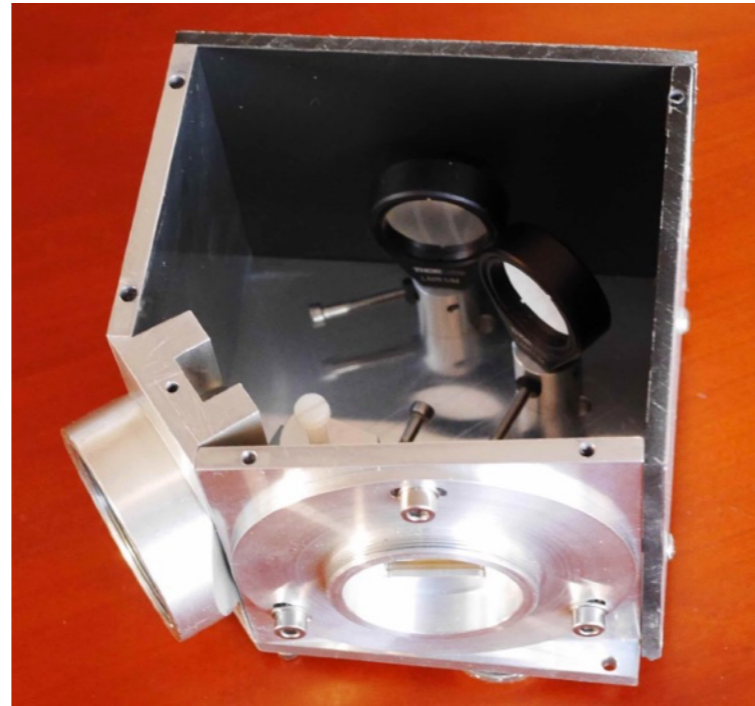
UVEX & LHIRES: Capacity to change the grating, but better chromatic correction for UVEX

LHIRES: Higher spectral resolution (R=15000 with a 2400 l/mm grating)

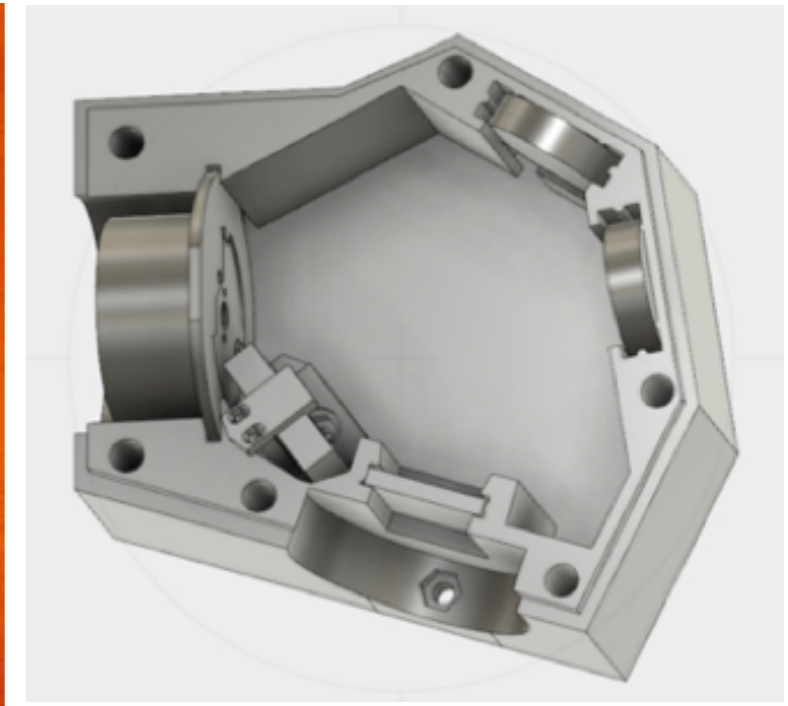


LHIRES III

The idea of a Czerny-Turner for amateur spectroscopy is from 2014. After some adventures (...) the first light of metallic UVEX(0) is doing the September 20, 2016 (Christian Buil). Tests validate the concept.



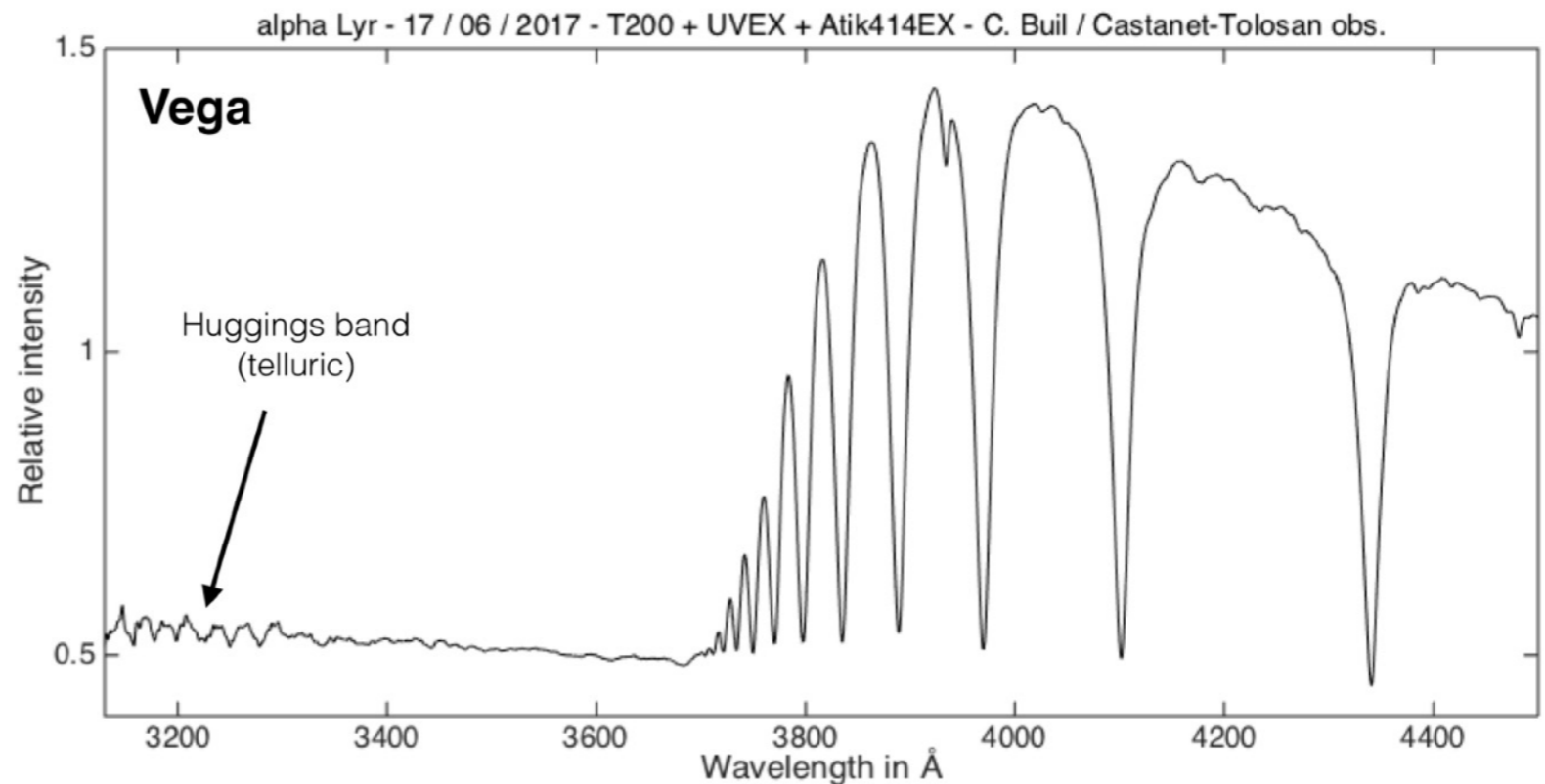
UVEX(0)



UVEX(1)

At the start of 2017, a new prototype is designed (Christian Buil and Pierre Thierry), by using a 3D printing technique. UVEX(1) take it's first spectra at spring 2017. Spectral features near wavelength 320 nm are observed. UVEX is a real ultraviolet explorer !

Left, detection of UV earth atmospheric ozone band (O3) in a Vega spectrum.



A short story (2/3)

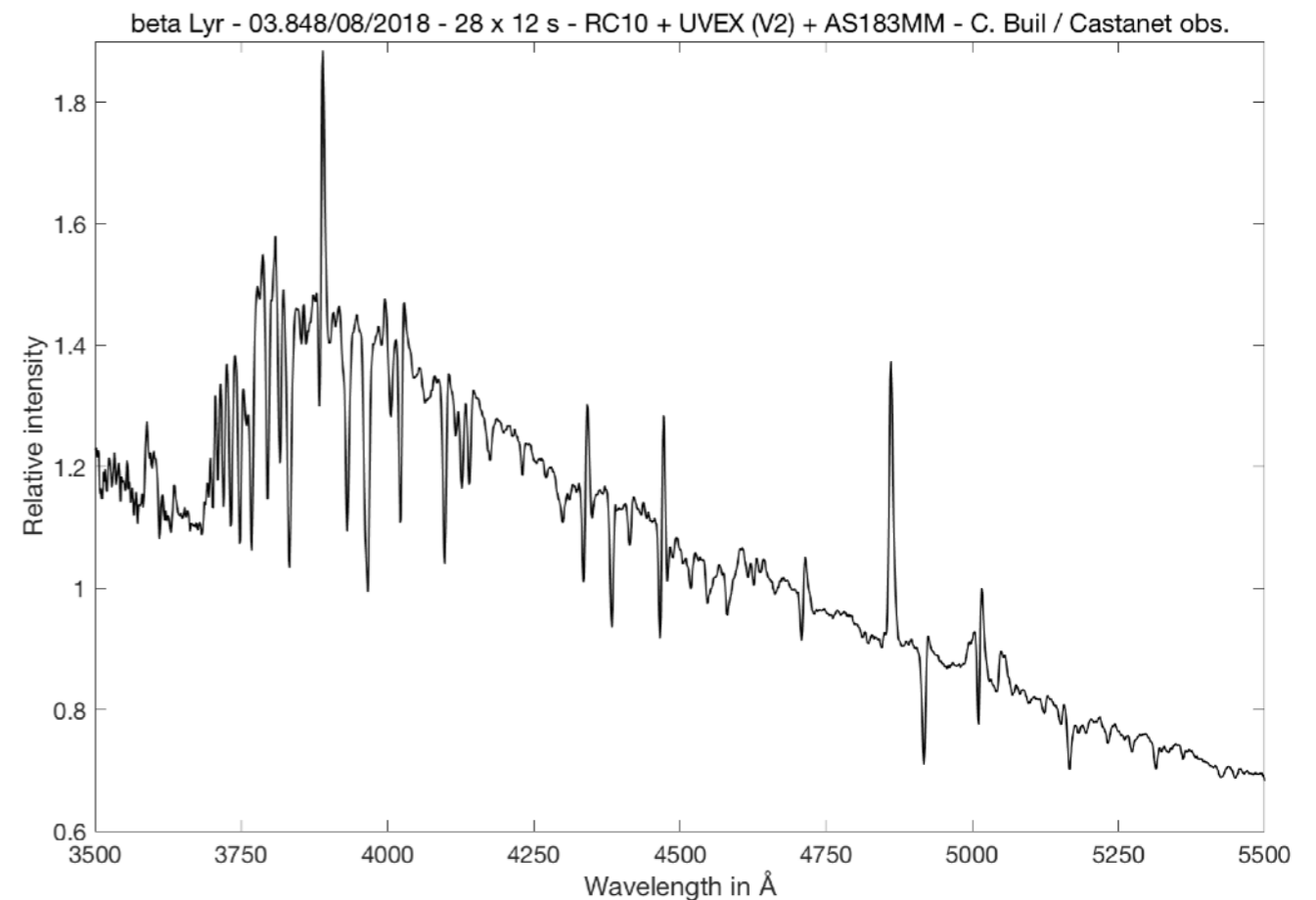
During the spring and summer of 2018, Christian Buil, Pierre Dubreuil, Stéphane Ubaud, Alain Lopez and Jean-Luc Martin (« Brice de Nice » group) develop UVEX (2) prototype on new basis, which benefits from the experience of the first two versions



Working session at Antibes (french Riviera) - summer 2018



UVEX(2) first light - August 3, 2018.



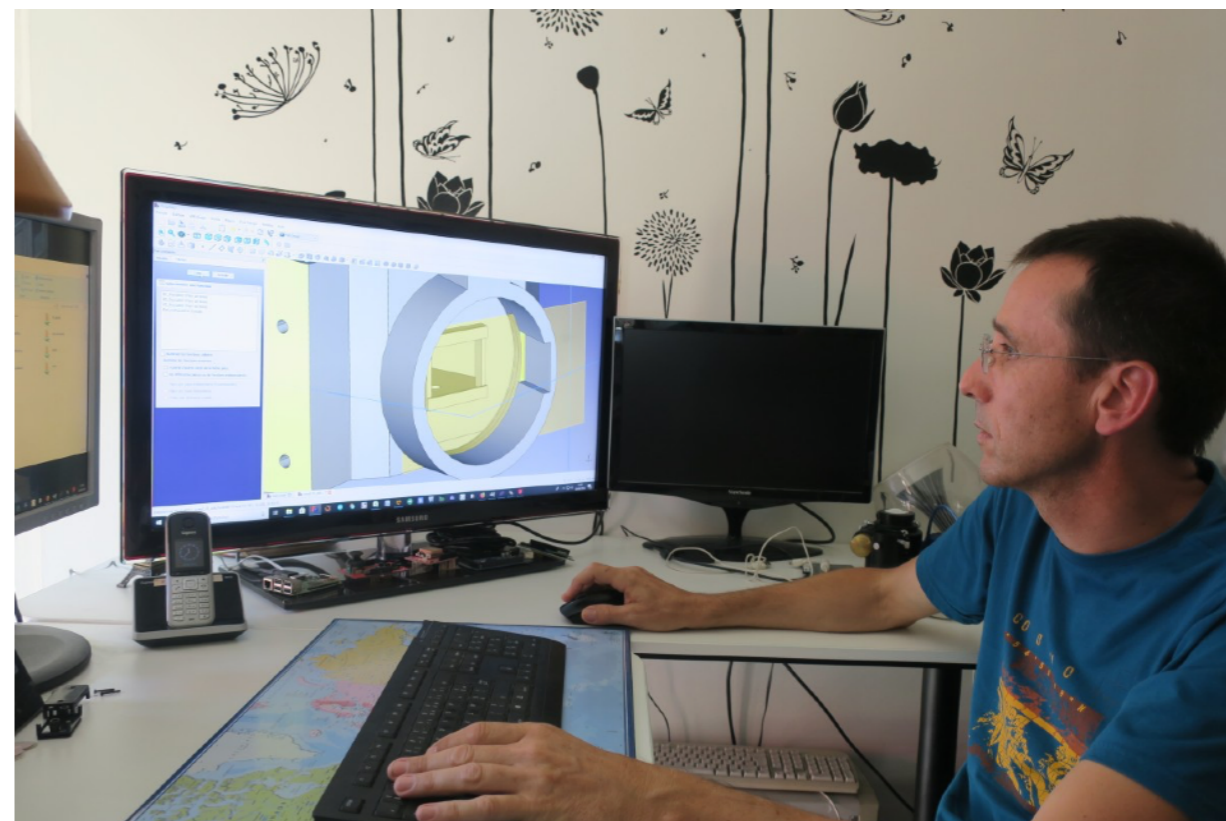


Test of UVEX(2) at the 60 centimeters telescope of Pic du Midi Observatory (french Pyrénées).



Valérie Desnoux during the september 2018 UVEX(2) mission at Pic du Midi observatory.

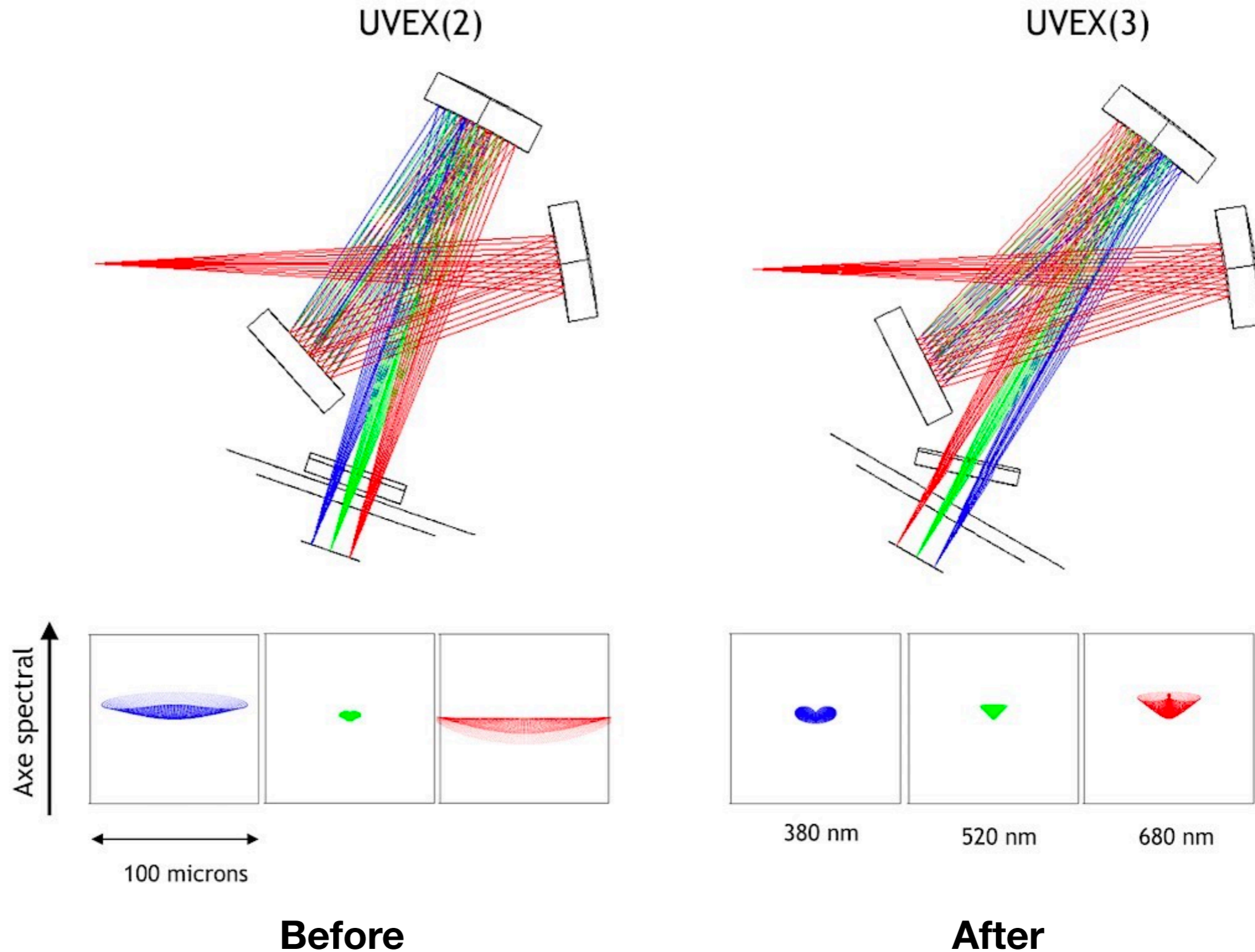
The latest version is **UVEX(3)** : improved optic and capacity to choose the camera model.



Stéphane Ubaud during an UVEX(3) conception session.

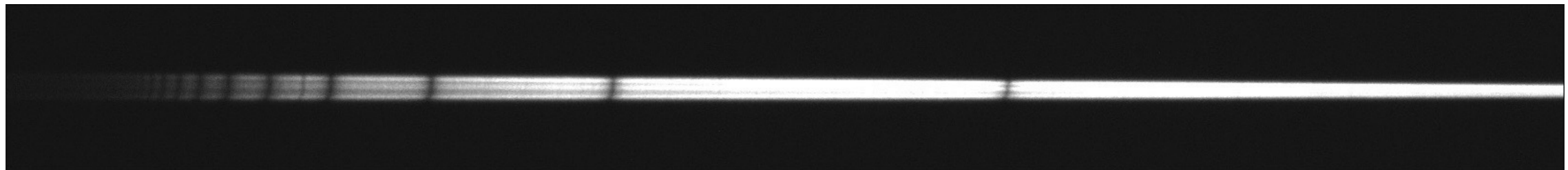
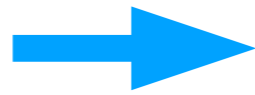
From UVEX(2) to UVEX(3)

Rotation of the cylindrical lens by an angle of 18° for a better correction of astigmatism :

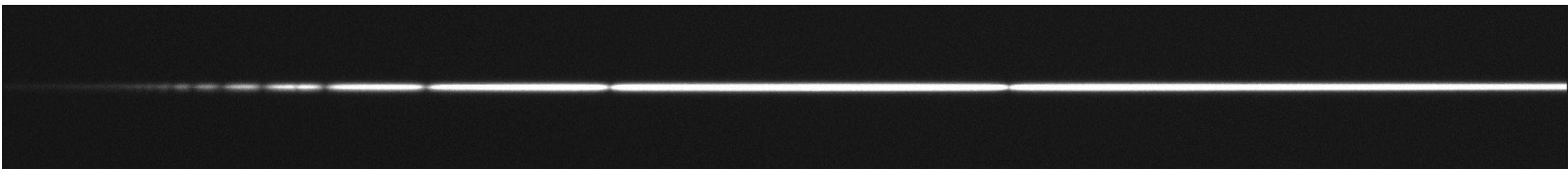


About astigmatism on Czerny-Turner spectrographs

An exemple of astigmatism aberration (CR-ROM spectroscopy)



UVEX 2D spectrum of a star before astigmatism correction



UVEX 2D spectrum of a star after astigmatism correction

Performances : Spectral resolution

UVEX is optimized for the use of a 300 lines/mm grating. But you can select the grating groove density for modulate the spectral resolution.

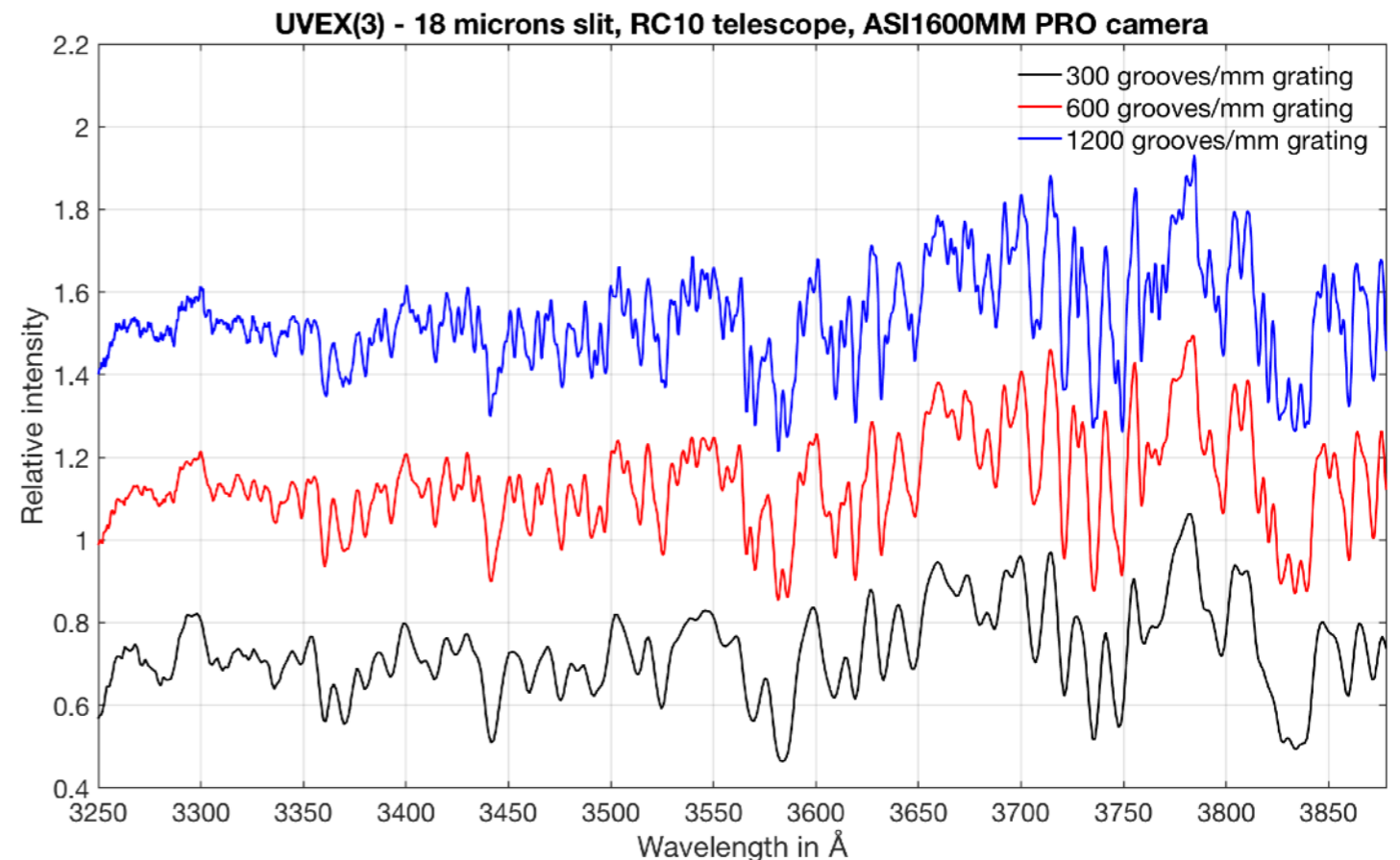
The spectral resolution is also function of the slit wide.

Here, the spectral resolution power ($R = \lambda/\Delta\lambda$) for some configurations at 650 nm:

Grating	Slit 18 microns	Slit 23 microns
300 l/mm	1200	950
600 l/mm	2000	1500
1200 l/mm	3100	2300

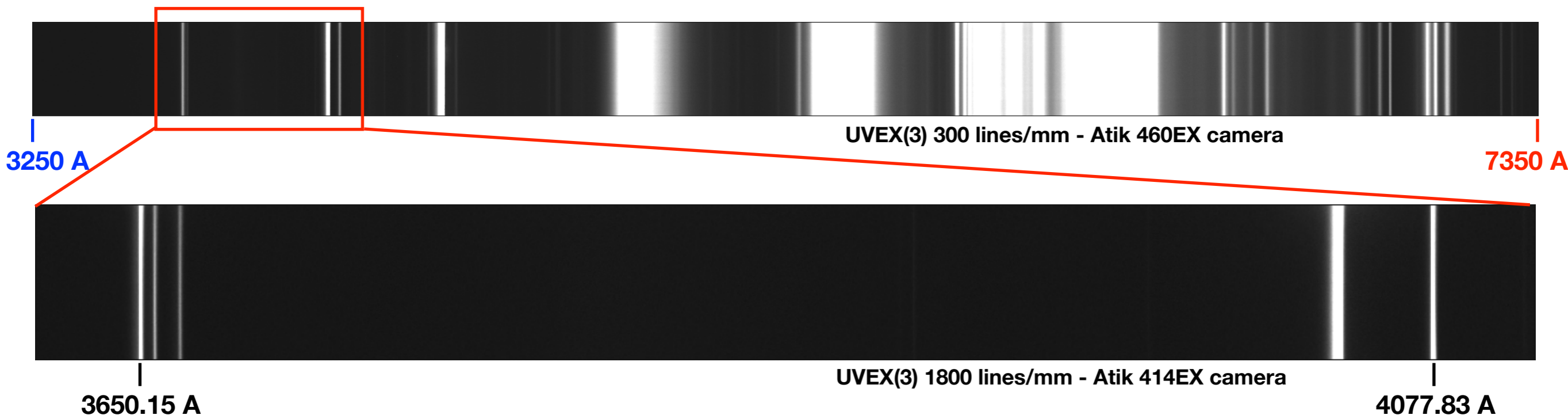


Left, aspect of daylight UV spectrum in function of grating groove density for a f/8 entrance beam.



« Extreme » resolution: 1800 lines/mm grating (only for the UV region)

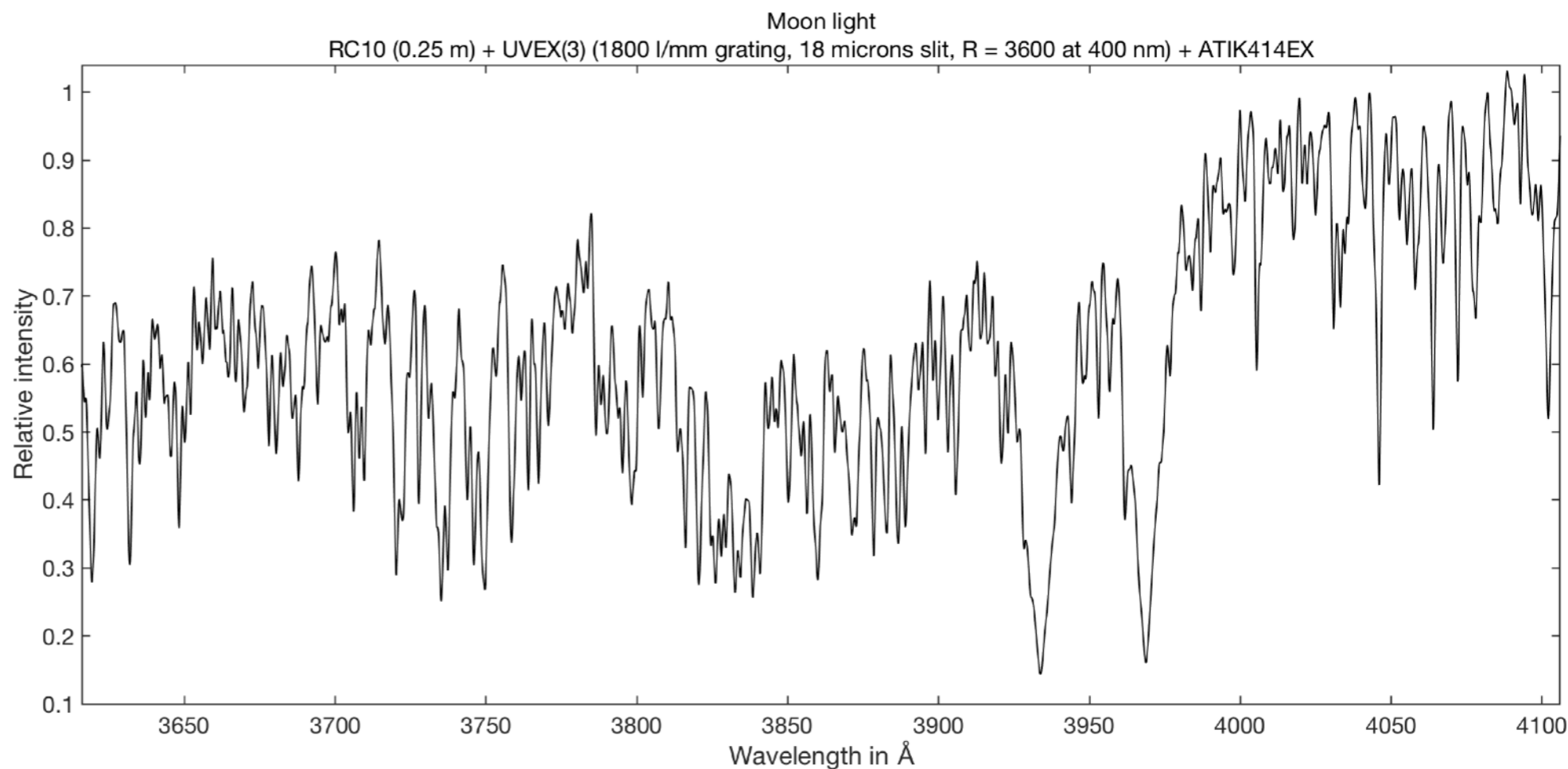
Aspect of a « fluo-compact » lamp spectrum for two UVEX(3) extrema spectral resolution:



Ideal for spectral classification (student project)

Left, UV moonlight spectrum
 $R = 3600$ at 400 nm

(but only an experimental mode)

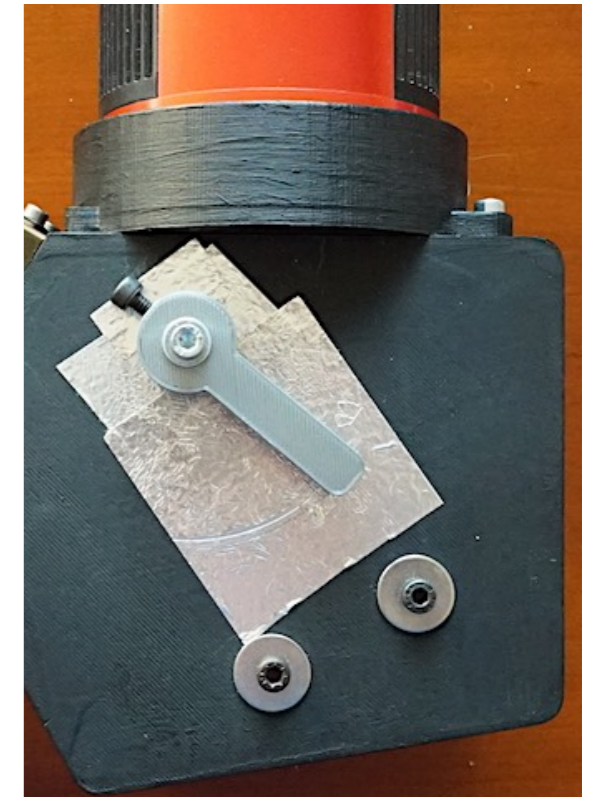


Spectral coverage

Theoretical observed spectral domain wide in function of the camera model:

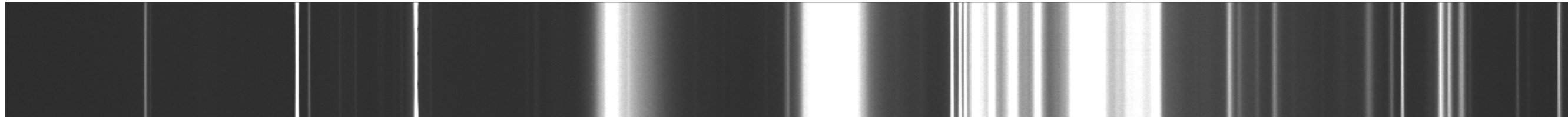
	300 lines/mm	600 lines/mm	1200 lines/mm
ATIK414EX	3000 A	1500 A	750 A
ATIK460EX	4170 A	2080 A	1040 A
ASI183MM	4400 A	2200 A	1100 A
ASI1600MM	(5900 A)	(2980 A)	(1490 A)

In practice, consider these values as the maximum values for UVEX

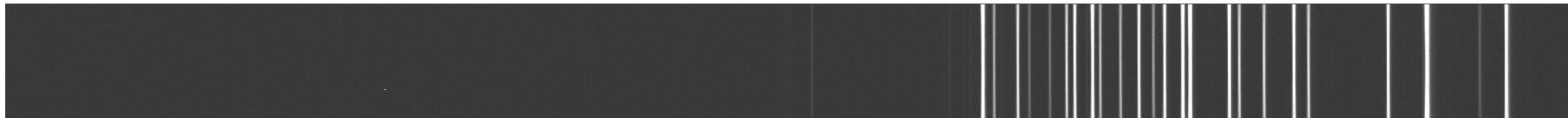


Spectral domain can be changed from the exterior

Example of covered spectral domain on some spectral source - Configuration : UVEX(3) 300l/mm associated at an Atik460EX camera



Fluo-compact lamp



Neon lamp



Sun spectrum

↑
3280 A

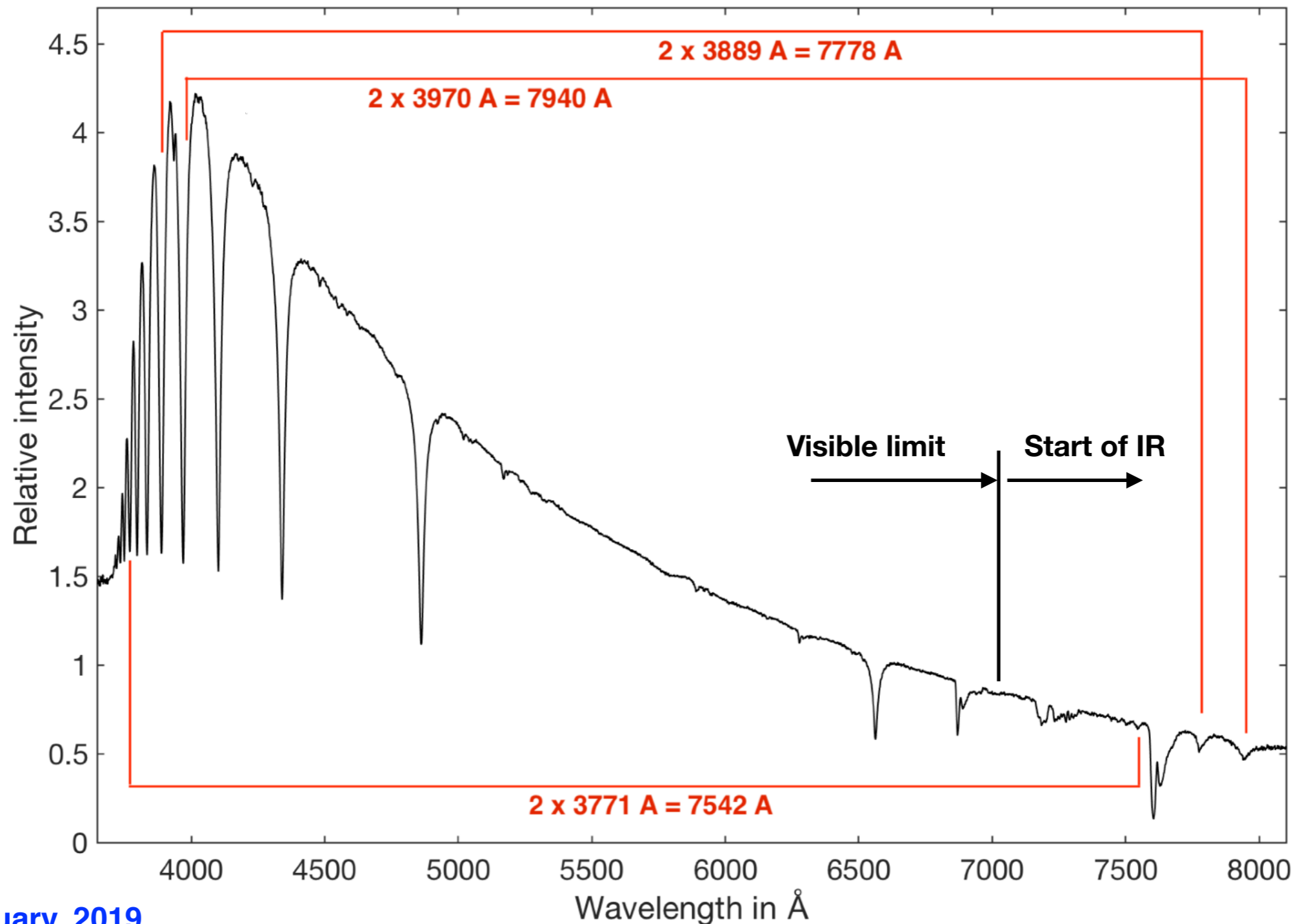
↑
7435 A

Spectral coverage

UVEX excels in the UV part of the spectrum, but of course, the visible part of the spectrum is also accessible.

Warning, pay attention to order recovery!

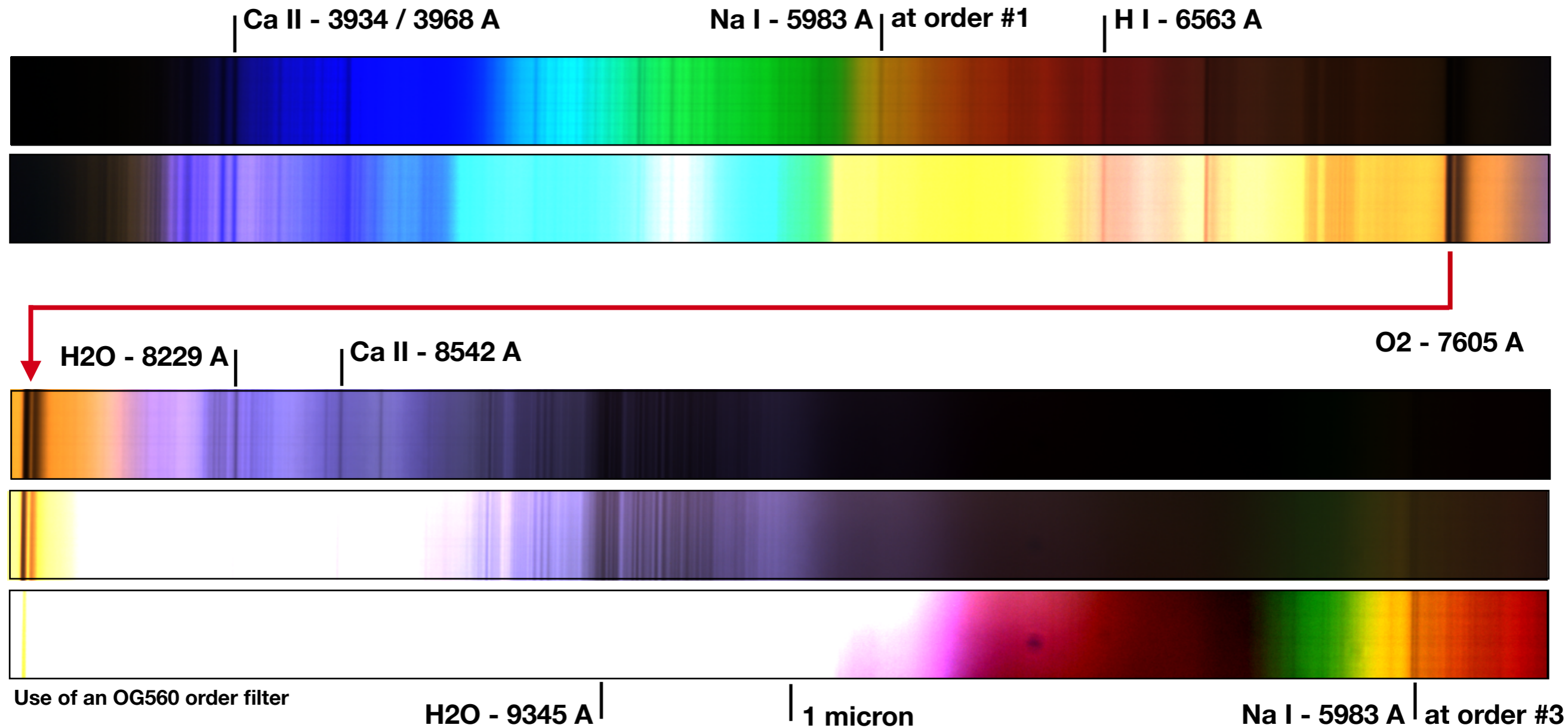
HD31295 (type A0V) - UVEX(3) 300 l/mm, slit 23 microns, ASI1600MM, RC10



Increase spectral coverage

« **True colors** » spectroscopy UVEX(3) 300 lines/mm + color camera ASI294MC (ZWO)

Use of a CFA detector (Color Filter Array) for capture color (Sony IMX294)

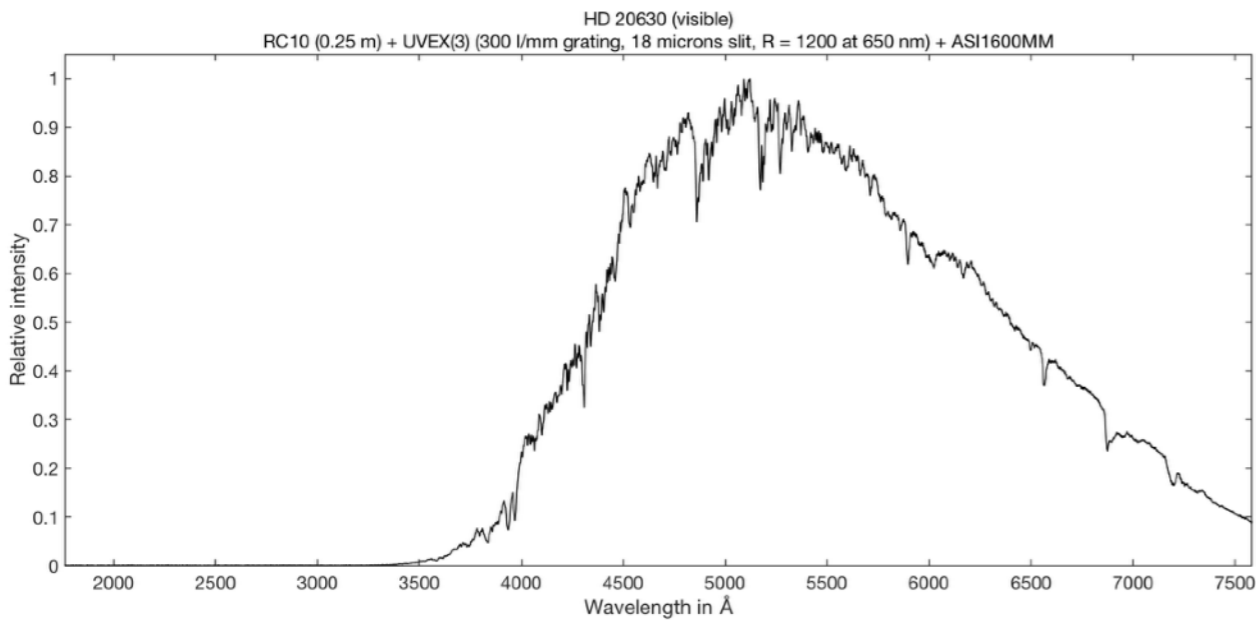


Sun light - A typical educational project (no telescope is needed)

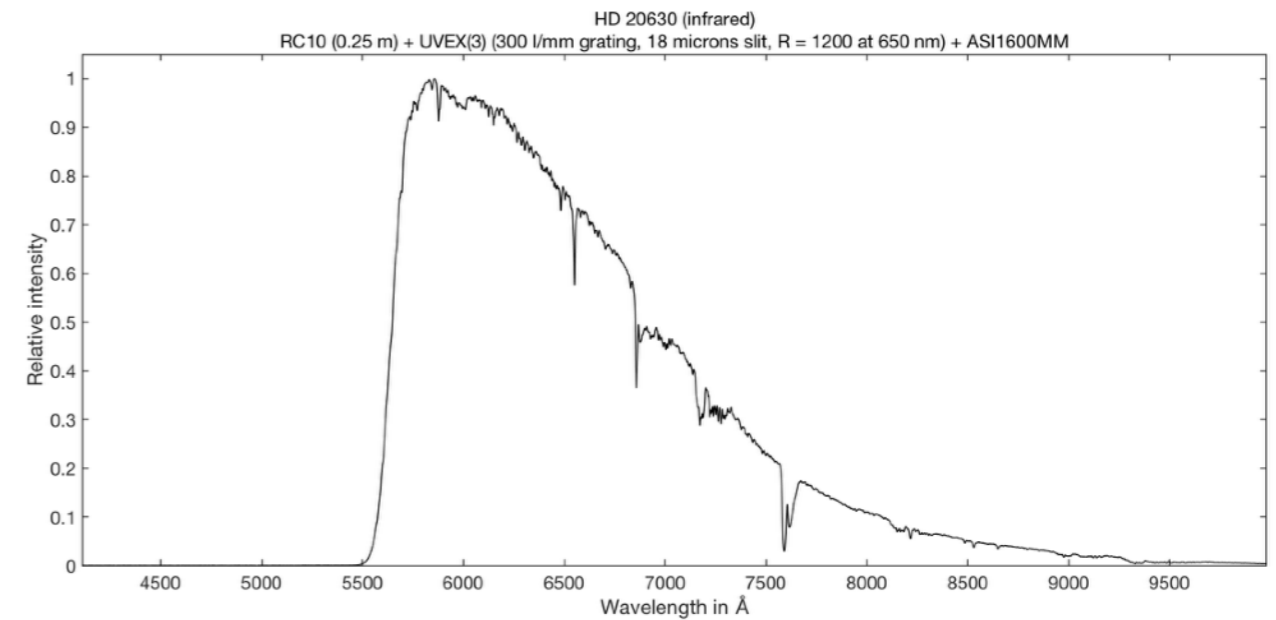
Increase spectral coverage

Thanks to the achromatism of the optical formula, UVEX makes it possible to observe a wide spectral range without refocusing the camera. The operation is simple, change the angle of the grating holder.

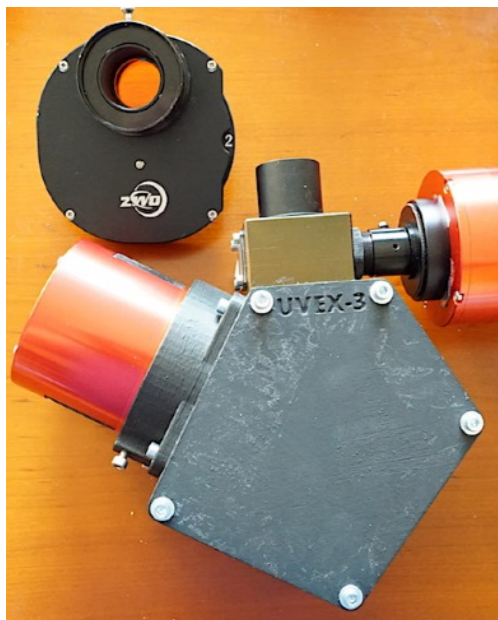
But remember that you must also use a red filter to capture the (near) infrared...



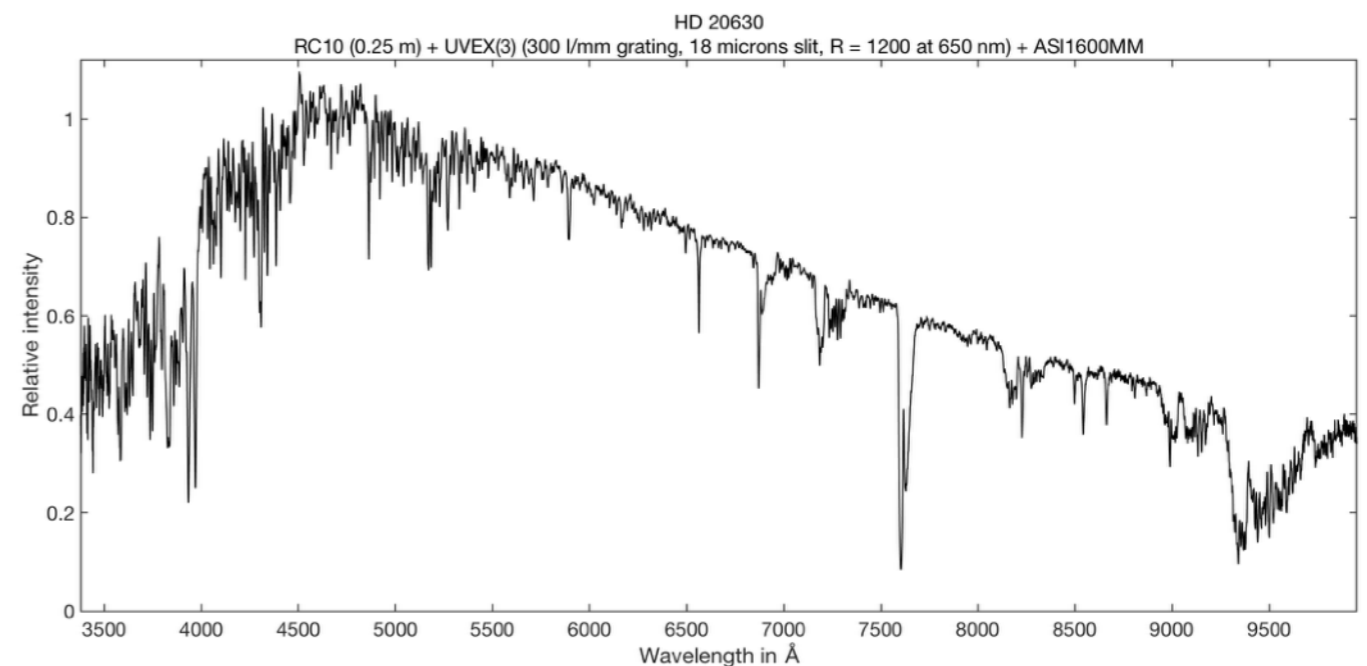
Step #1: Acquisition of the « visible » part of the spectrum.



Step #2: Acquisition of the « infrared » part of the spectrum (add of OG560 order filter).



The red order filter is fixed into a filter wheel (ZWO).



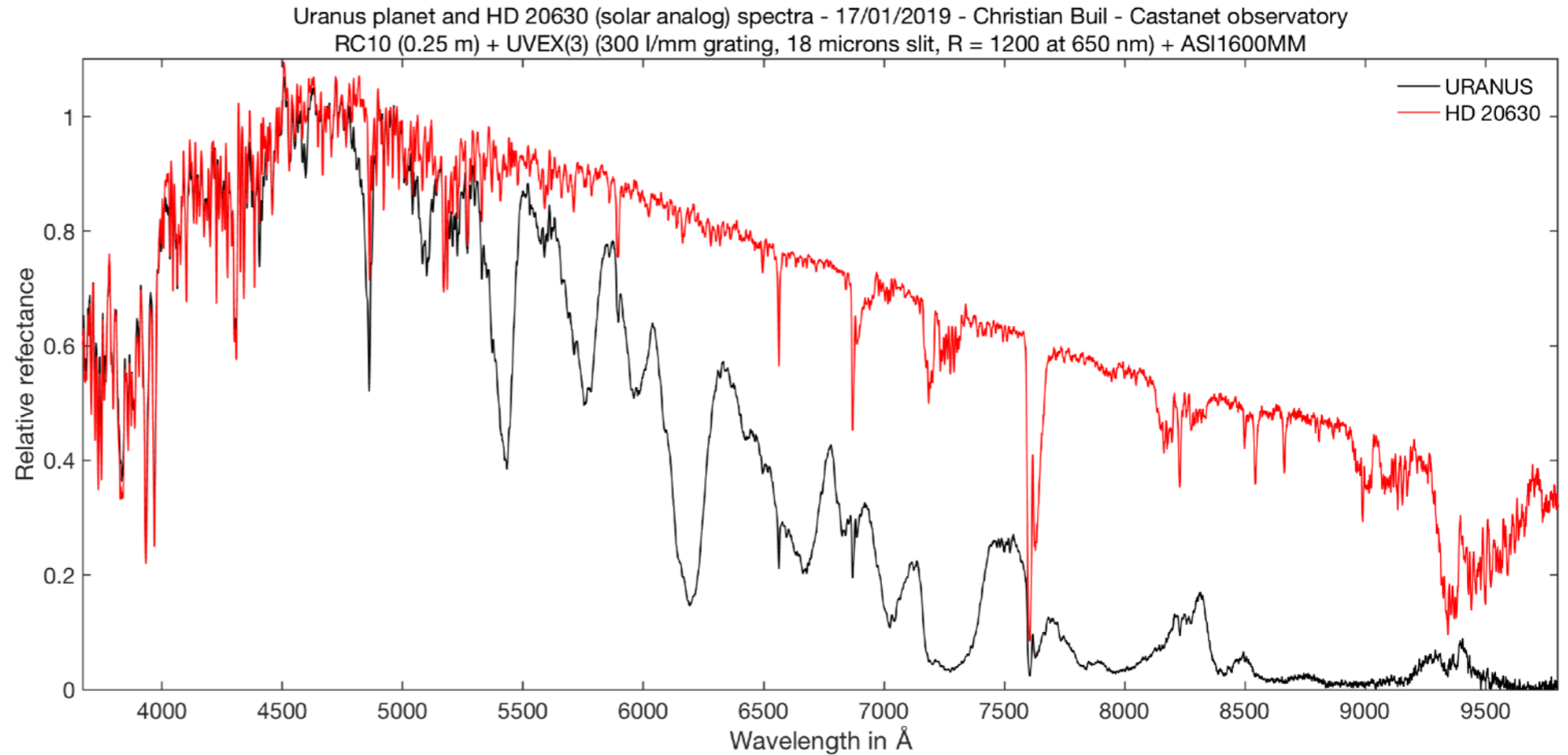
Fusion of visible and infrared part (HD20630 is a solar like star). Instrumental response is now corrected.

Increase spectral coverage

An exemple of wide spectral band spectroscopy: observation of near infrared planetary atmosphere.

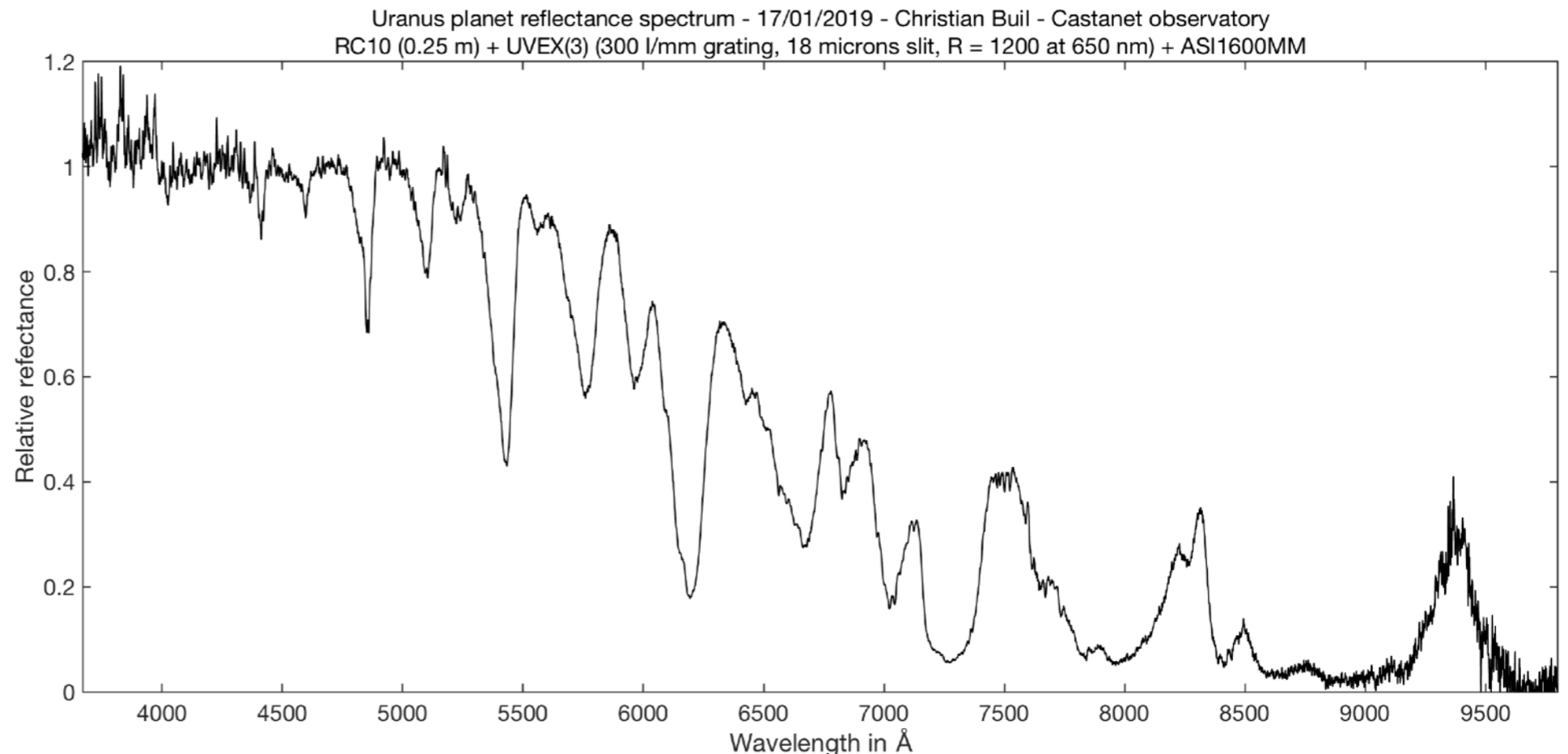
In red: the spectrum of a star similar to the sun

In dark: the apparent spectrum of Uranus planet



The ratio of Uranus apparent spectrum and solar like spectrum = reflectance of Uranus atmosphere (note presence of many deep CH4 bands)

*Fusion of two UVEX(3) spectra (VIS + IR).
CMOS ASI1600MM camera*



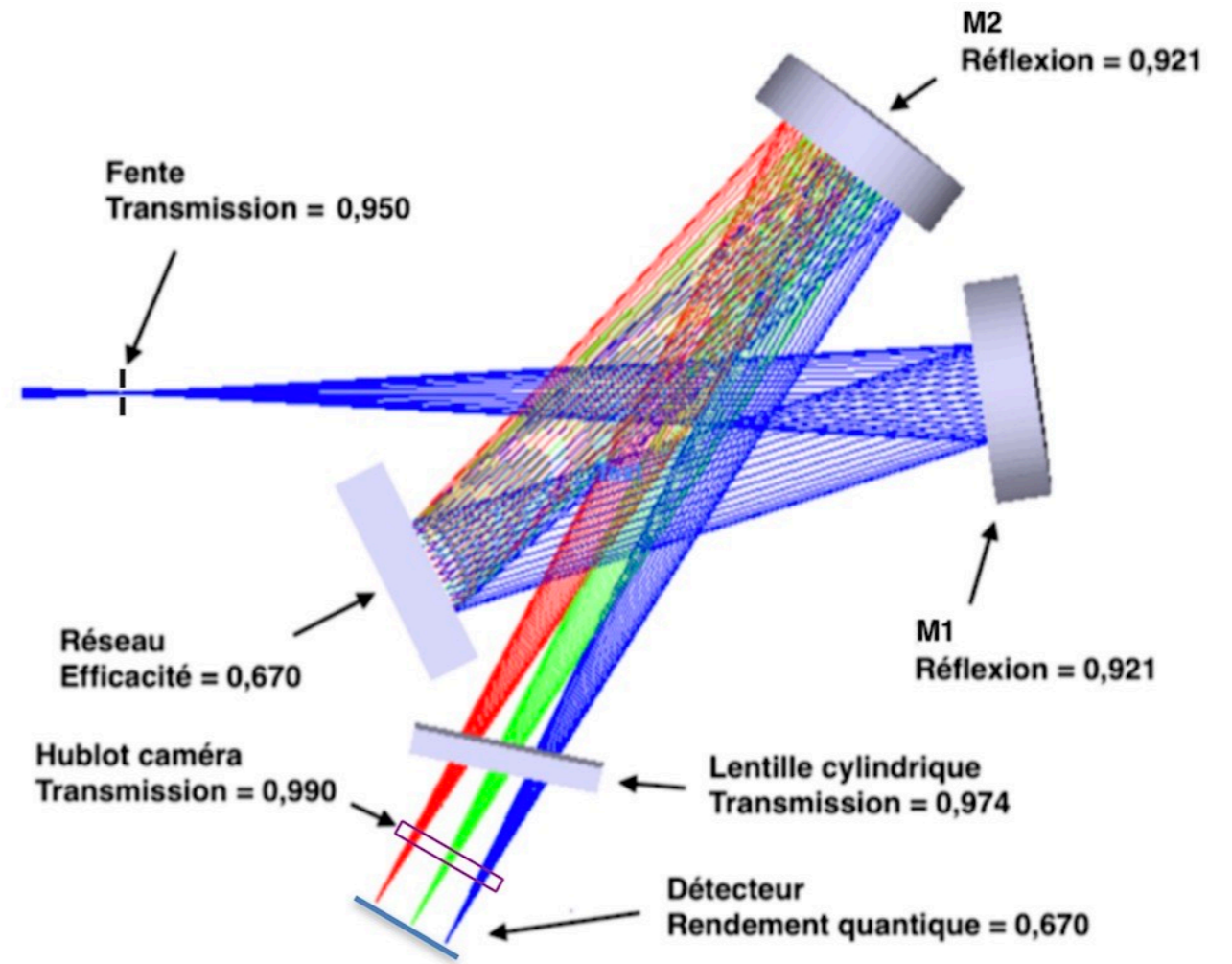
Radiometric efficiency (throughput)

Throughput at 550 nm

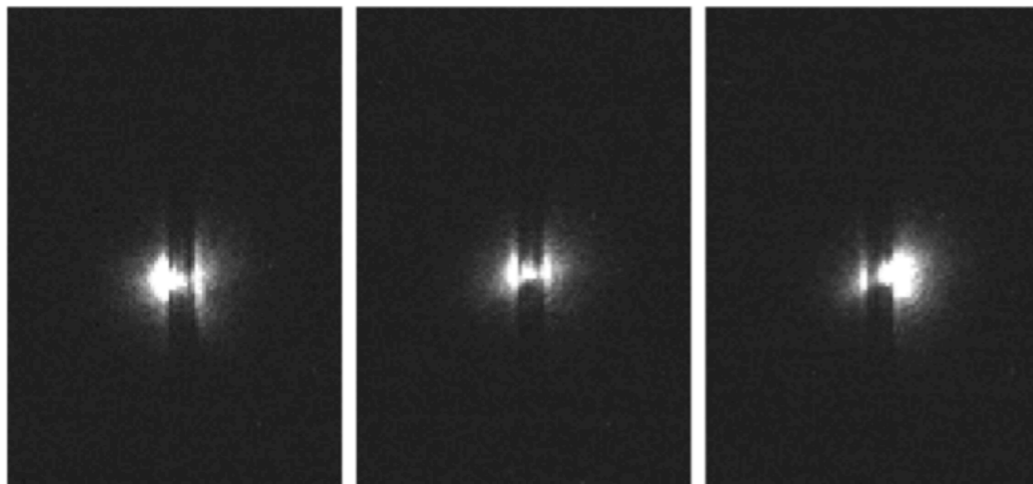
$$Th = 0,950 \times 0,921 \times 0,670 \times 0,921 \times 0,974 \times 0,990 \times 0,670 = 0,349$$

A throughput of 35% is an excellent performance for a spectrograph

It is also necessary to take into account the slit transmission...



Stellar image on the slit



Slit geometrical transmission - Seeing 2.5 arcsec - f/10

	Slit 18 microns	Slit 23 microns
D = 20 cm	0,618	0,726
D = 25 cm	0,516	0,618
D = 30 cm	0,440	0,534
D = 40 cm	0,338	0,415
D = 50 cm	0,273	0,338

Typical total spectrograph efficiency (2.5 arcsec seeing) : $0.35 \times 0.62 = 0.22$

Impact of grating selection

Measured relative diffraction efficiency values of THORLABS grating (500 nm blaze, pixel 6.45 microns) :

At wavelength 400 nm

Grating	Dispersion	Relative diffraction efficiency
300 l/mm	2,140 A/pixel	1,000
600 l/mm	1,078 A/pixel	0,588
1200 l/mm	0,542 A/pixel	0,510
1800 l/mm	0,358 A/pixel	0,434

At wavelength 650 nm

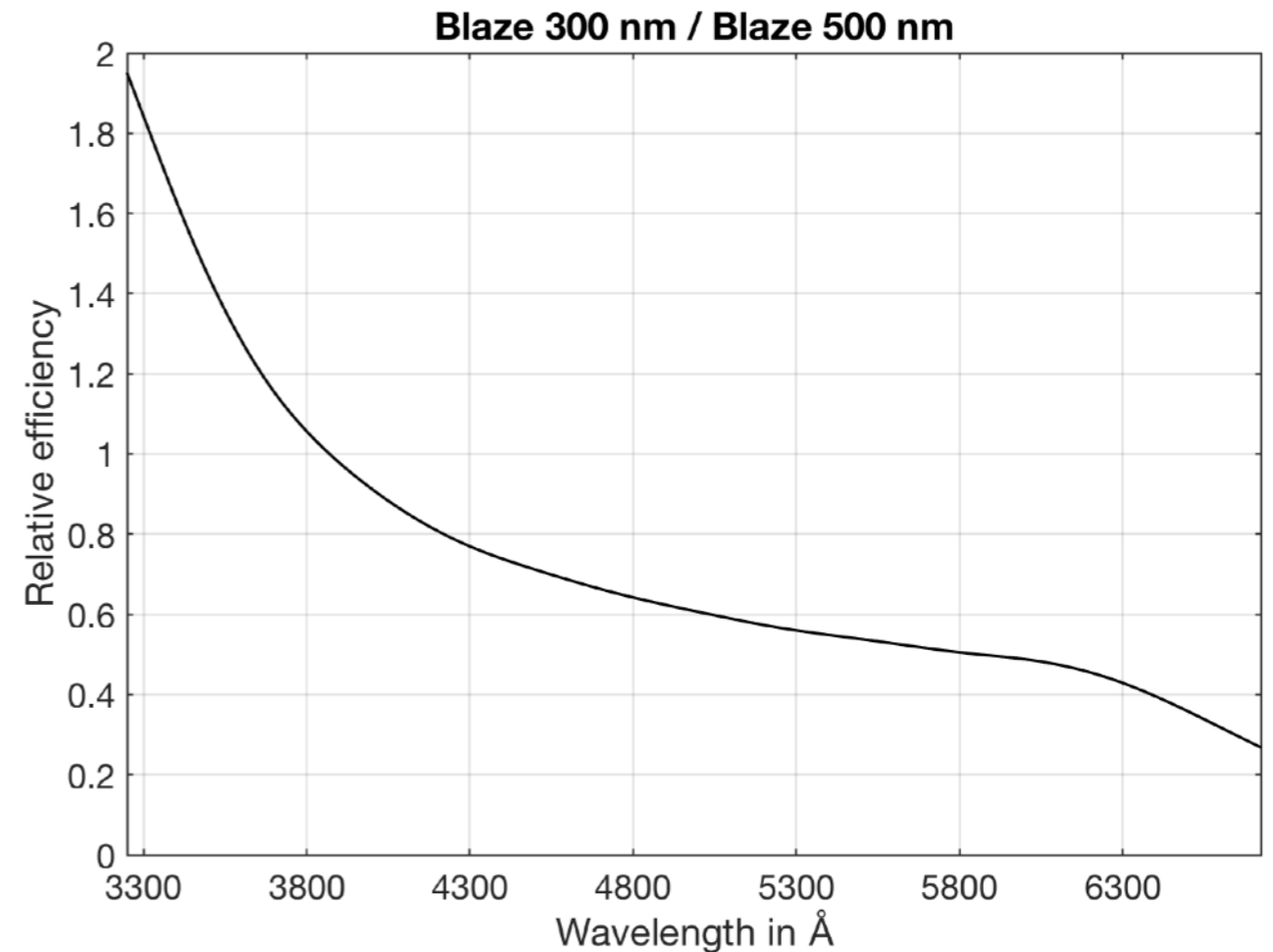
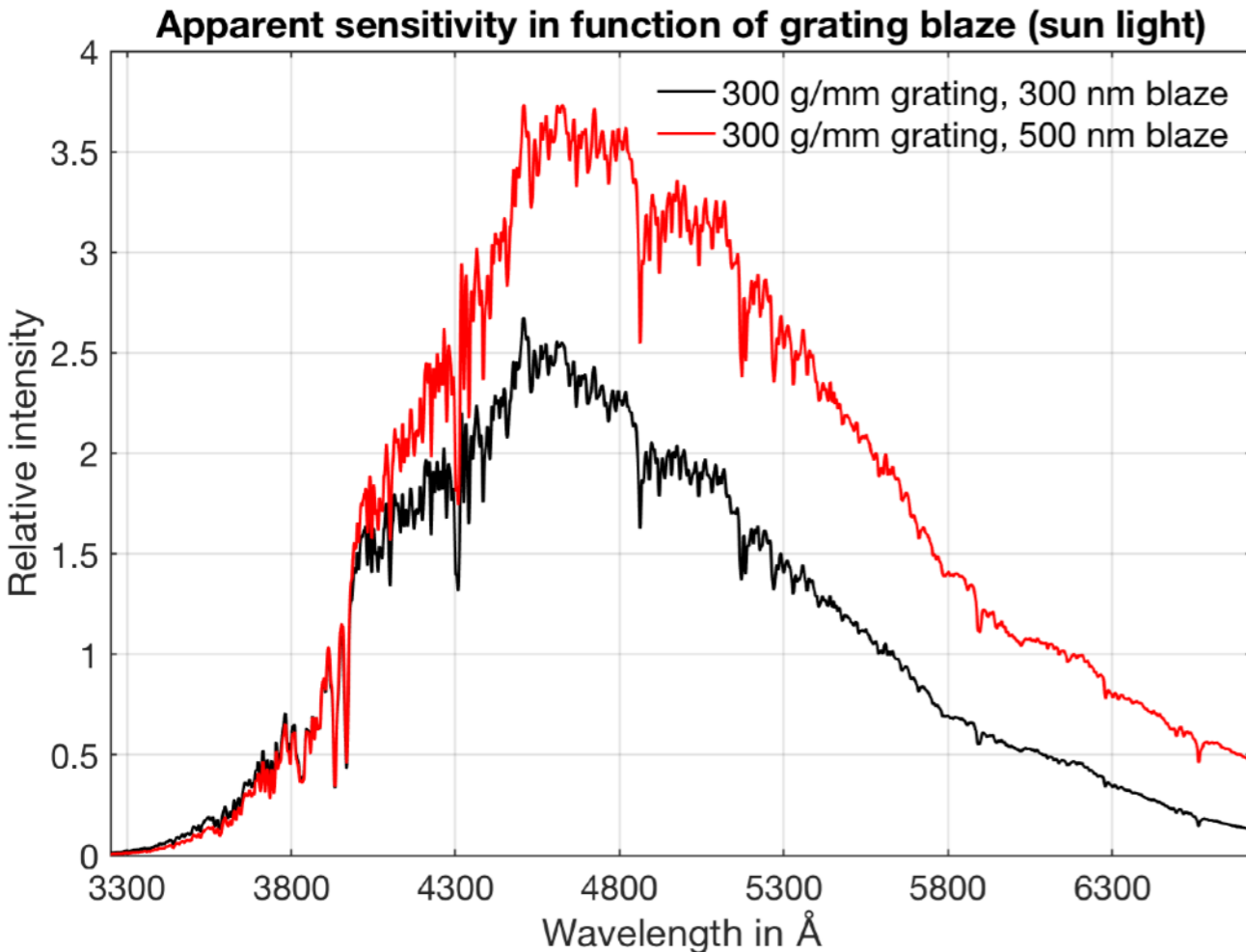
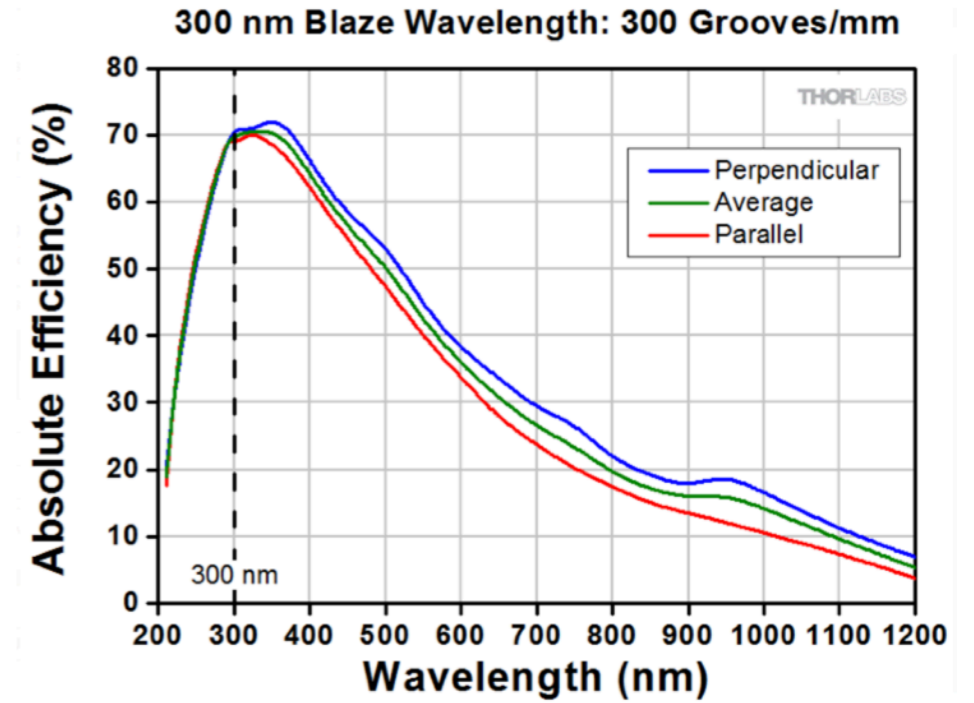
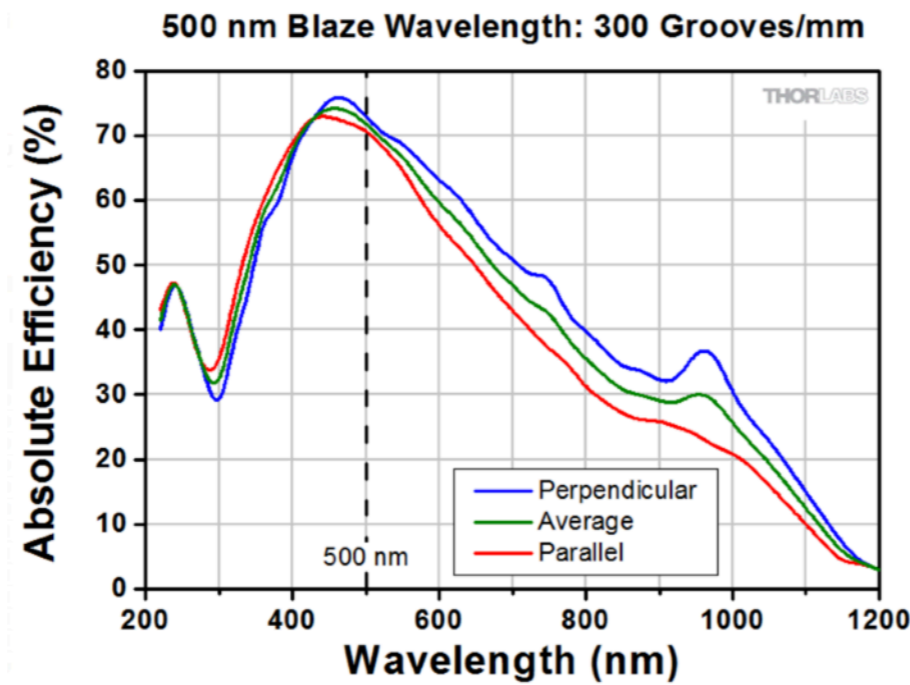
Grating	Dispersion	Relative diffraction efficiency
300 l/mm	2,151 A/pixel	1,000
600 l/mm	1,084 A/pixel	0,940
1200 l/mm	0,533 A/pixel	1,019
1800 l/mm	0,330 A/pixel	0,888

The maximum efficiency is achieved by using the 300 lines/mm grating

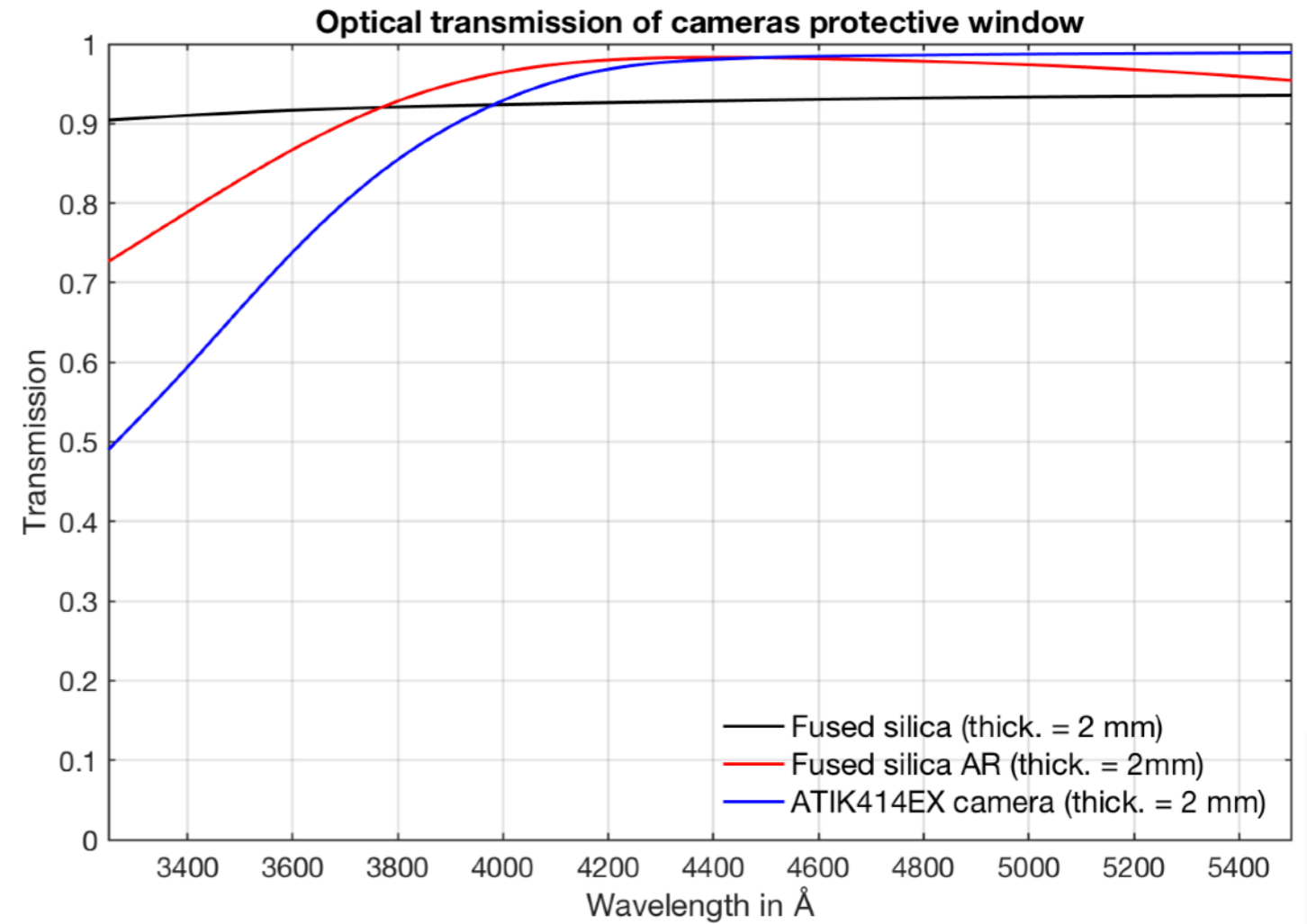
Radiometric efficiency (throughput)

Optimize wavelength blaze of the grating for tracking the UV photons

Documents THORLAB



Change the protective glass of CMOS/CCD camera for improve UV responsivity



Optional of course !

The essential parameters for a detector in spectroscopy :

- The readout noise (RON)
- The quantum efficiency (QE)

Values for popular cameras :

Atik 414EX

ReadOut Noise (RON) = 4.1 e-
 Electronic gain = 0.265 e-/ADU
 Pixel size = 6.45 microns

Wavelength	Quantum efficiency
7500 A	38 %
6500 A	52 %
5500 A	65 %
4500 A	66 %
4000 A	51 %
3800 A	40 %
3500 A	17 %

Atik 460EX

ReadOut Noise (RON) = 5.5 e-
 Electronic gain = 0.274 e-/ADU
 Pixel size = 4.54 microns

Wavelength	Quantum efficiency
7500 A	35 %
6500 A	47 %
5500 A	67 %
4500 A	68 %
4000 A	54 %
3800 A	35 %
3500 A	7 %

ASI1600MM

ReadOut Noise (RON) = 1.3 e-
 Electronic gain (20 dB) = 0.475 e-/ADU
 Pixel size = 3.80 microns

Wavelength	Quantum efficiency
7500 A	18 %
6500 A	35 %
5500 A	52 %
4500 A	59 %
4000 A	45 %
3800 A	33 %
3500 A	11 %

Comparison between ATIK 414EX and ASI1600MM

A performance criteria : the Signal to Noise Ratio (SNR)

The fundamental formulae :

$$\text{SNR} = \frac{QE \times N_p}{\sqrt{QE \times N_p + \text{BinFactor} \times \text{RON}^2}}$$

QE = Quantum Efficiency, RON = ReadOut Noise, N_p = number of incident photons per unit area, BinFactor = conversion factor to the same surface detection (or same spectral resolution element).
 If BinFactor = 1 for ATIK camera (arbitrary), BinFactor = 2.88 for ASI camera (square of pixel size ratio)

Not an unique answer...

Photon limited regime (high signal)

Suppose $N_p = 10\ 000$

Wavelength	ATIK SNR	ASI SNR
7500 A	62	42
6500 A	72	59
5500 A	81	72
4500 A	81	77
4000 A	71	67
3800 A	63	57
3500 A	41	33

Detector limited regime (faint signal)

Suppose $N_p = 10$

Wavelength	ATIK SNR	ASI SNR
7500 A	0.84	0.70
6500 A	1.11	1.21
5500 A	1.35	1.64
4500 A	1.38	1.80
4000 A	1.09	1.47
3800 A	0.88	1.15
3500 A	0.39	0.45

Radiometric efficiency (throughput) : detector impact (3/3)

ASI 294 MC (color camera)

ReadOut Noise (RON) = 1.4 e-

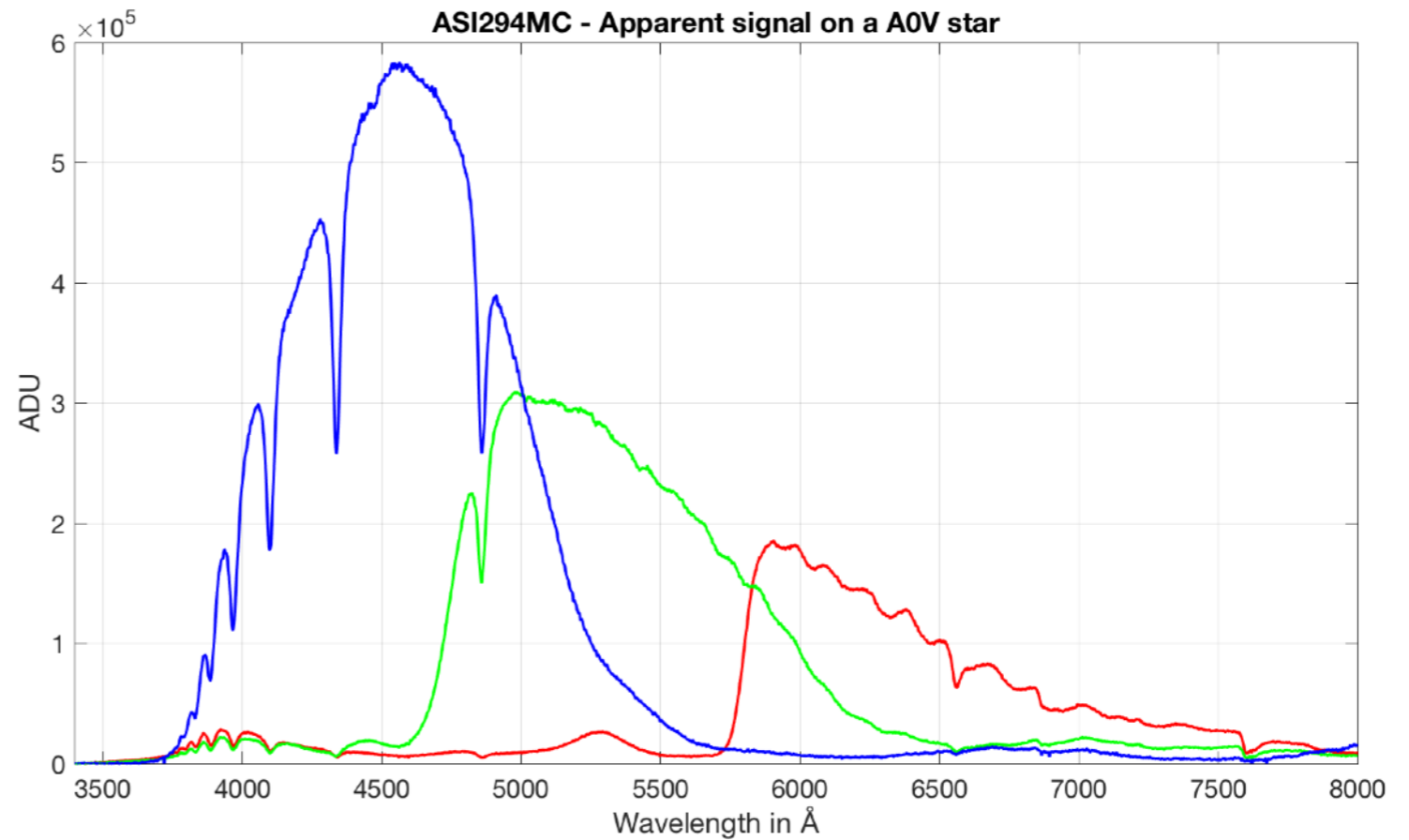
Electronic gain (20 dB)

R = 0.326 e-/ADU

V = 0.379 e-/ADU

B = 0.197 e-/ADU

Pixel size = 4.63 microns



Channel R

Wavelength	Quantum efficiency
7500 A	6 %
6500 A	10 %
5500 A	0 %
4500 A	0 %
4000 A	2 %
3800 A	2 %
3500 A	0 %

Channel G

Wavelength	Quantum efficiency
7500 A	3 %
6500 A	2 %
5500 A	16 %
4500 A	1 %
4000 A	2 %
3800 A	2 %
3500 A	1 %

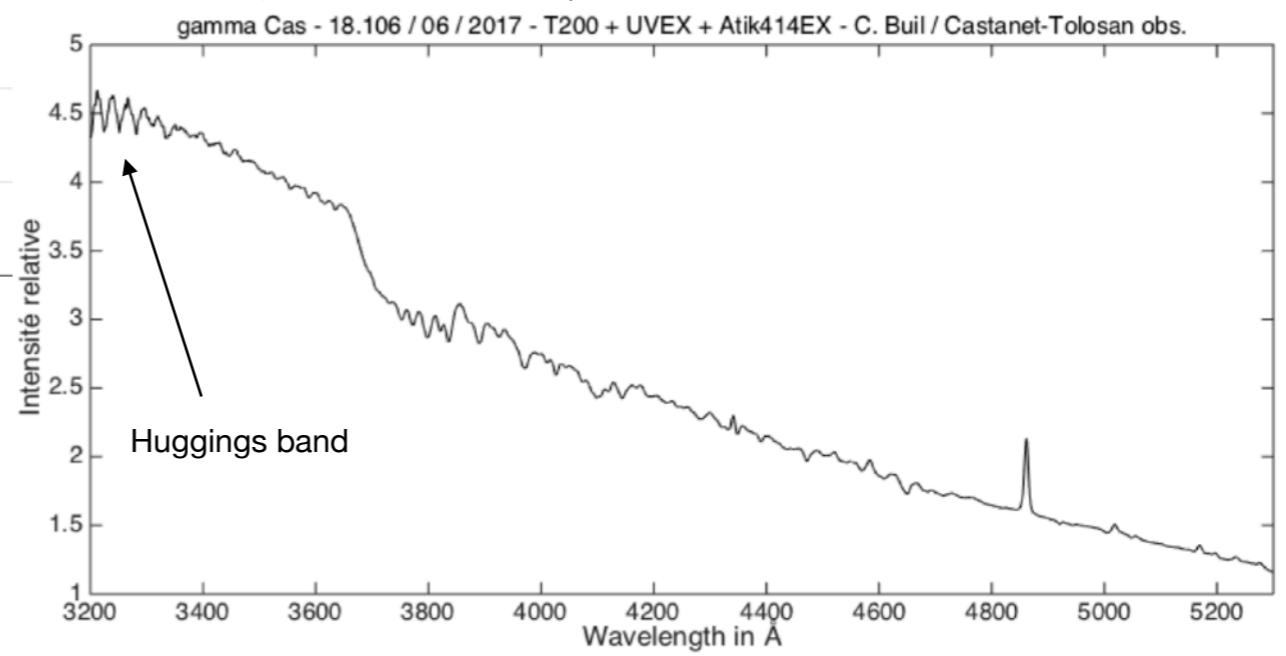
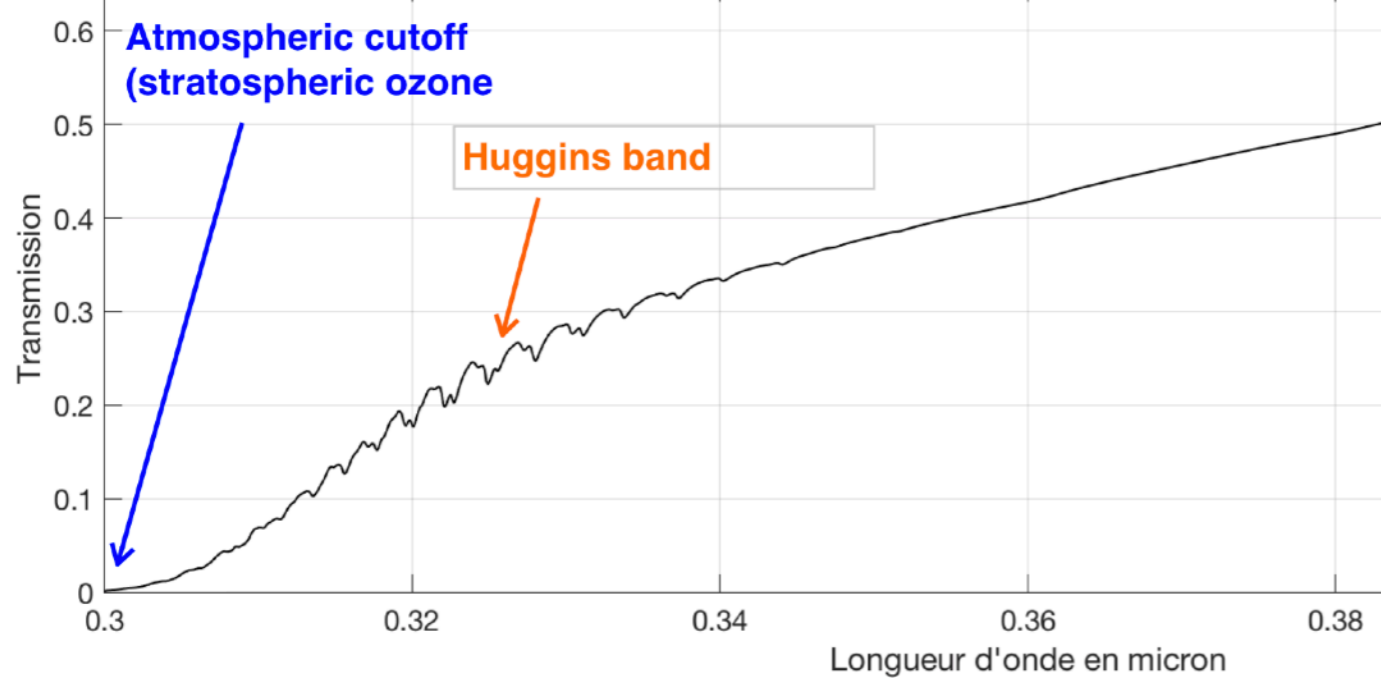
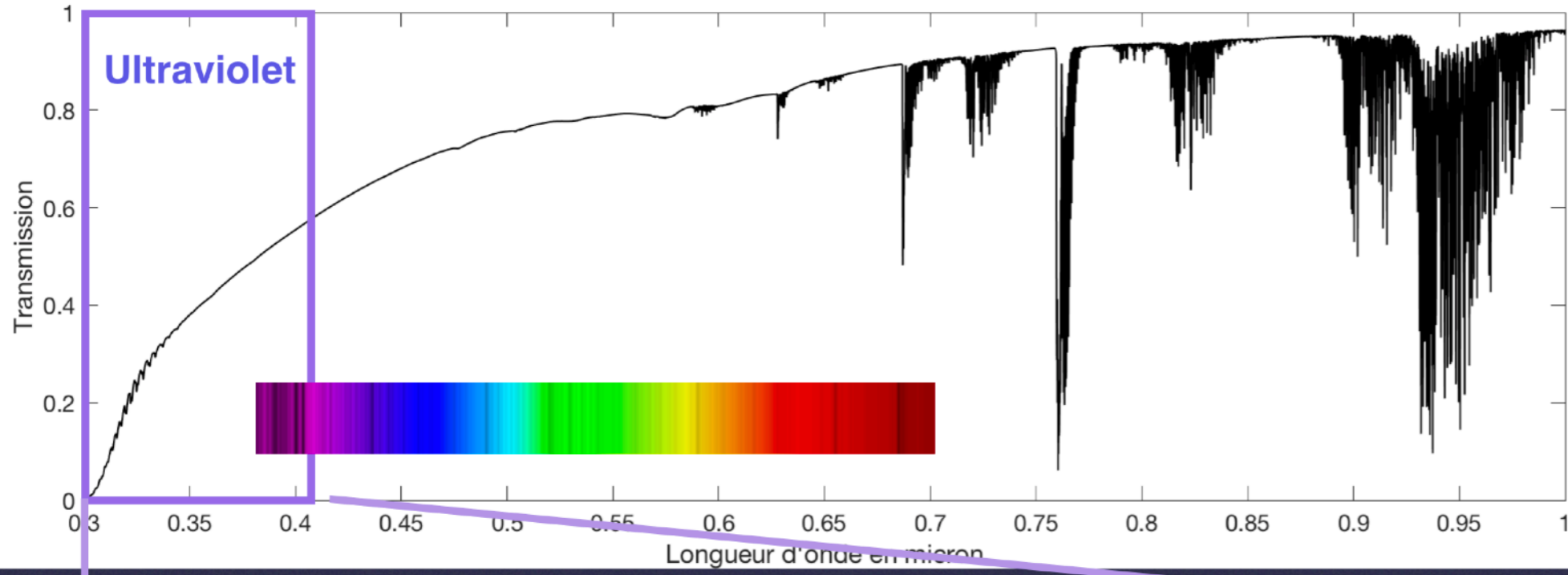
Channel B

Wavelength	Quantum efficiency
7500 A	0 %
6500 A	1 %
5500 A	1 %
4500 A	17 %
4000 A	10 %
3800 A	3 %
3500 A	0 %

B&W 9.26 microns

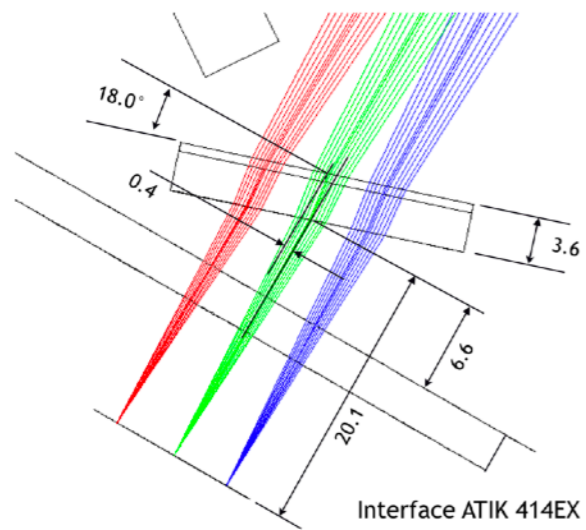
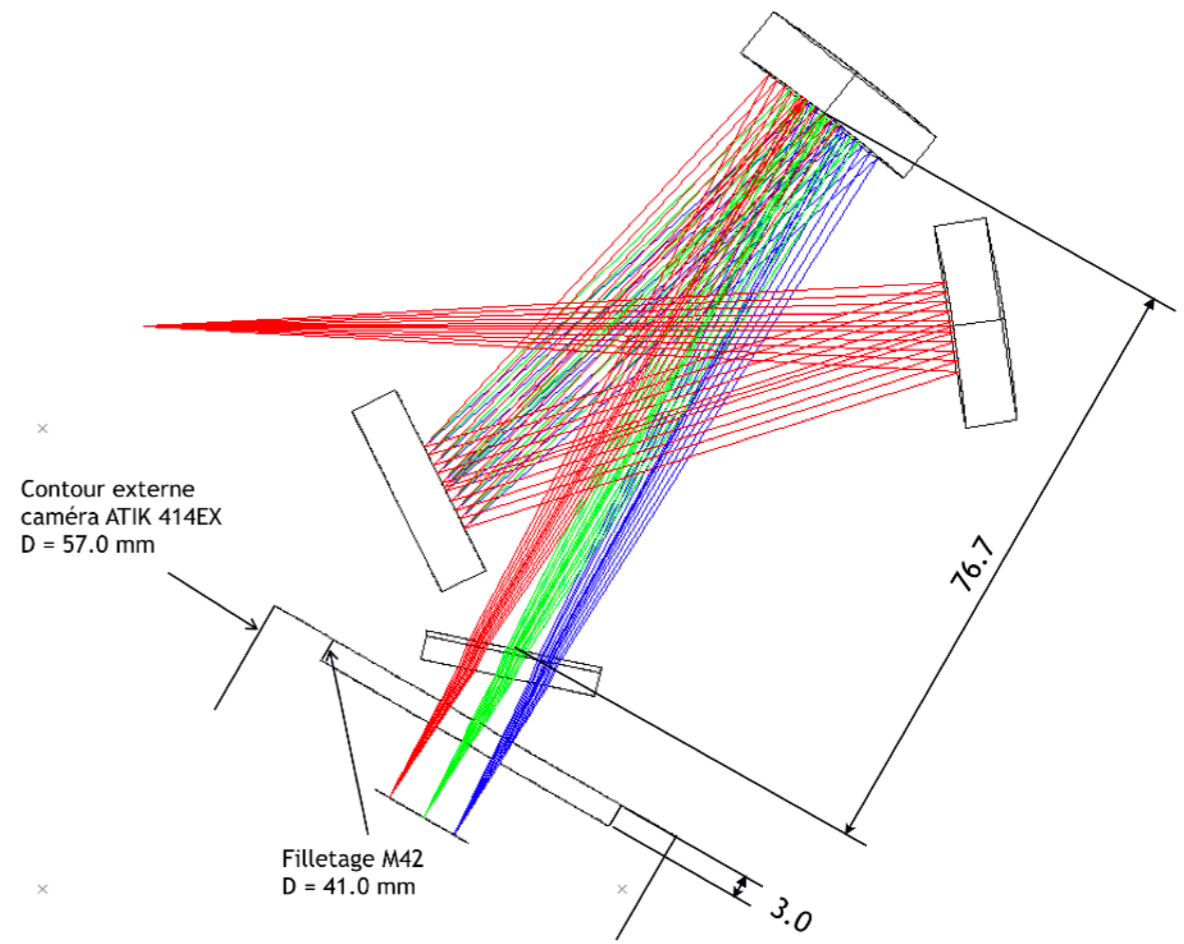
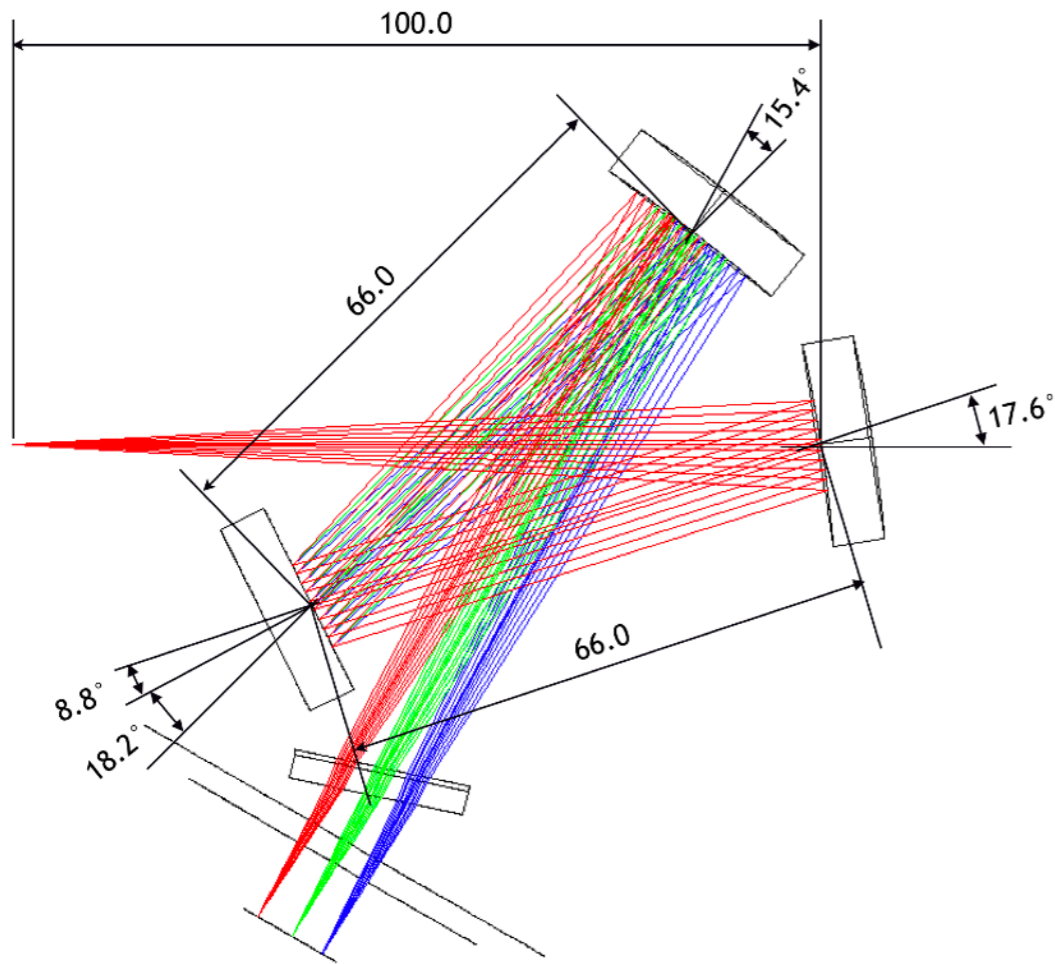
Wavelength	Quantum efficiency
7500 A	18 %
6500 A	15 %
5500 A	33 %
4500 A	19 %
4000 A	14 %
3800 A	9 %
3500 A	2 %

The Ultraviolet fundamental limit : the terrestrial atmosphere

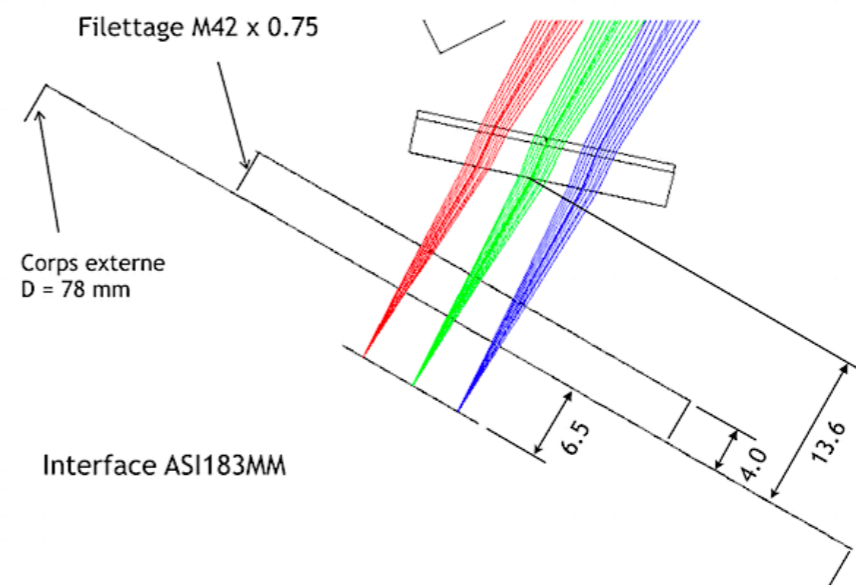


UVEX(3) details

Important: all UVEX(3) project plans will be public (also STL files for 3D manufacturing)

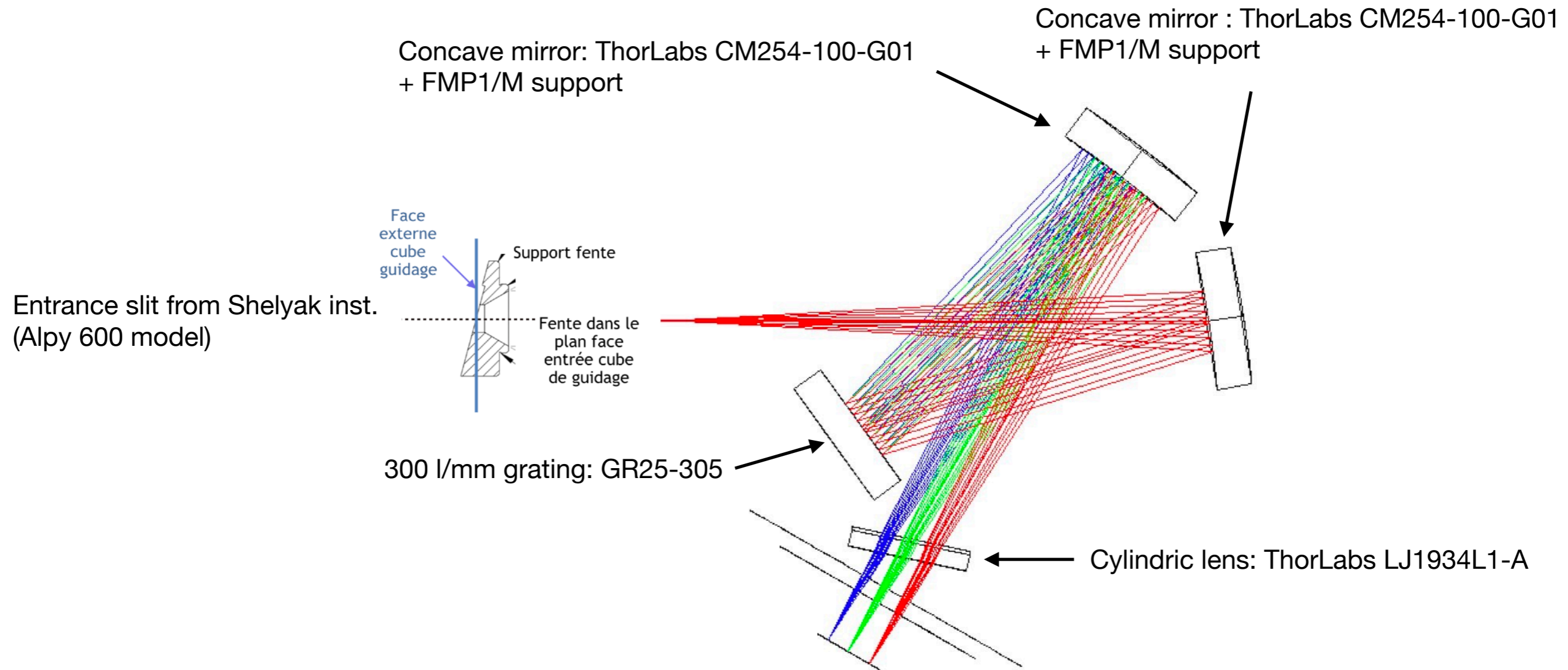


Interface ATIK 414EX



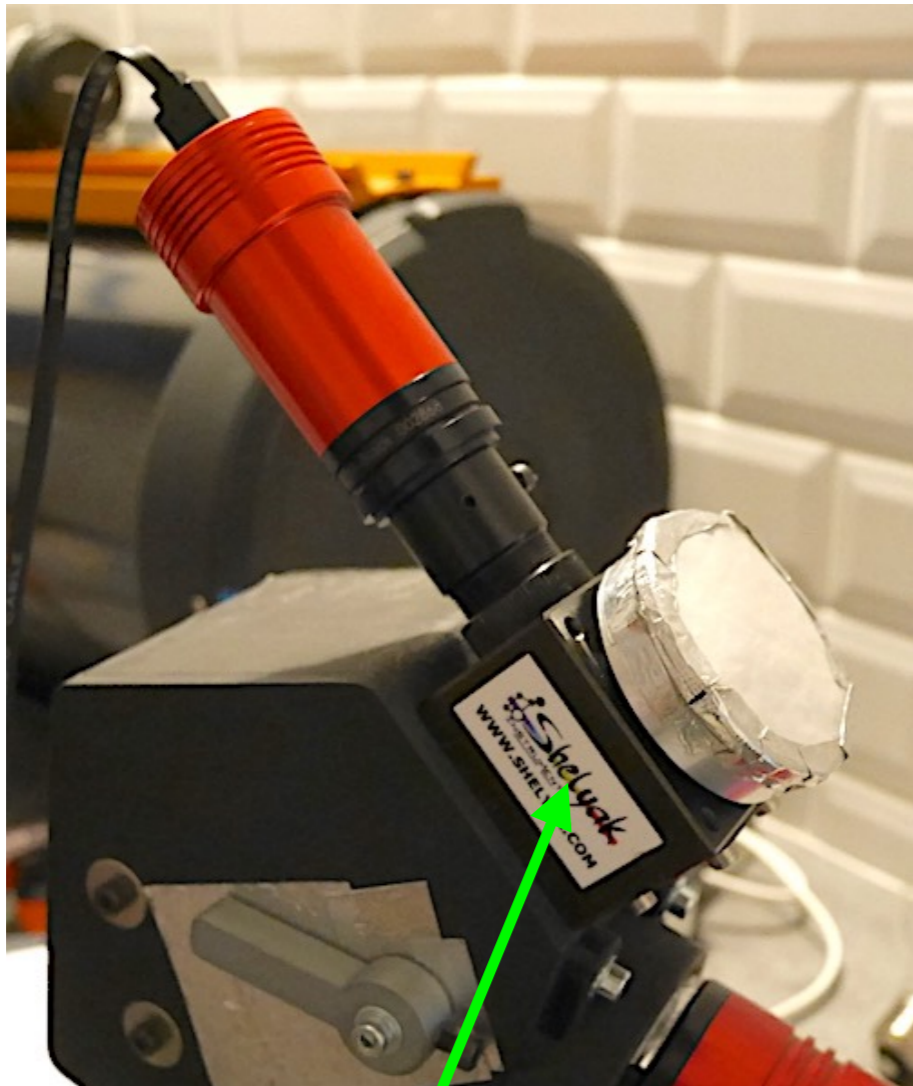
Interface ASI183MM

All optical components are available from THORLABS catalog



Design compatible with Shelyak guidance module (Alpy 600 spectrograph)

A companion for faint object spectroscopy...



Shelyak Inst. guidance « cube » (Alpy 600).



Shelyak guidance module (PF0036)



Amovable slit (SE0145)

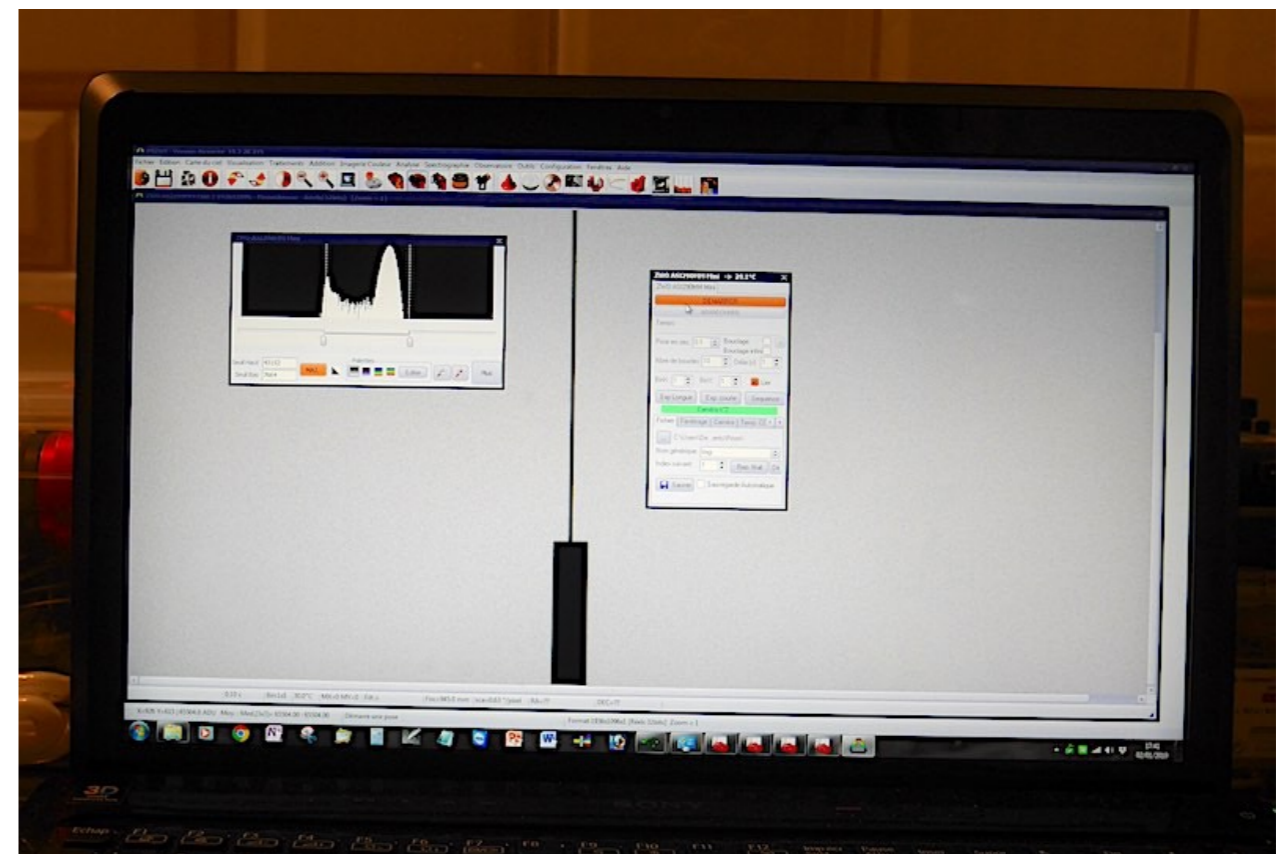
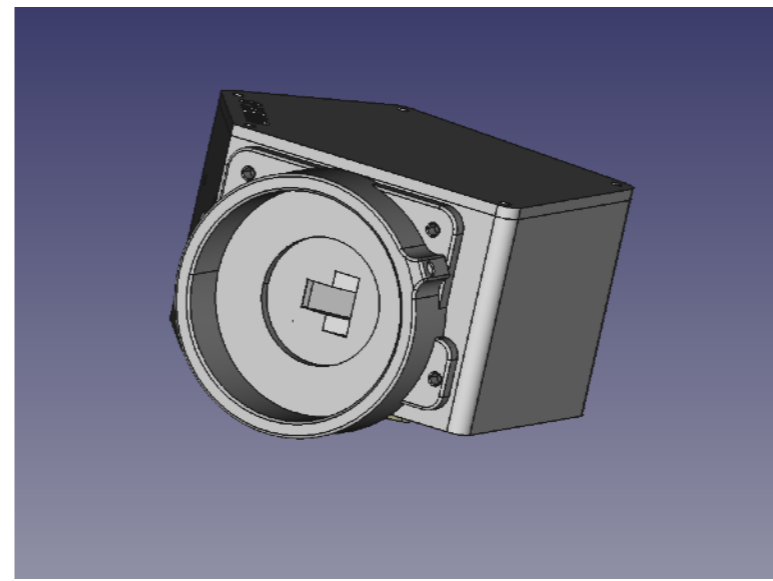
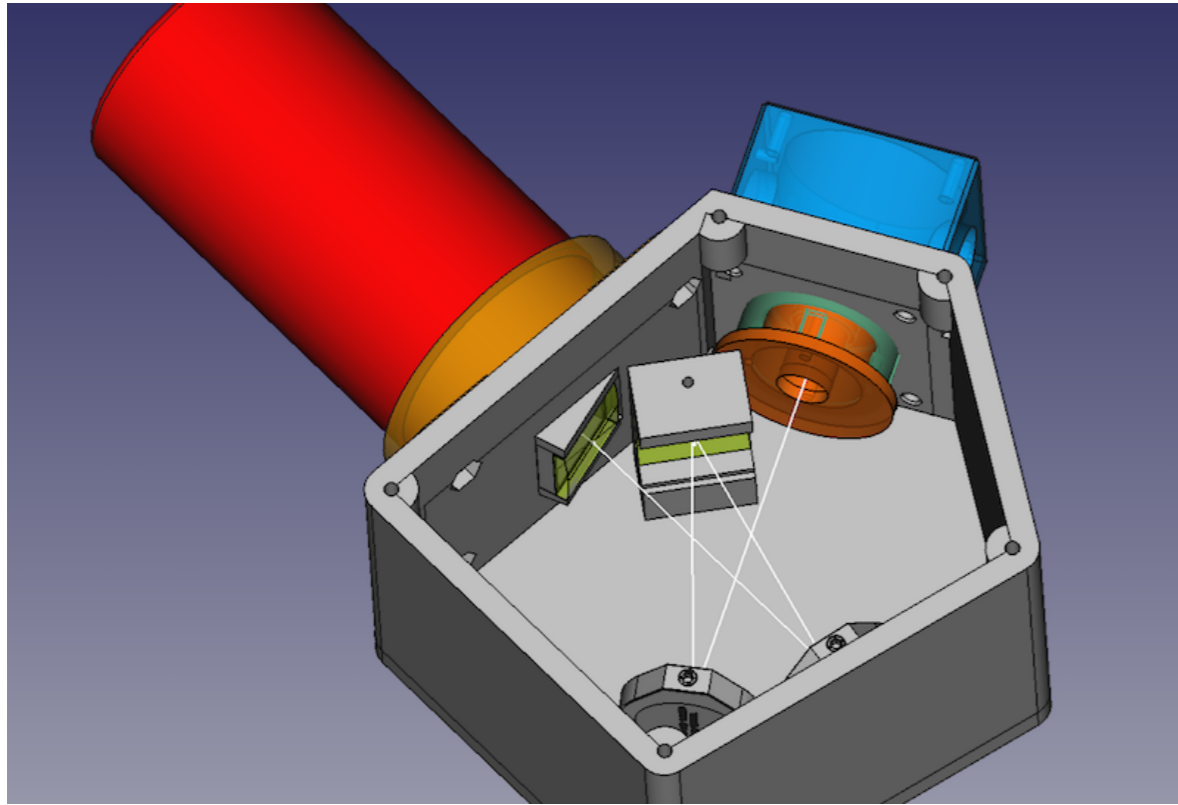
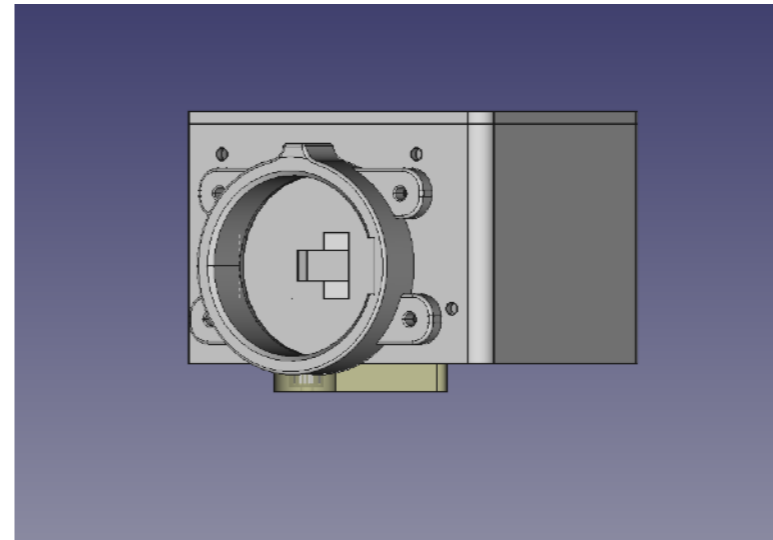


Image of a Shelyak photometric slit given by a mini camera ASI290MM (ZWO).

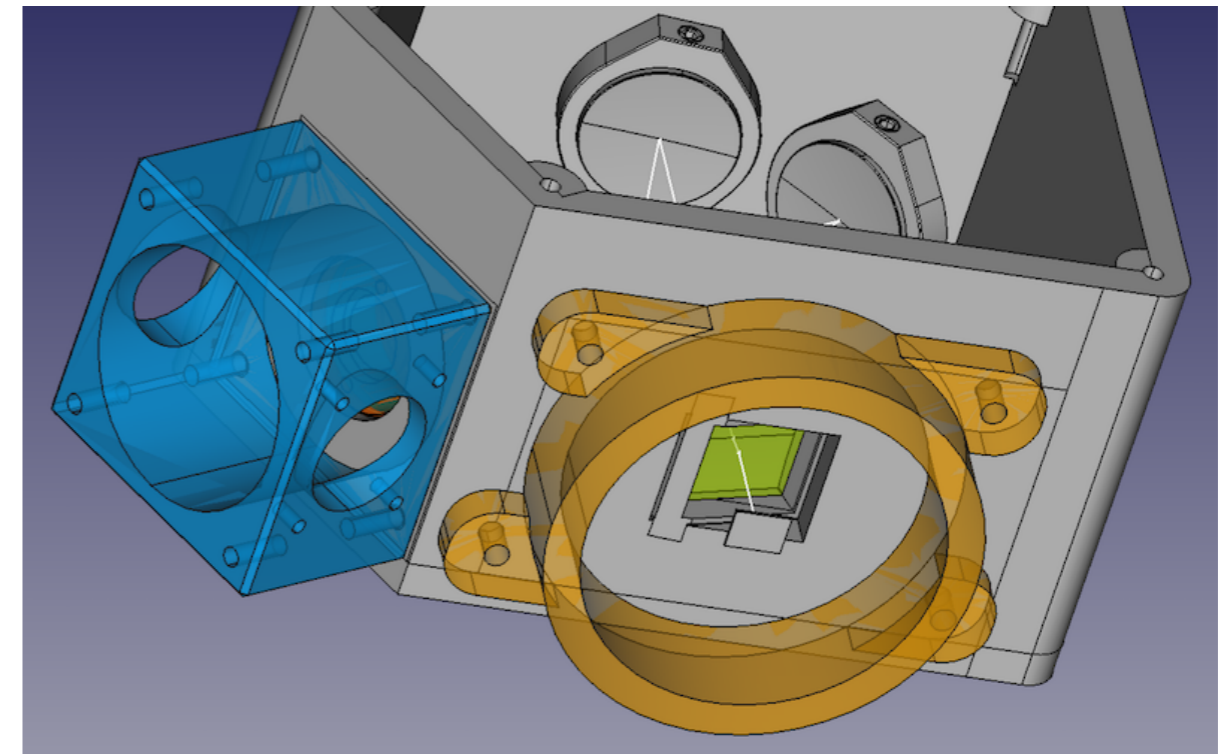
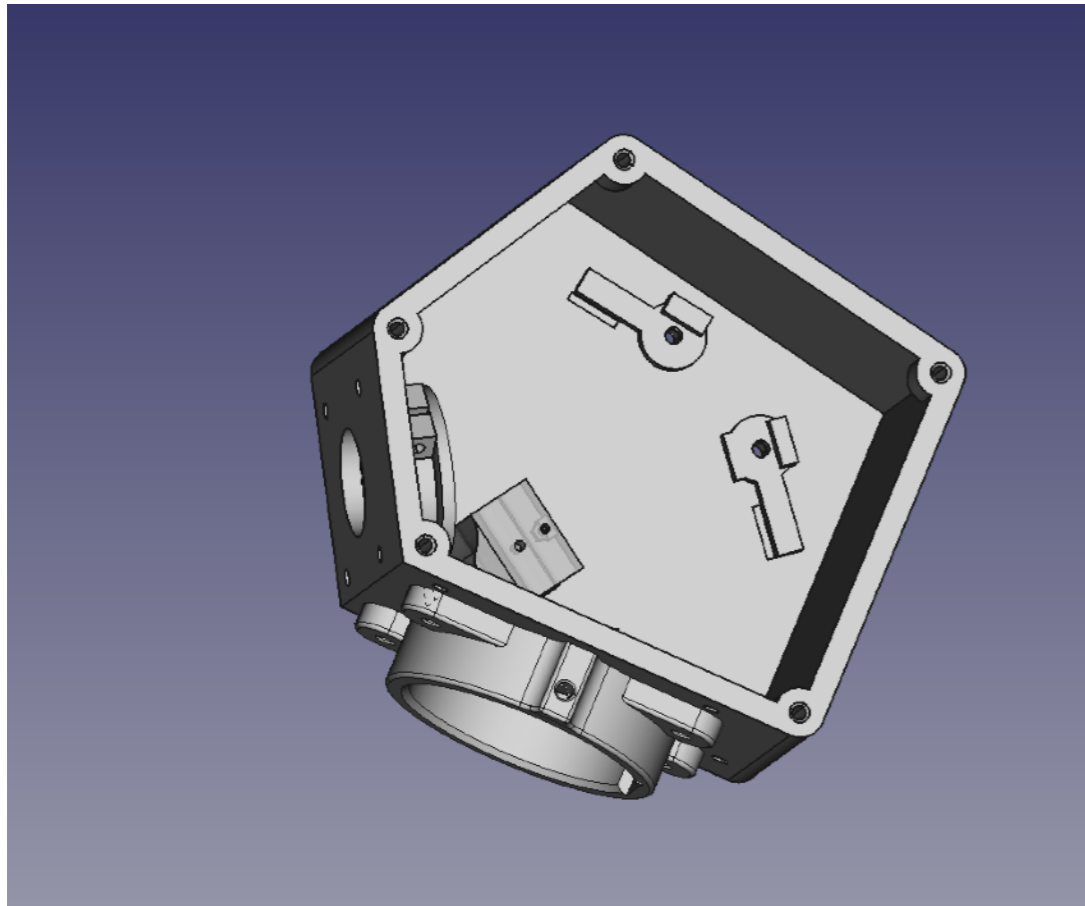
Some CAO views

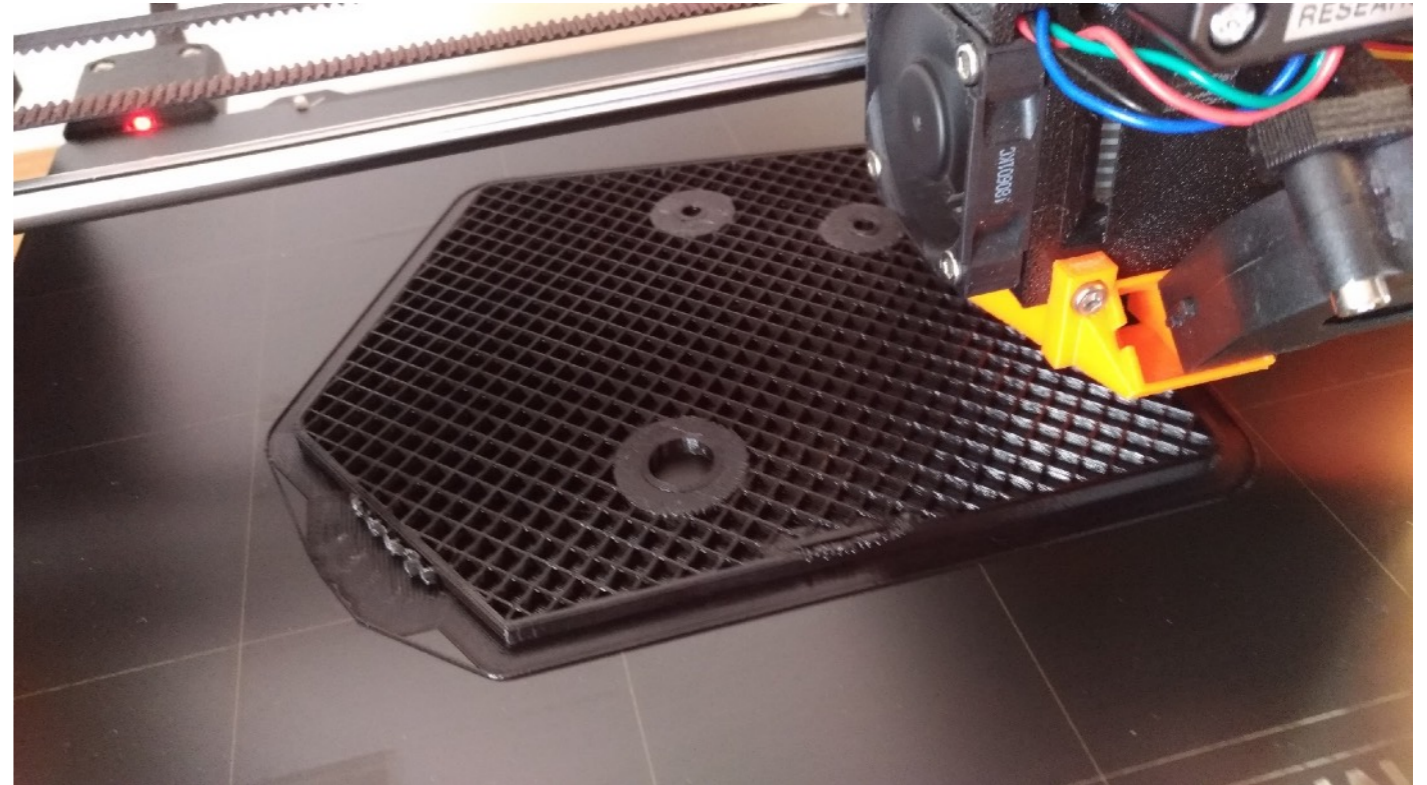
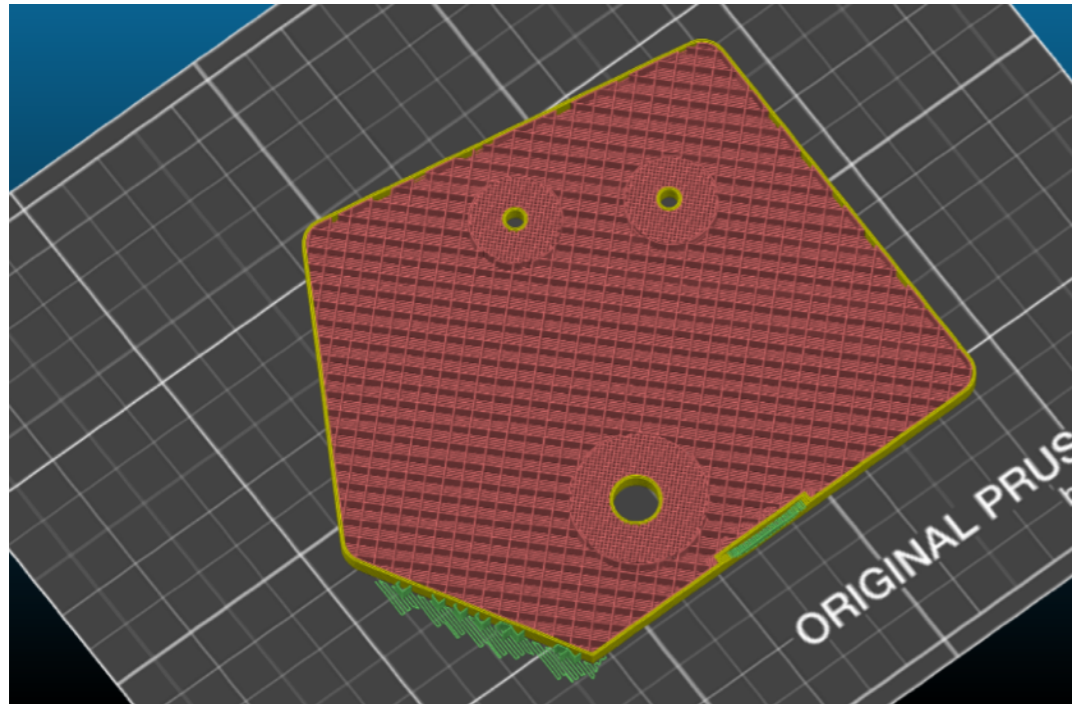


**Amovible ZWO
cameras interface.**



**Amovible ATIK
cameras interface.**



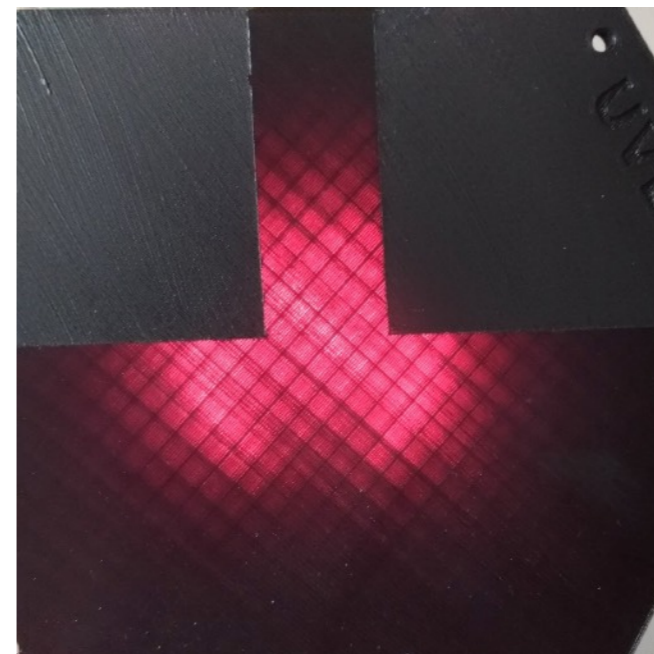


For the UVEX(3) we use a PRUSA MK3 I3 printer

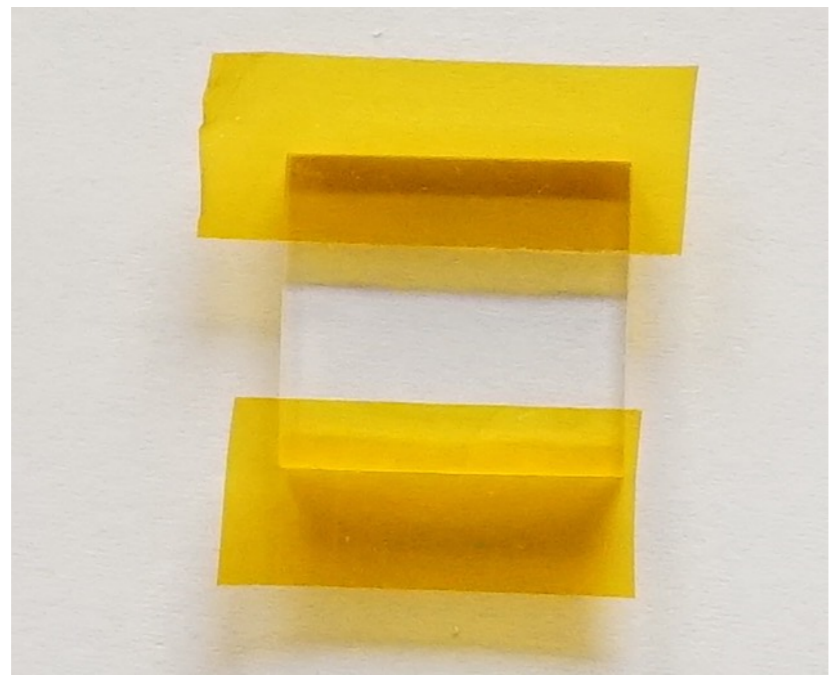
Material selection

The PLA is good option (but sensitive to temperature)

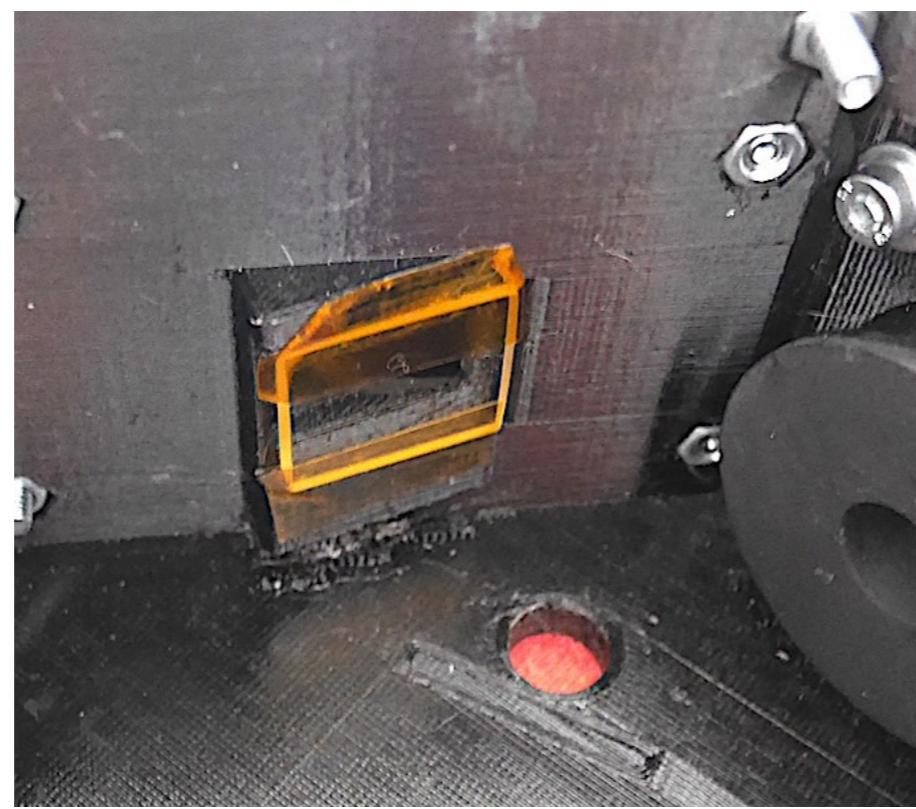
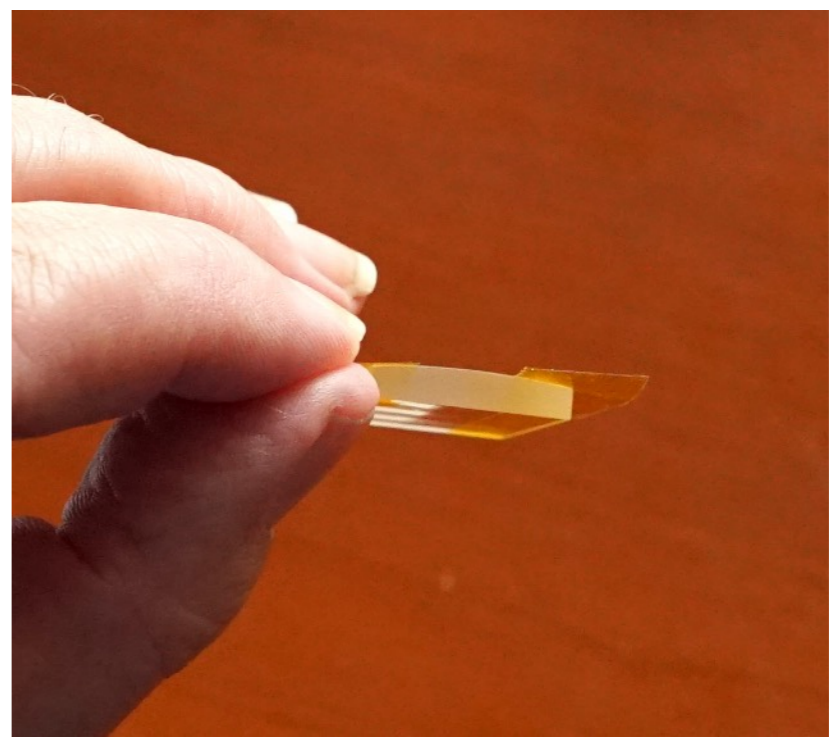
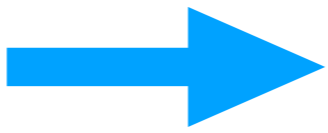
The PETG is more robust, but transparent to deep-red and infrared radiations is you do not select an opaque version!



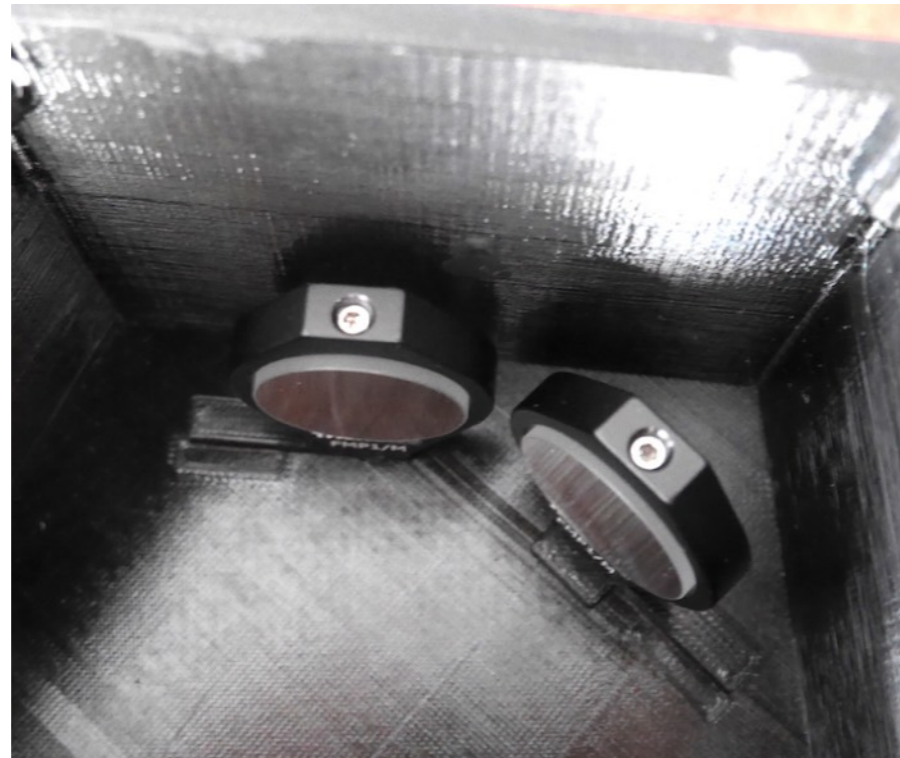
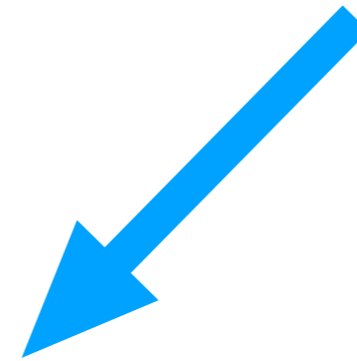
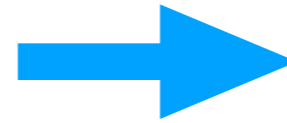
Integration : Cylindric lens



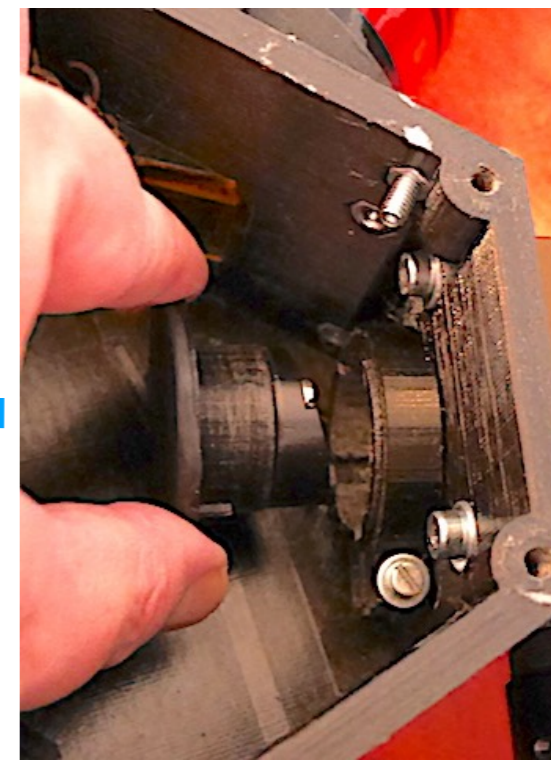
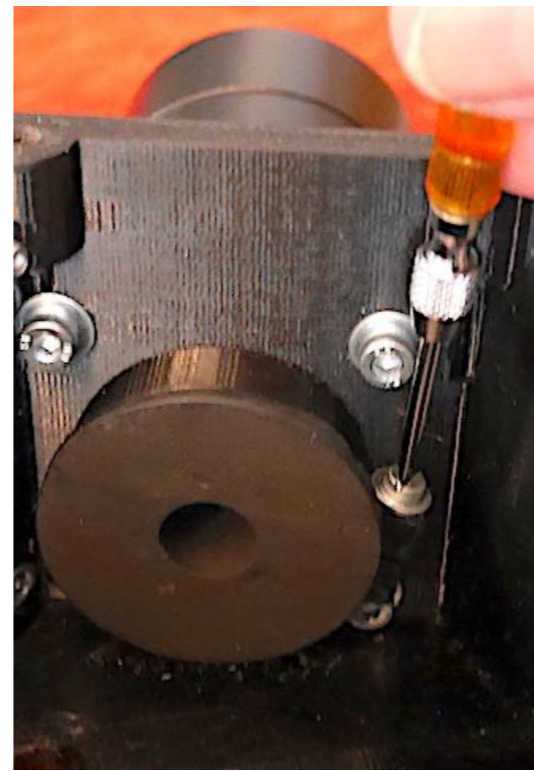
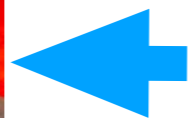
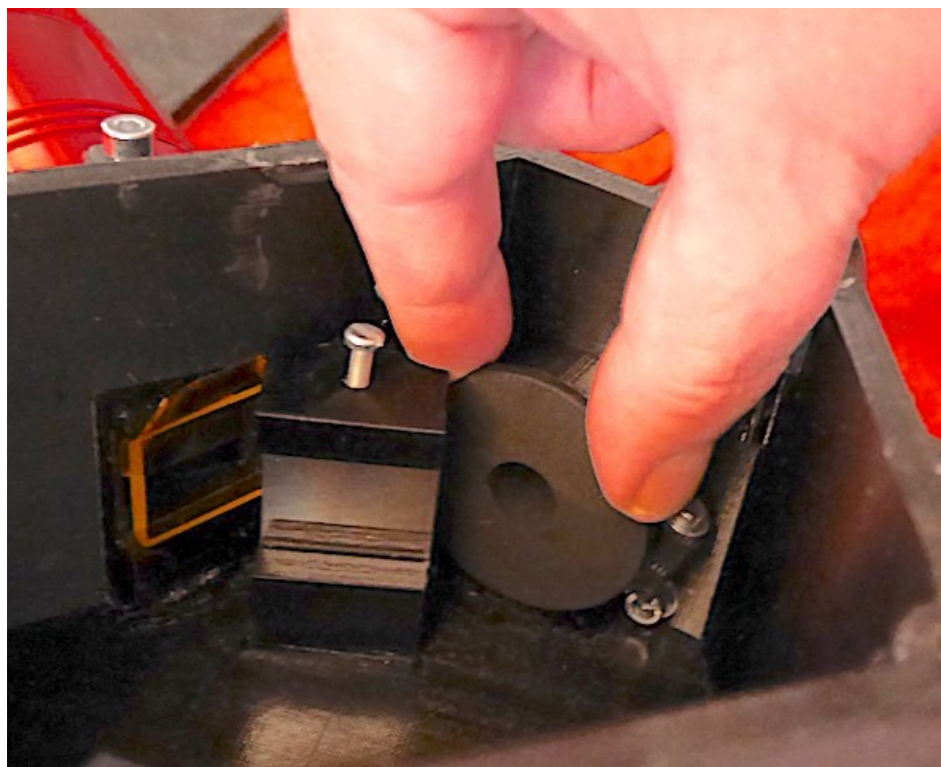
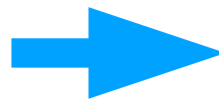
Kapton adhesive film



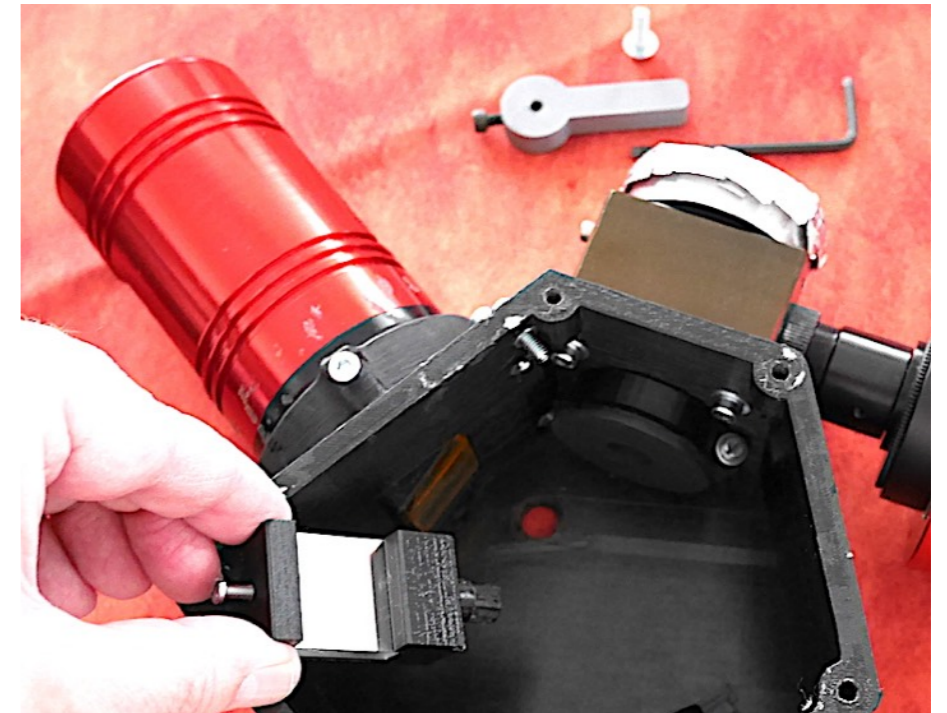
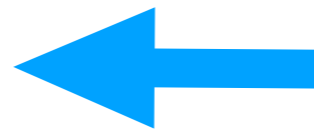
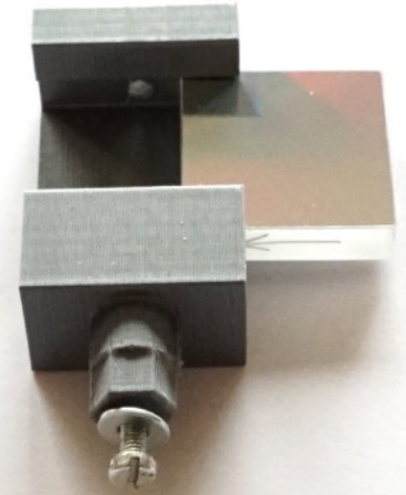
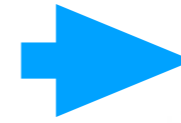
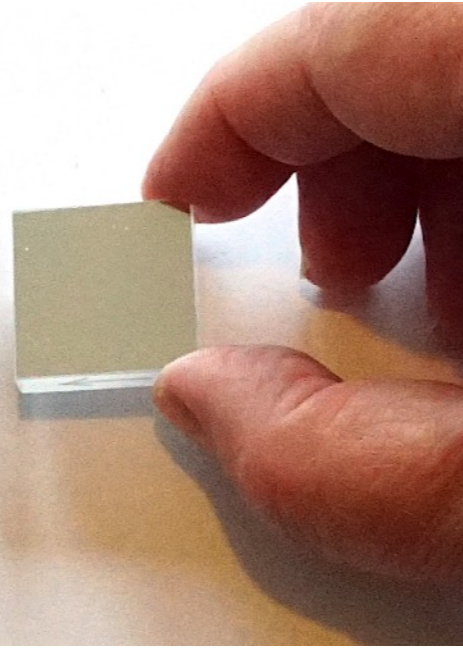
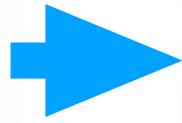
Integration : Mirrors



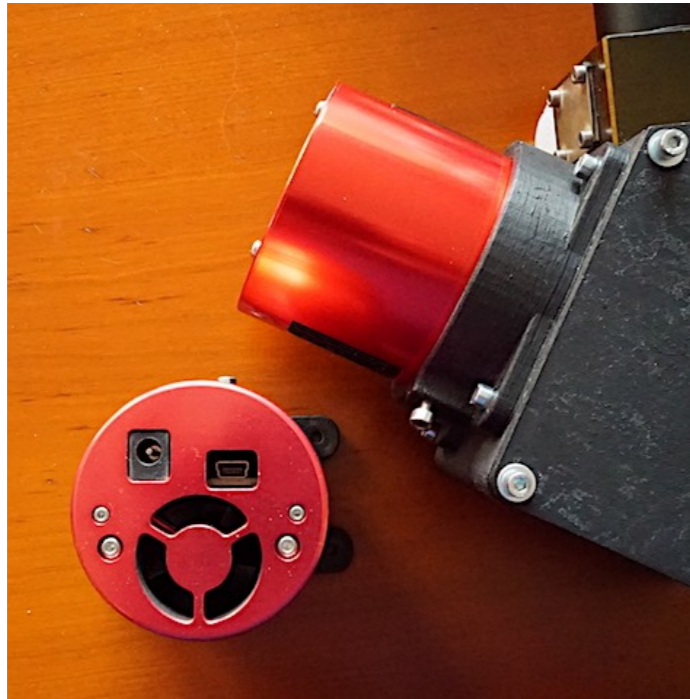
Integration : Slit



Grating fixation



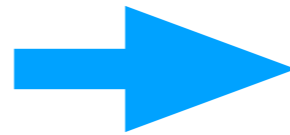
The final touch



Attach the camera



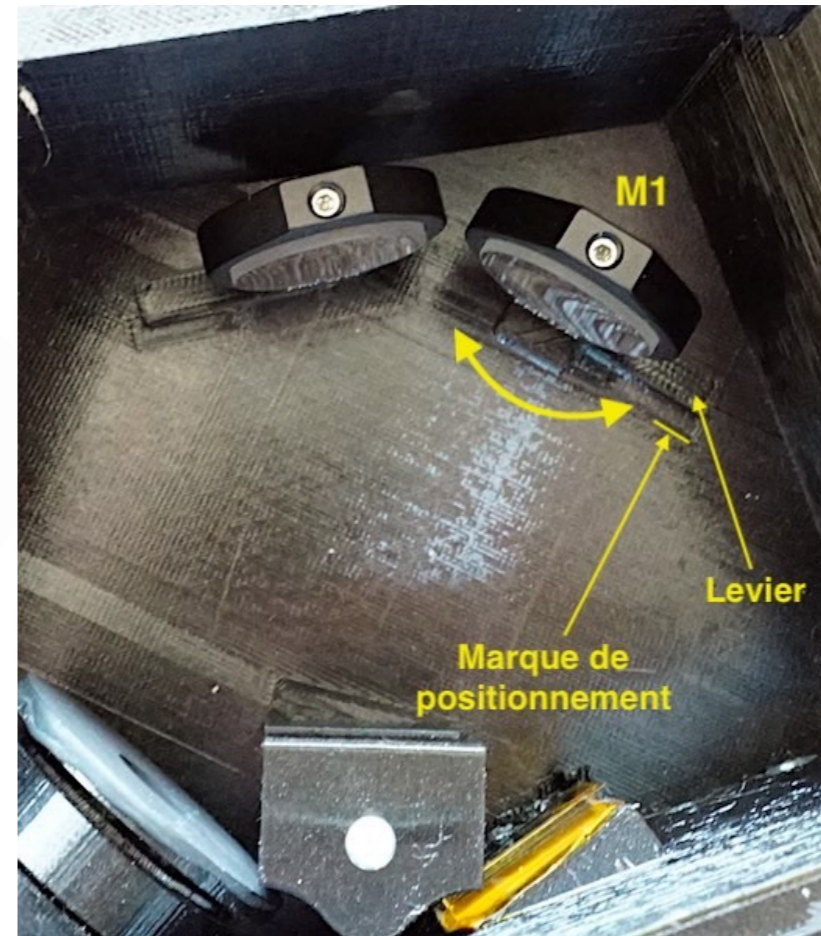
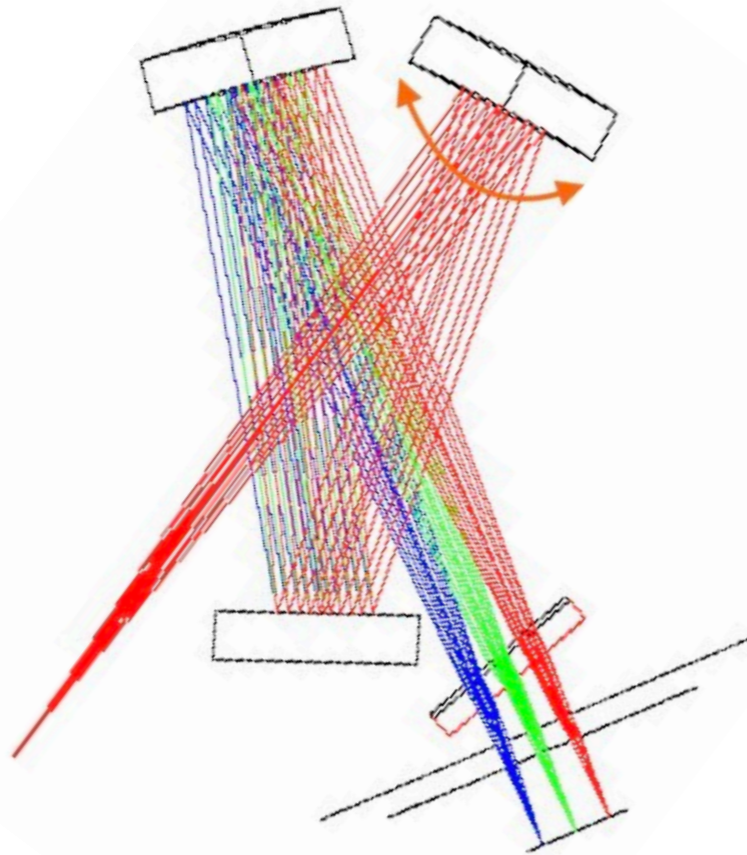
Choose the spectral domain



and observe...

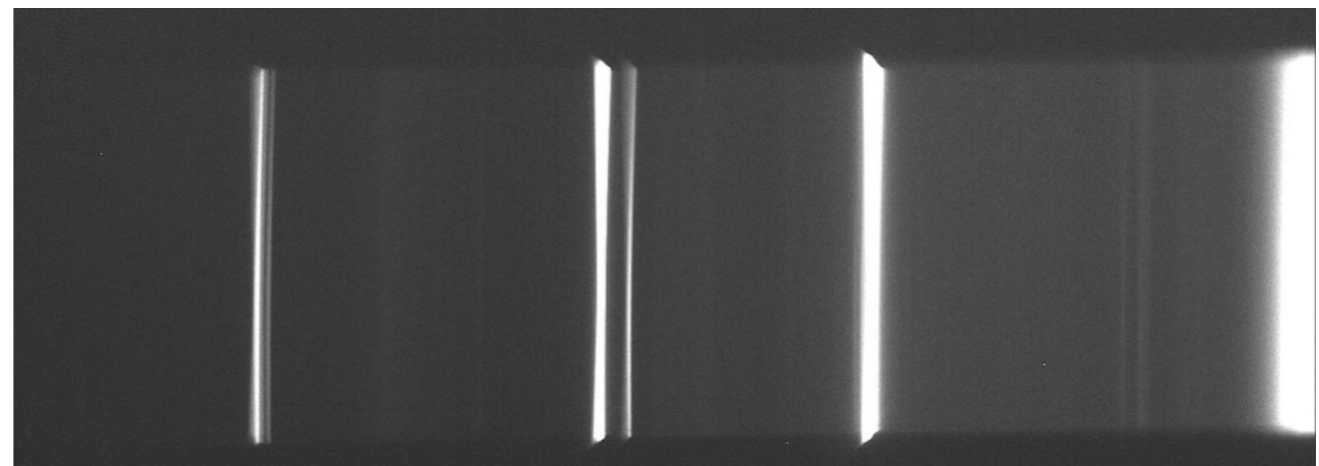
Hum... it's no so easy !

Some adjustments are needed to get a fine spectrum...



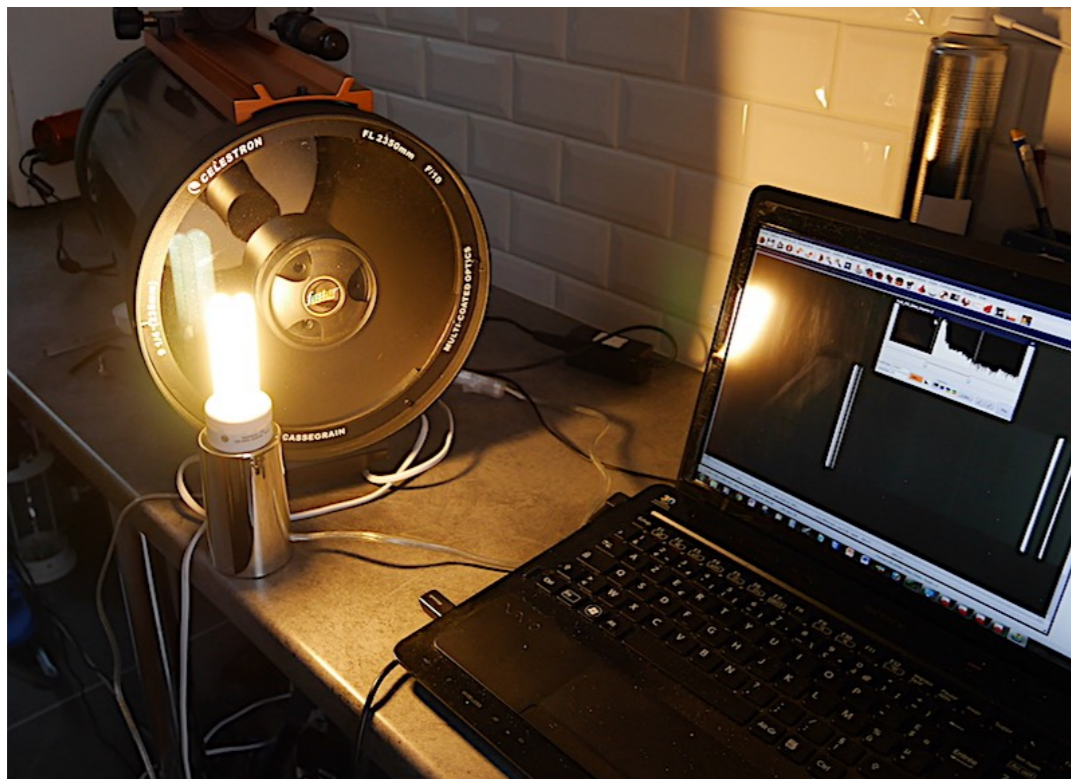
The main difficulty is to find the correct M1 and M2 orientation. The tolerance is near $\pm 0,1^\circ$

The criterion success is based on the observation of the appearance of the emission lines. An iterative process...



Highly recommended: « laboratory » bench test of the spectrograph

UVEX during setting at the focus of a C9.25 telescope (on a table)

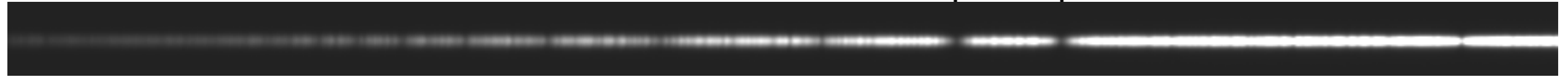


Ultraviolet spectral calibration : Use of stellar lines

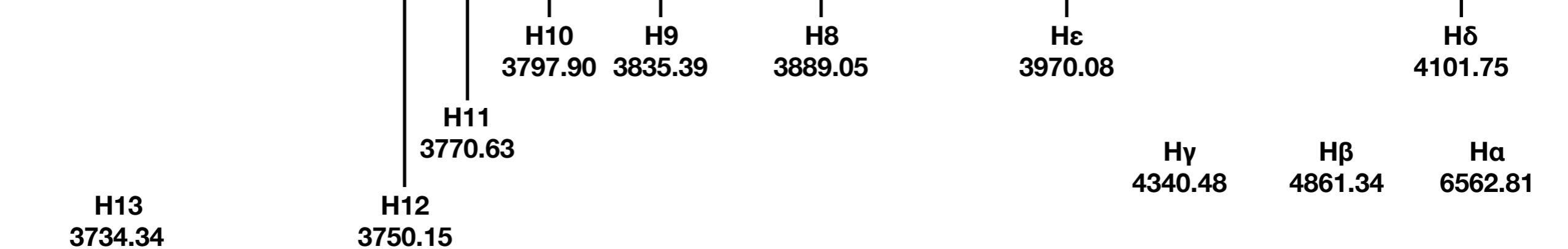
...for evaluate spectral dispersion equation (2nd order polynomial function)

UVEX(3) 1200 lines/mm, 23 microns slit, Atik414EX camera

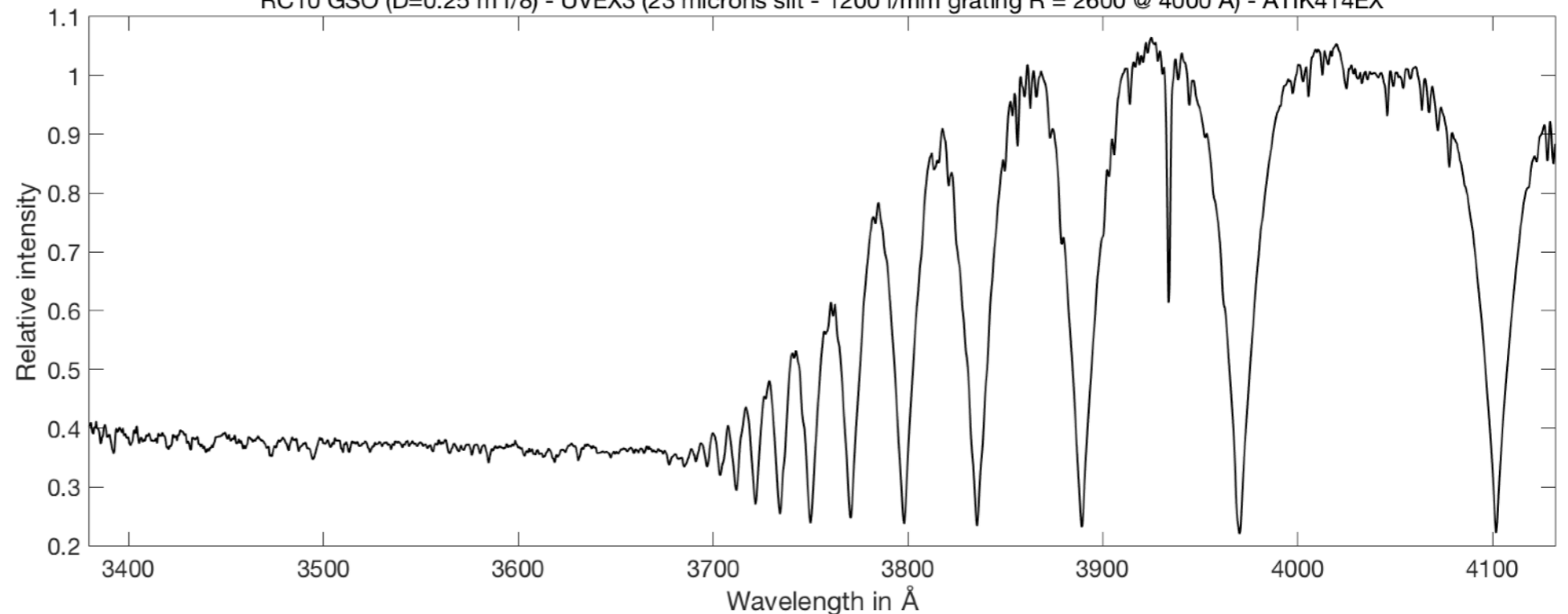
Procyon (F5IV)



Castor (A1V+A2V)



alpha Gem (Castor)- Type A1V+A2Vm - 18 december 2018
RC10 GSO (D=0.25 m f/8) - UVEX3 (23 microns slit - 1200 l/mm grating R = 2600 @ 4000 Å) - ATIK414EX

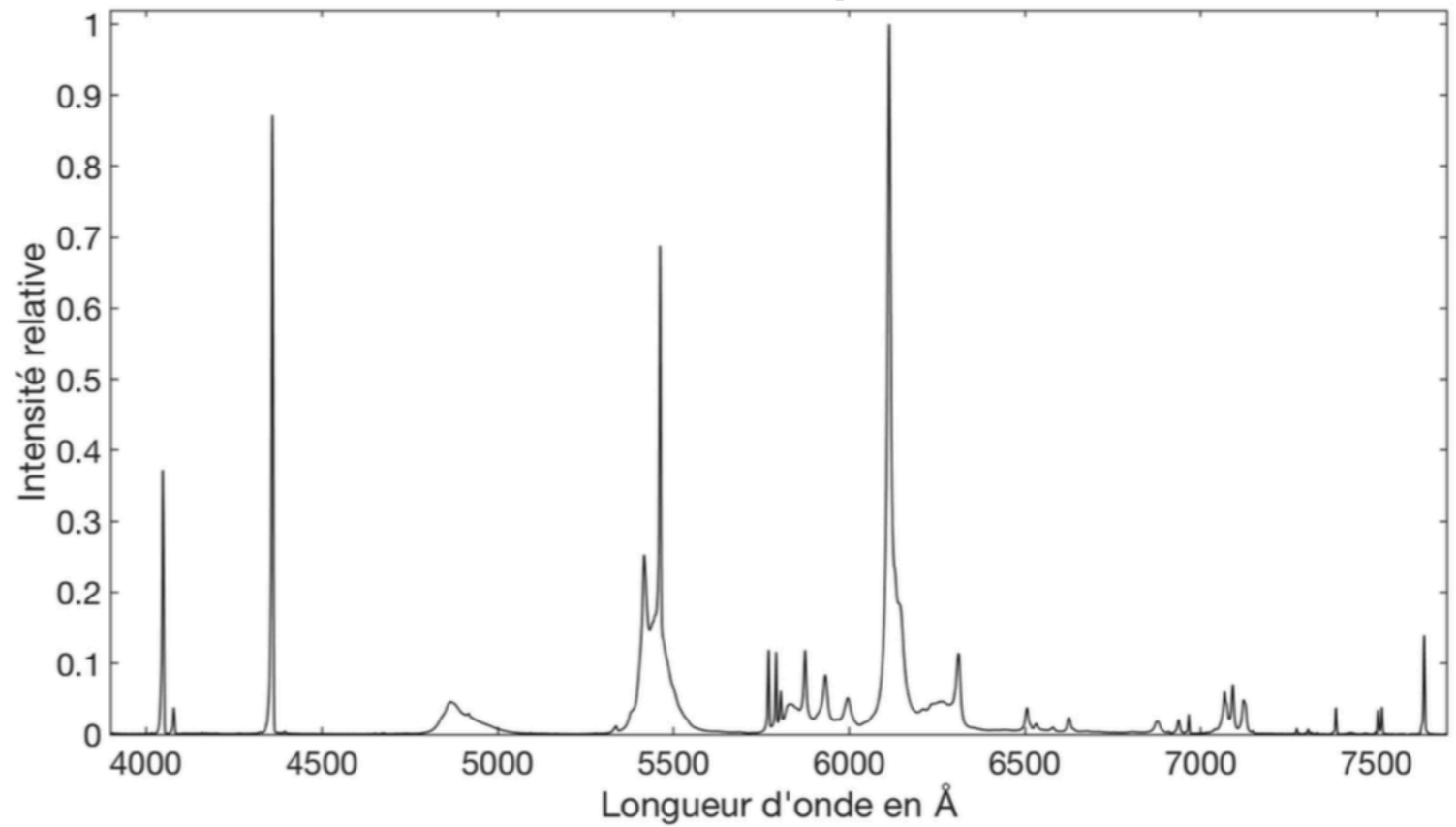


Emission lines lamp (easy to find)

Fine for calibrate UVEX
300 lines/mm spectra
(Hg and Ar lines)



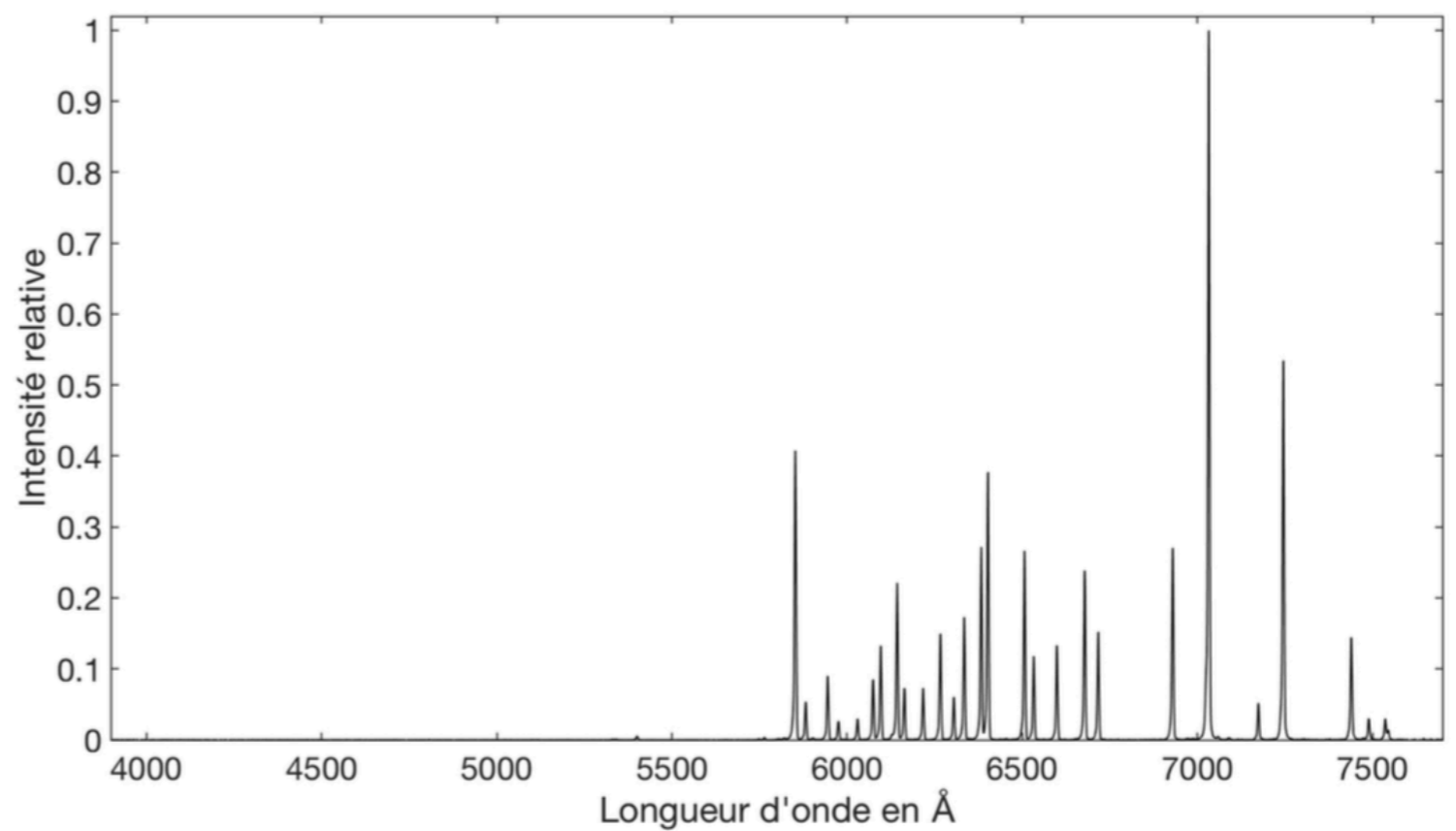
Fluo-compact



Fine for calibrate red
spectra at all resolution
power (neon lines)



Neon

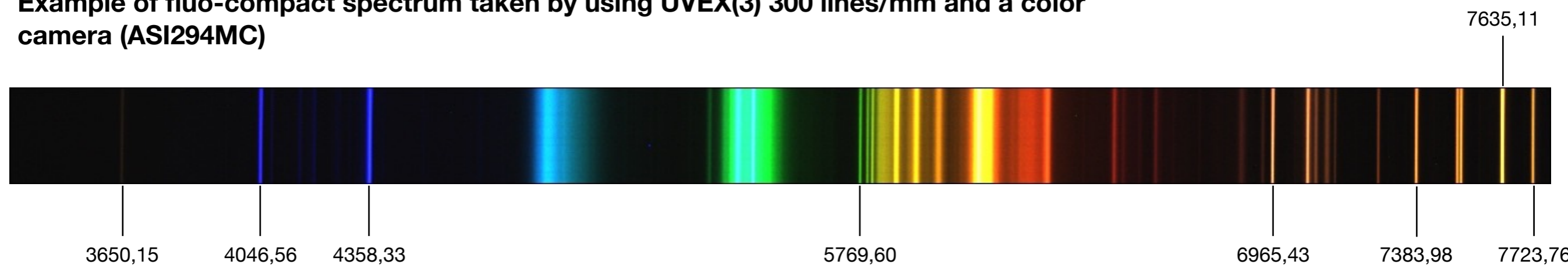


Use of an emission lines lamp (domestic fluo-compact, i.e. Hg + Ar lines)

A manual method, but effective... the calibration lamp at the front telescope aperture



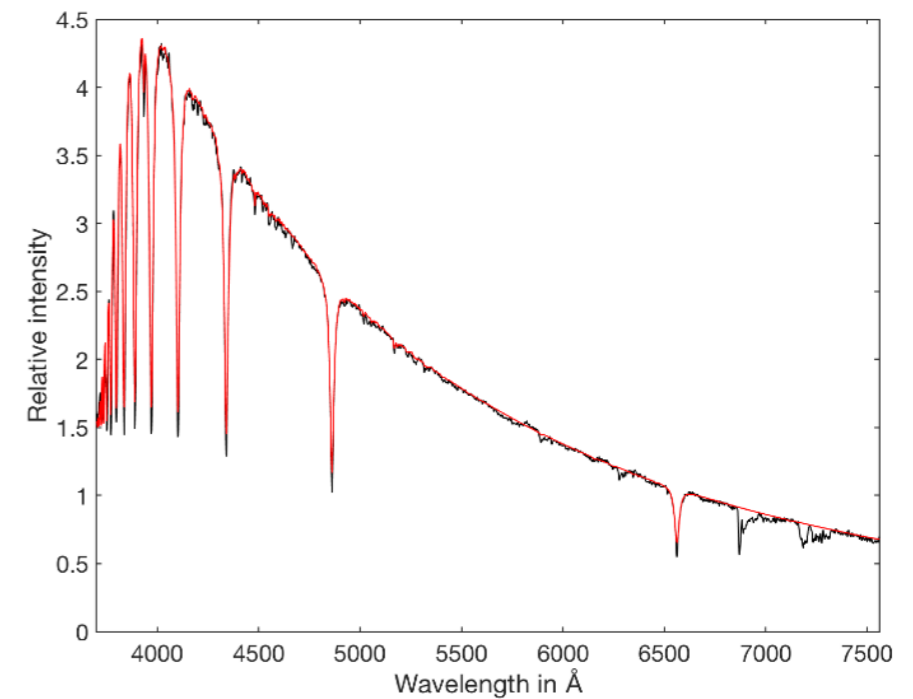
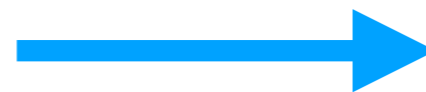
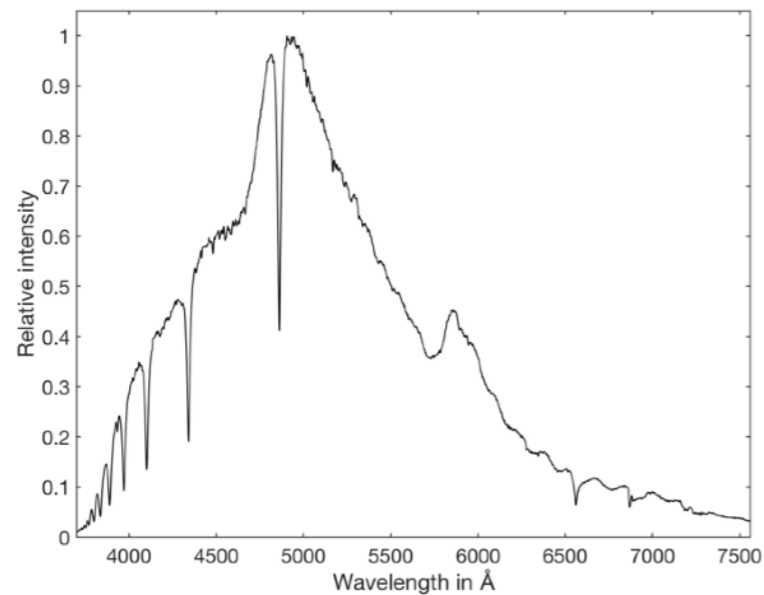
Example of fluo-compact spectrum taken by using UVEX(3) 300 lines/mm and a color camera (ASI294MC)



Use a continuum lamp for responsivity evaluation

A manual method... halogen lamp at the front telescope aperture

Here a standard use of halogen 3000 K (120 W)



Before instrumental response rectification
(data from a ASI294MC color camera)

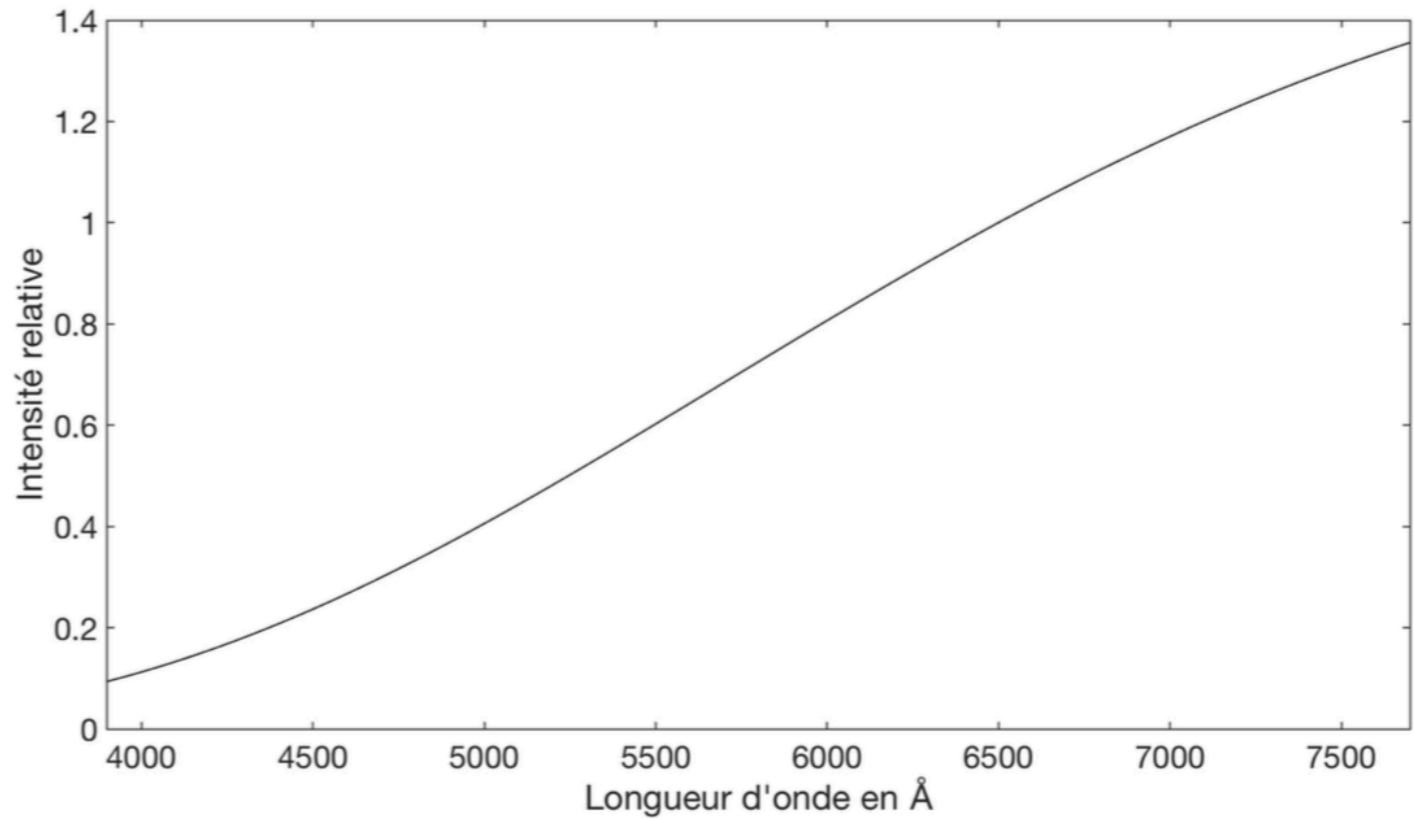
After instrumental response rectification
(A0V type star)

Good solution

Regular and well know (Planck)



3000 K halogen lamp

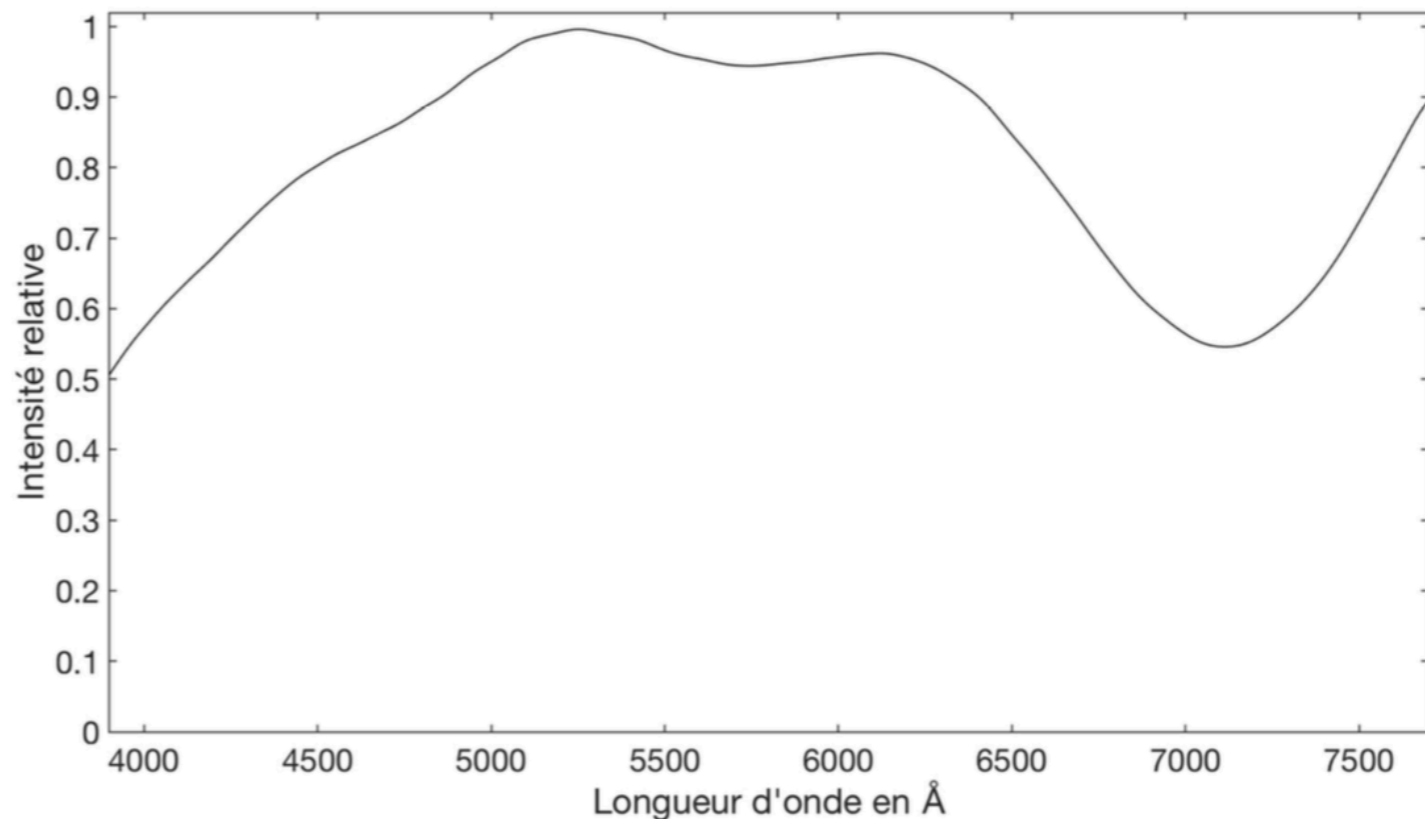


Good solution

White and intense UV flux (StarLux model)



4700 K halogen lamp

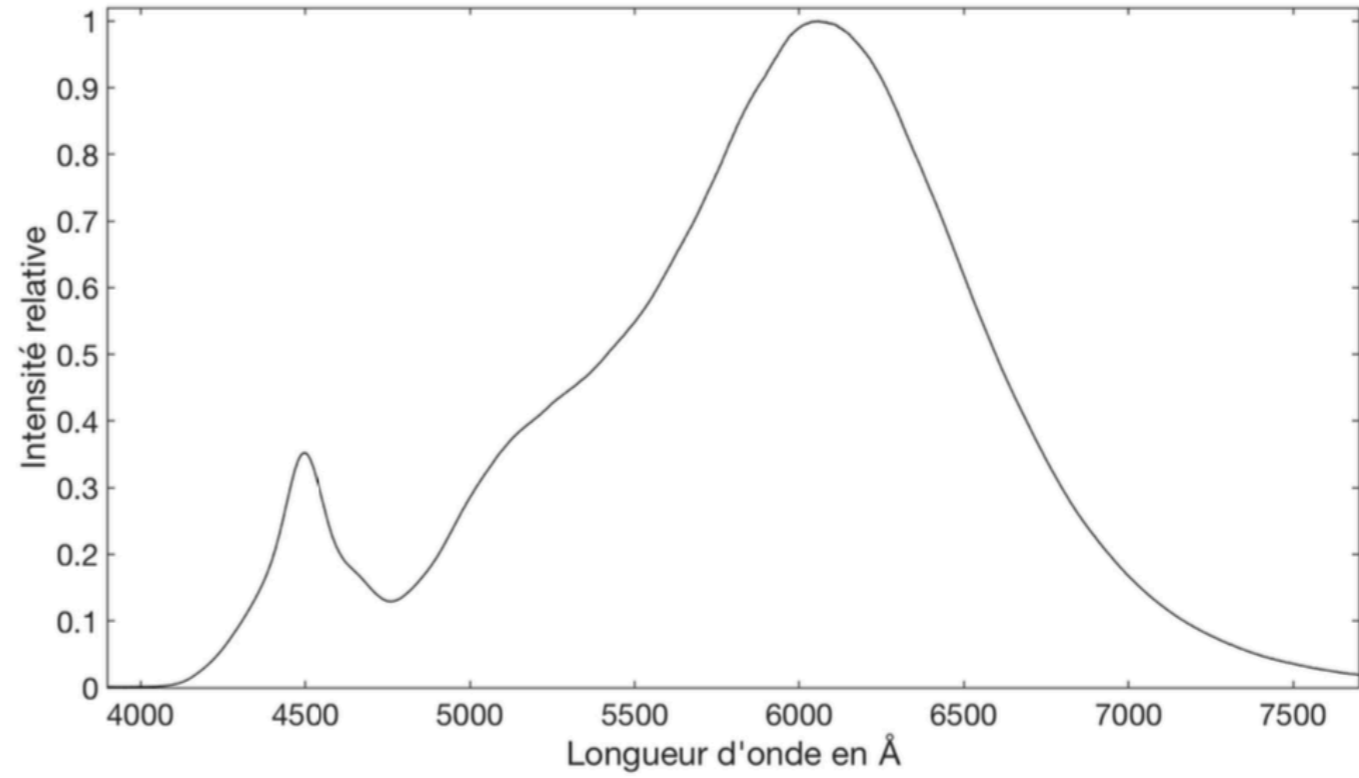


Bad solution

Poor UV and instable



LED

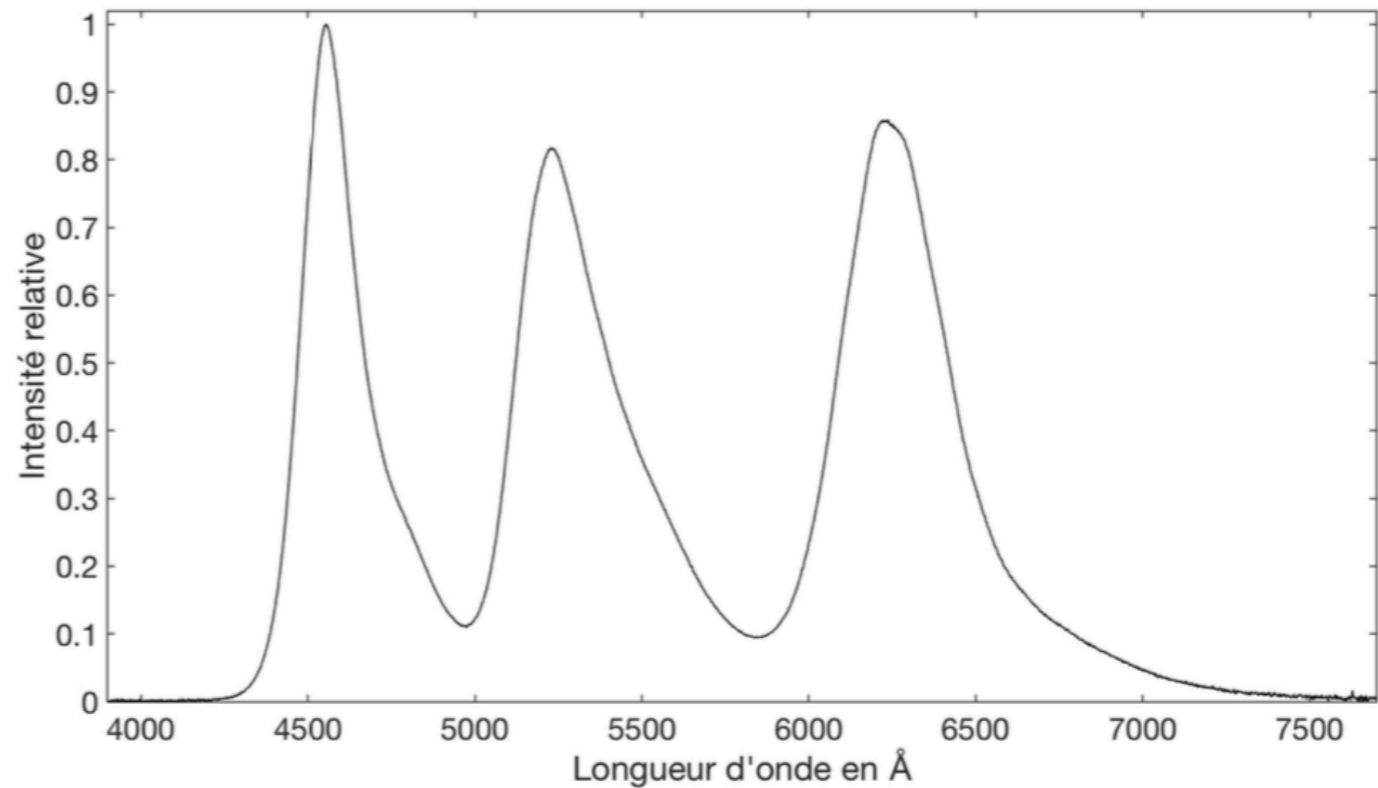


Bad solution !

...



iPhone screen



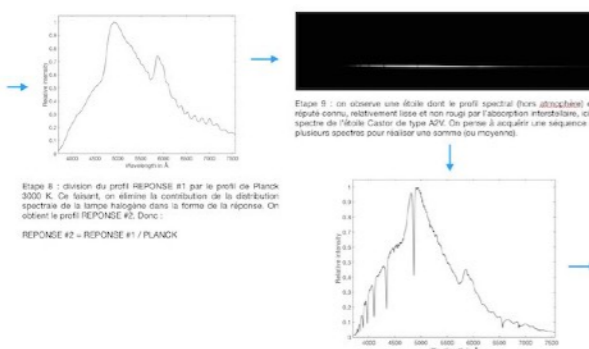
UVEX is the opportunity for ISIS improvements AND updated documentation !

Many PDF format slide available on-line + graphical approach adopted for a quick and practical access to the information

Support demo spectra can be downloaded from the UVEX link

These new documentation is also useful for Alpy 600, LISA, ... user's, of course !

Réponse instrumentale - application aux images CFA (3/5)



Etape 9 : on observe une étoile dont le profil spectral (hors atmosphère) est rigoureusement connu, relativement lisse et non rugé par l'absorption interstellaire, c'est le spectre de l'étoile Castor de type A7V. On pense à acquérir une séquence de plusieurs spectres pour réaliser une somme (ou moyennage).

Etape 8 : division du profil REPOSE #1 par le profil de Planck 3000 K. On voit, on élimine la contribution de la distribution spectrale de la lampe halogène dans la forme de la réponse. On obtient le profil REPOSE #2. Donc : $REPOSE\ #2 = REPOSE\ #1 / PLANCK$

Etape 10 : le profil spectral de l'étoile est calculé comme celui de la lampe halogène (parabolaire), addition des spectres de la séquence, séparation RVVB, fusion RVVB, binning). Le profil obtenu ne ressemble pas du tout à celui d'une étoile de type A 1 en revanche, il y a une similitude avec le profil REPOSE #2... On appelle ce spectre intermédiaire de l'étoile : PROFIL #1.


Etalonnage avec un spectre de lampe - Utiliser un fichier de raies

Dans l'onglet - Etalonnage -, indiquer la coordonnée X d'une raie dont on connaît la longueur d'onde (choisir une raie relativement intense, non saturée, et détachée de ces voisines), ici, j'utilise la raie d'émission du néon de longueur d'onde 650.25 Å que l'on trouve à la coordonnée X=1022 :

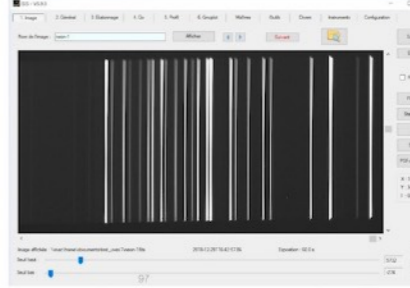


Etalonnage avec un spectre de lampe - Procédure manuelle

On propose dans cette section de montrer comment évaluer la loi de dispersion de UVEX dans le rouge en utilisant une lampe néon comme référence et le logiciel ISIS.



Le spectre est réalisé sur table (éventuellement sur le télescope) en déplaçant une lampe velleux (ou de marée) à éclairer la pupille approximativement uniformément au terme du temps de pose (dans ce cas de 60 secondes). Le télescope est ici un C9.25 (Celestron) ouvert à F11.5. Le spectrographe UVEX(s) est équipé d'un réseau 300 l/mm, d'une fente de 23 microns et d'une caméra CCD-KESJ utilisée en binning 1x1.



La nom du spectre est - néon-1 -. Vous pouvez visualiser son image FITS depuis l'onglet - Image -.

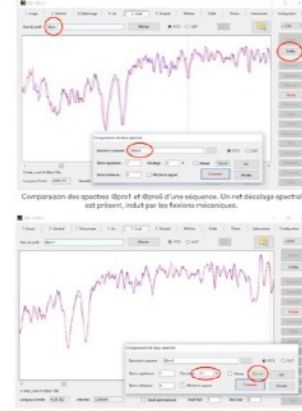
Etalonnage dans l'UV à partir des raies de Balmer

Dans sa version - impression 3D -, UVEX est clairement victime de problèmes de flexions mécaniques. C'est assurément le défaut principal de cet instrument sous cette forme. Le matériau employé en impression 3D pour la structure est loin en effet d'avoir la rigidité mécanique du métal (mais même un spectrographe en métal montre ce type de problème... avec une force moindre bien sûr). À la suite d'un pointage du télescope sur une nouvelle cible, le spectrographe - respire - un certain temps, sa structure mécanique se déforme lentement sous son propre poids avant de se stabiliser. Parfois cela se passe bien, mais il est arrivé que le temps de stabilisation dure un bon quart d'heure ! Il n'y a pas de vraie règle et la vigilance est de mise.

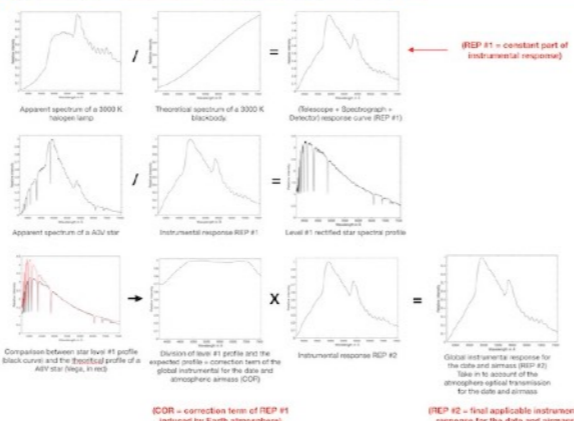
Pour limiter cet effet, bien fixer le capot de fermeture du boîtier, ainsi que la caméra dans son interface.

Si la déformation se produit durant le temps de pose, non seulement l'étalonnage spectral (valeur du terme A0) est affecté, mais le spectre obtenu est flou. Il ne faut donc pas chercher à réaliser des temps de pose excessivement longs car le résultat n'est plus réparable. En situation de déformation temporelle significative, fractionner le temps de pose total, et avec un outil logiciel, recoller les spectres individuels (à la main ou automatiquement).

À gauche, on exploite l'outil - Comparaison - de ISIS pour recoller les spectres d'une séquence sur le premier spectre de la dite séquence (astuce). Dans ISIS, les spectres individuels traités (hors correction de la réponse instrumentale) sont dans le répertoire de travail sous les noms de @profil_01profil_02, ... @profil_0x. Voir la documentation du logiciel ISIS pour plus de détails.



Spectral response : How to evaluate applicable spectral response



Apparent spectrum of a 3000 K halogen lamp / Theoretical spectrum of a 3000 K blackbody = (Telescope + Spectrograph + Detector) response curve (REP #1)

Apparent spectrum of a A7V star / Instrumental response REP #1 = Local A7V star spectral profile

Comparison between star level #1 profile (black curve) and the theoretical profile of a A7V star (red, in red) / Instrumental response REP #2 = Global instrumental response for the site and airmass (REP #2). Take in to account the atmospheric optical transmission for the date and airmass.

ICOR = correction term of REP #1 induced by Earth atmosphere

(REP #1 = constant part of instrumental response)

(REP #2 = final applicable instrumental response for the date and airmass)



Example...

ISIS version 4.9.4 and upper

Improved function for compensate spectral shift during an acquisition sequence (spectrograph mechanical flexure along the time)

General parameters

Pixel size (microns) : 9.08

Cosmetic file : cosme

Instr. responsivity : reponse_planck_cor

Wavelength shift (A) : 4.5

Heliocentric radial velocity correction

Auto atmosphere AOD : 0.13

Atmo. transmission :

Fixed Y value for sequence

Sky not removed

Wavelength registration

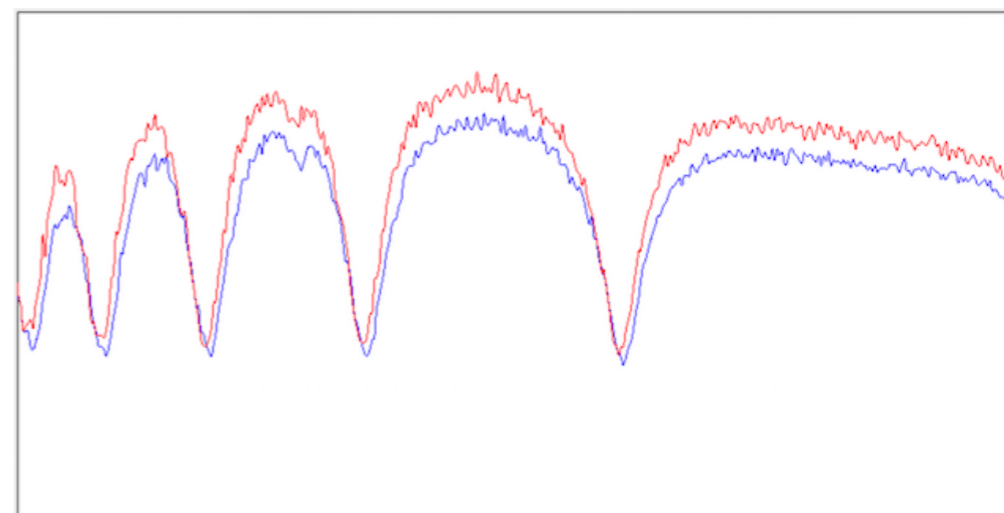
L1 : 3760 L2 : 5000

Cosmic rays filter

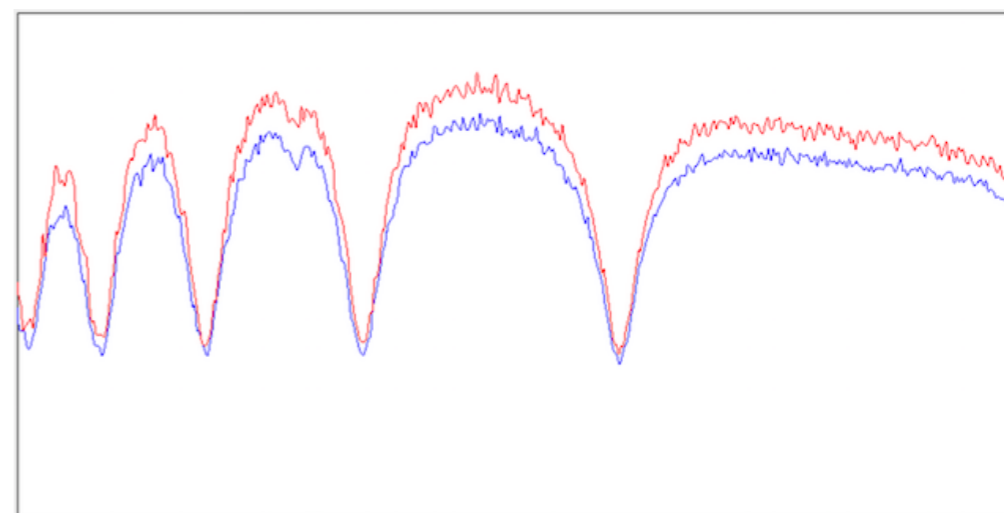
Optimal binning

Rejection coef. : 50

Automatic air mass computing



No correction



Automatic correction applied

Registration of individual spectra...
(3760, 5000)

File #1 -> 0.000 A
File #2 -> -0.408 A
File #3 -> -0.155 A
File #4 -> -0.291 A
File #5 -> 0.274 A
File #6 -> 0.145 A
File #7 -> 0.076 A
File #8 -> 0.183 A
File #9 -> 0.469 A
File #10 -> 0.996 A
File #11 -> 0.360 A
File #12 -> 1.318 A

You can check the spectral shift values

Write final profile : w:\test_uvex31_tmp_20190215_763.fits
Write final profile : w:\test_uvex31_tmp_20190215_763.dat

A recommandation: consult ARAS forum
<http://www.spectro-aras.com/forum/>

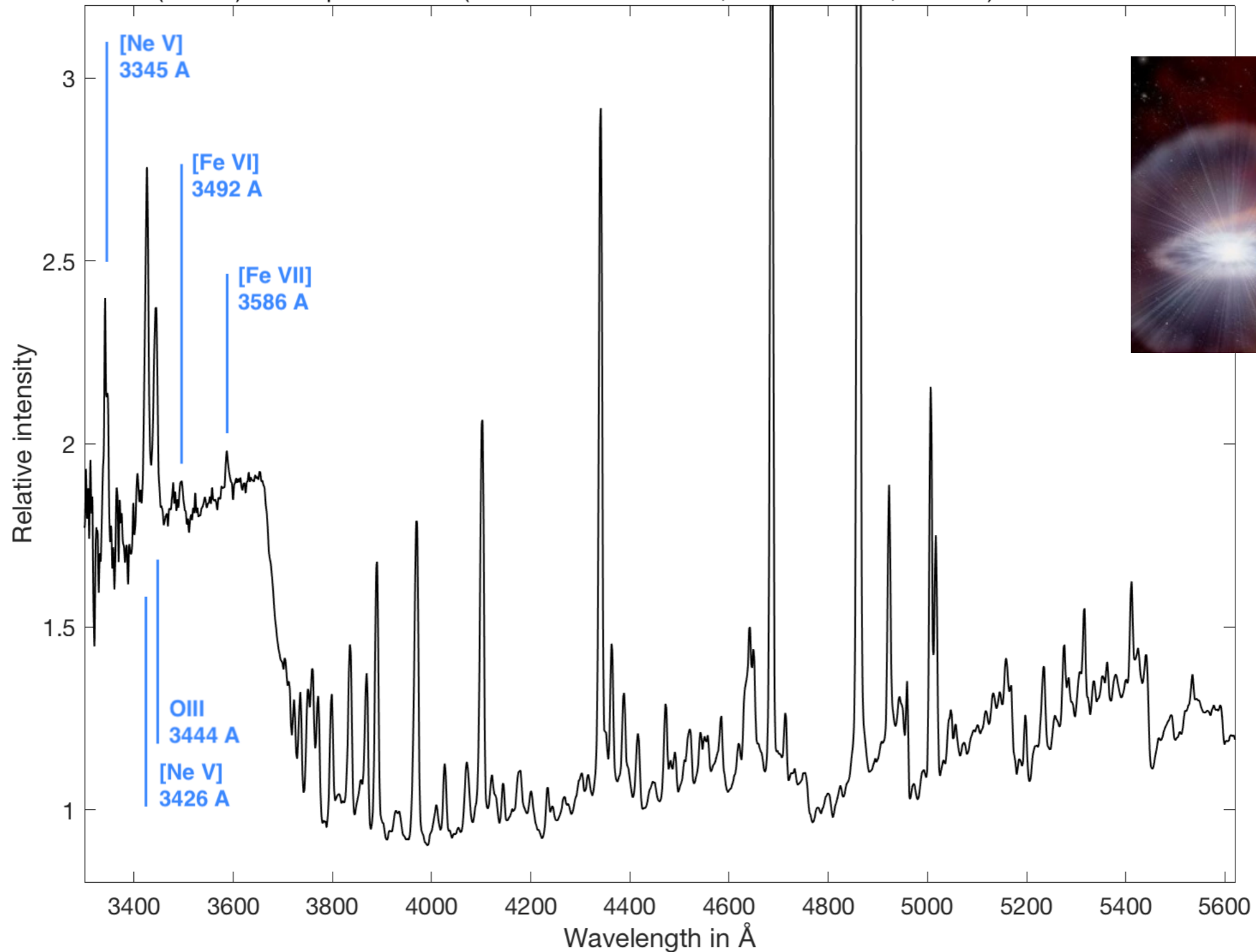
UVEX Project

TOPICS	REPLIES	VIEWS	LAST POST
UVEX(3) 300 traits/mm - Slit 18 microns avec C8 by Dubreuil Pierre » Fri Feb 08, 2019 9:32 am	0	95	by Dubreuil Pierre Fri Feb 08, 2019 9:32 am
Test réseau 1800 traits/mm sur UVEX by Christian Bull » Sun Jan 27, 2019 6:50 pm	3	280	by Christian Bull Fri Feb 01, 2019 1:33 am
UVEX3 1200 traits/mm vers H Alpha + réglages M1 by Dubreuil Pierre » Mon Jan 28, 2019 10:59 am	0	124	by Dubreuil Pierre Mon Jan 28, 2019 10:59 am
UVEX3 N2 by Dubreuil Pierre » Mon Jan 07, 2019 8:01 am	14	1221	by Michel Verlinden Thu Jan 17, 2019 9:56 pm
UVEX spectrograph (version 2) by Christian Bull » Mon Aug 06, 2018 11:36 pm	34	4176	by Christian Bull Fri Oct 12, 2018 6:14 pm
3D printed UVEX spectrograph by Christian Bull » Mon Jun 19, 2017 12:25 am	42	22252	by Gerard Arlic Fri Aug 10, 2018 6:39 am

Display topics from previous: All Topics Sort by Post time Descending

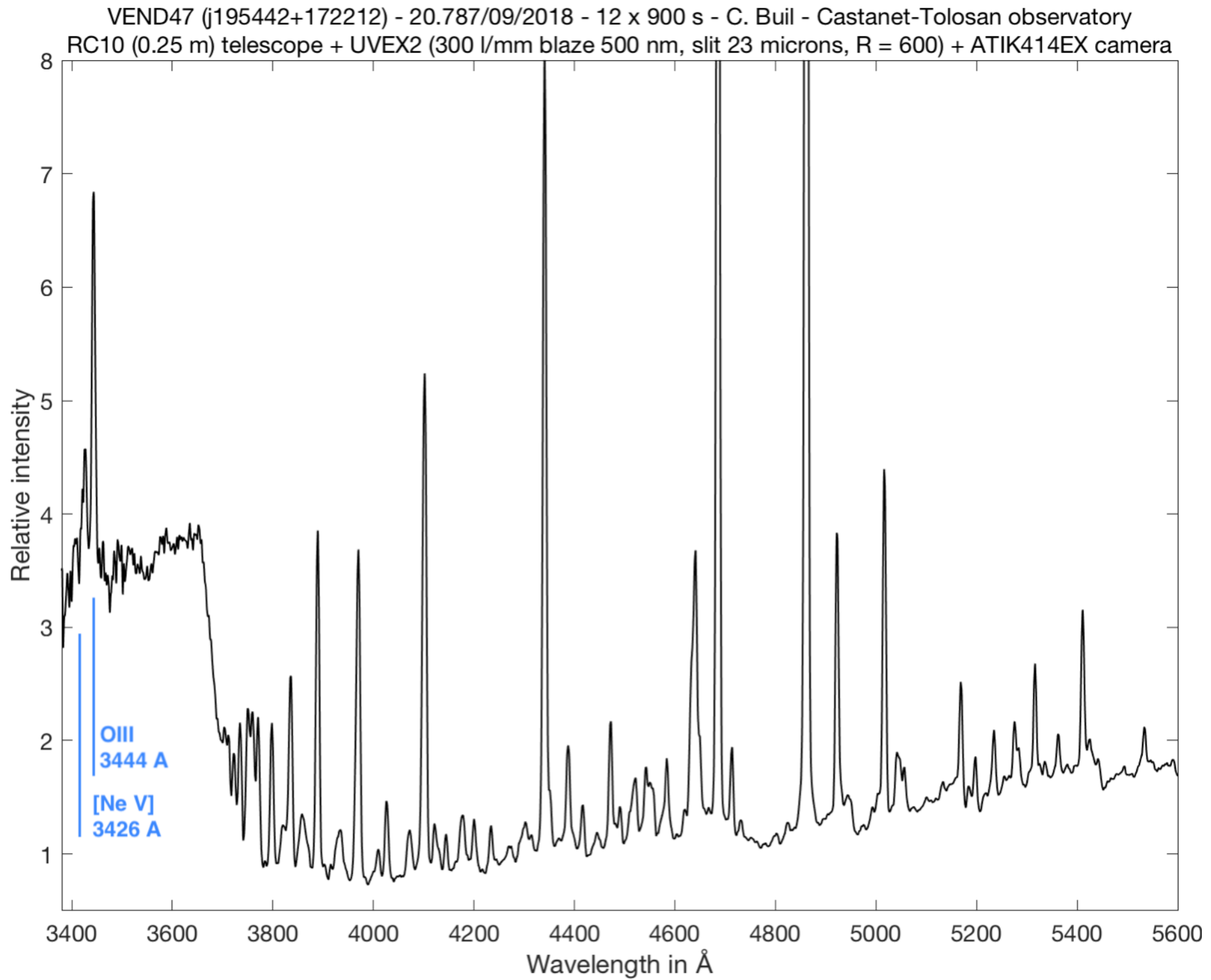
Sample of spectra - near UV observations (1/4)

Z And - 20.920/09/2018 - 13 x 900 s - C. Buil - Castanet-Tolosan observatory
RC10 (0.25 m) telescope + UVEX2 (300 l/mm blaze 500 nm, slit 23 microns, R = 600) + ATIK414EX camera



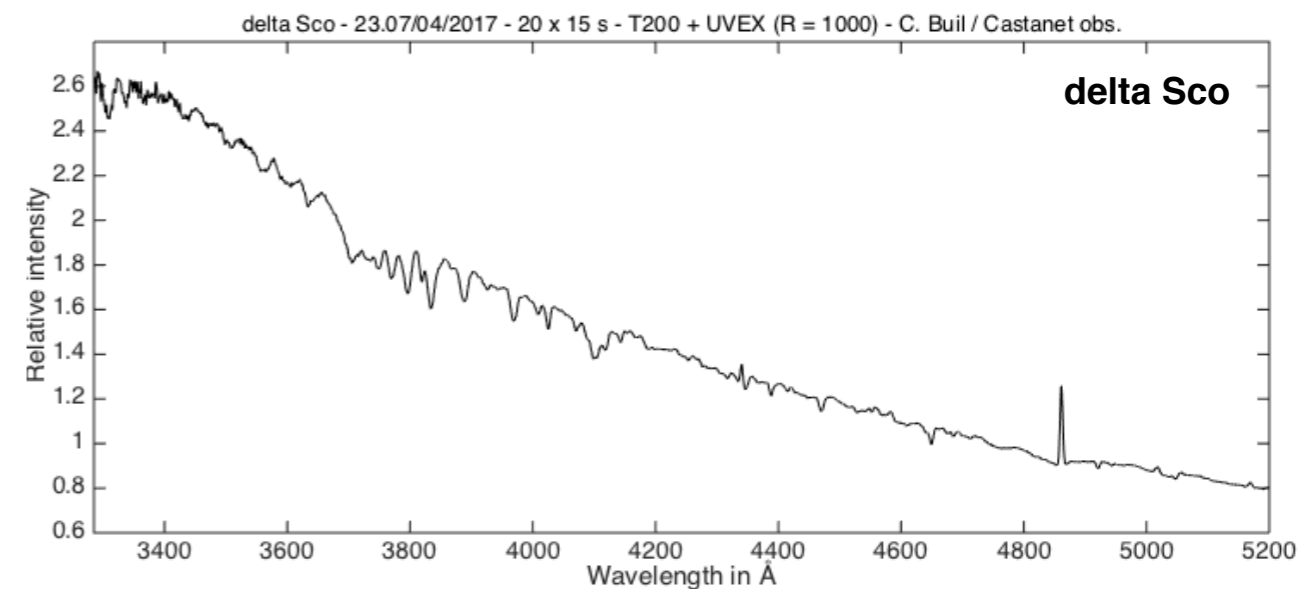
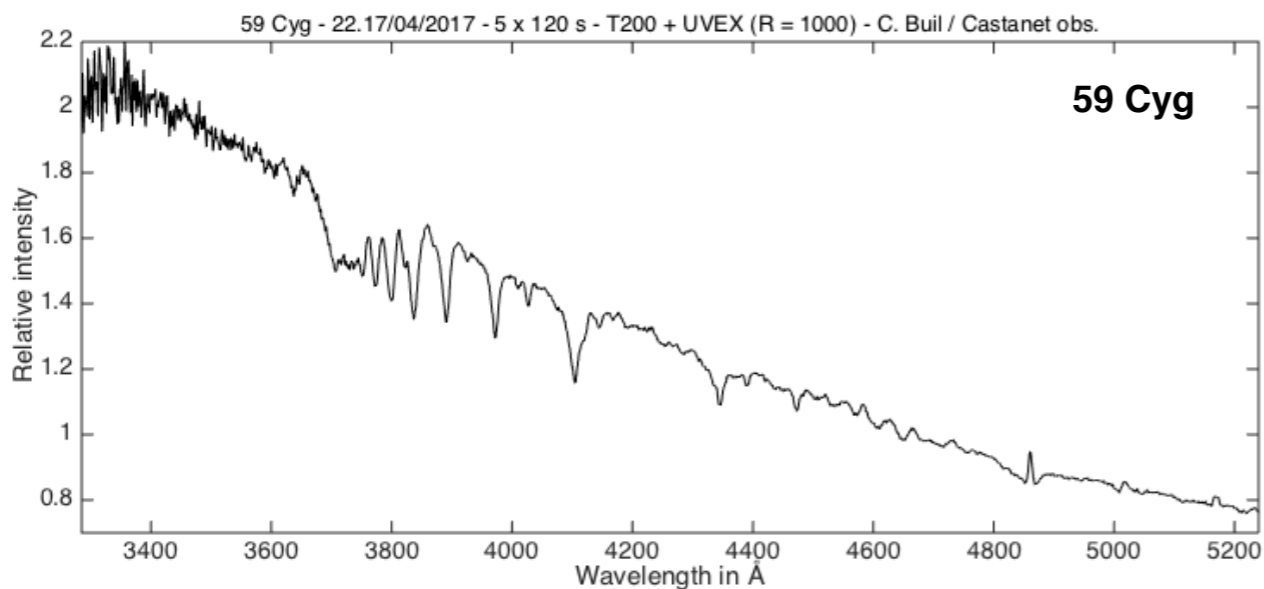
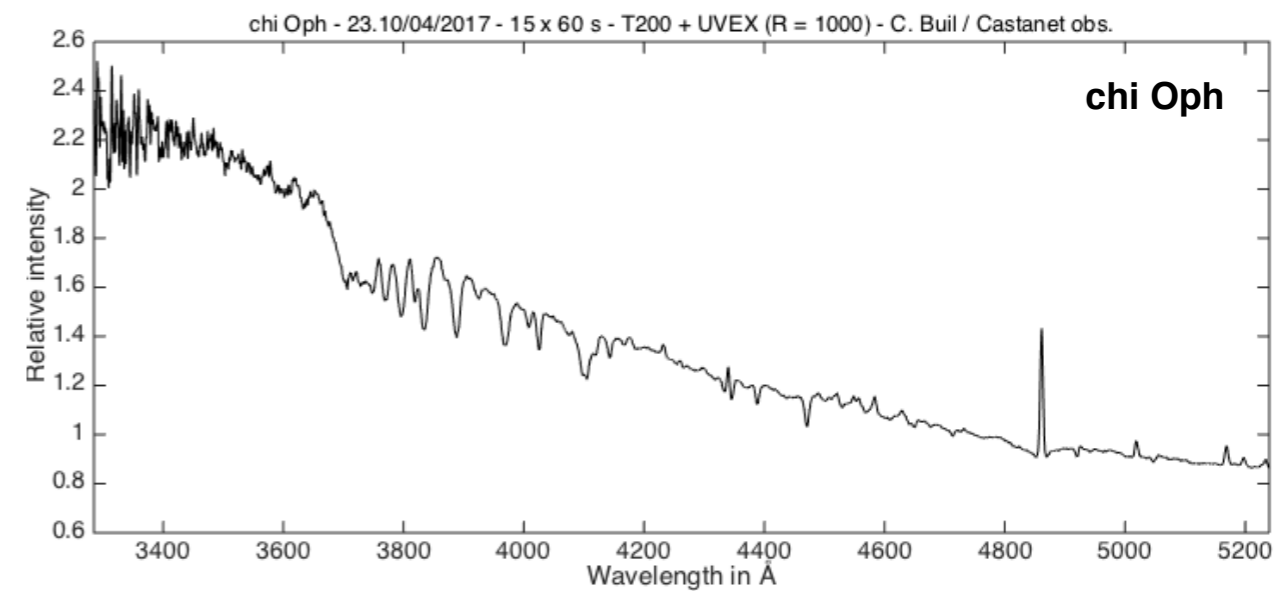
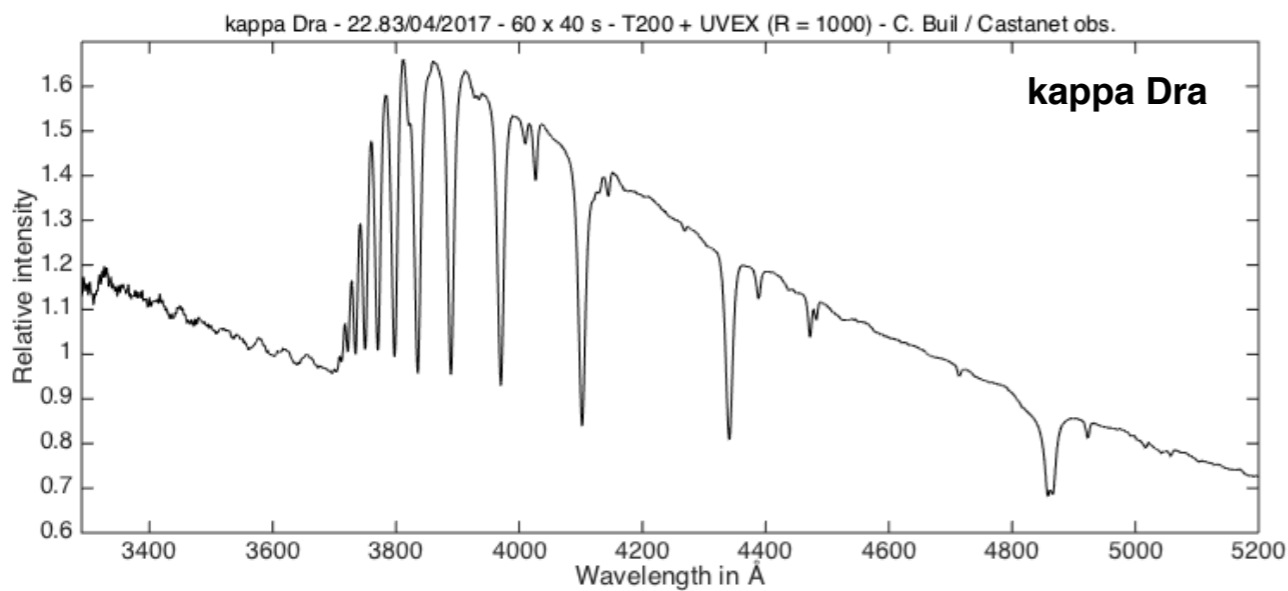
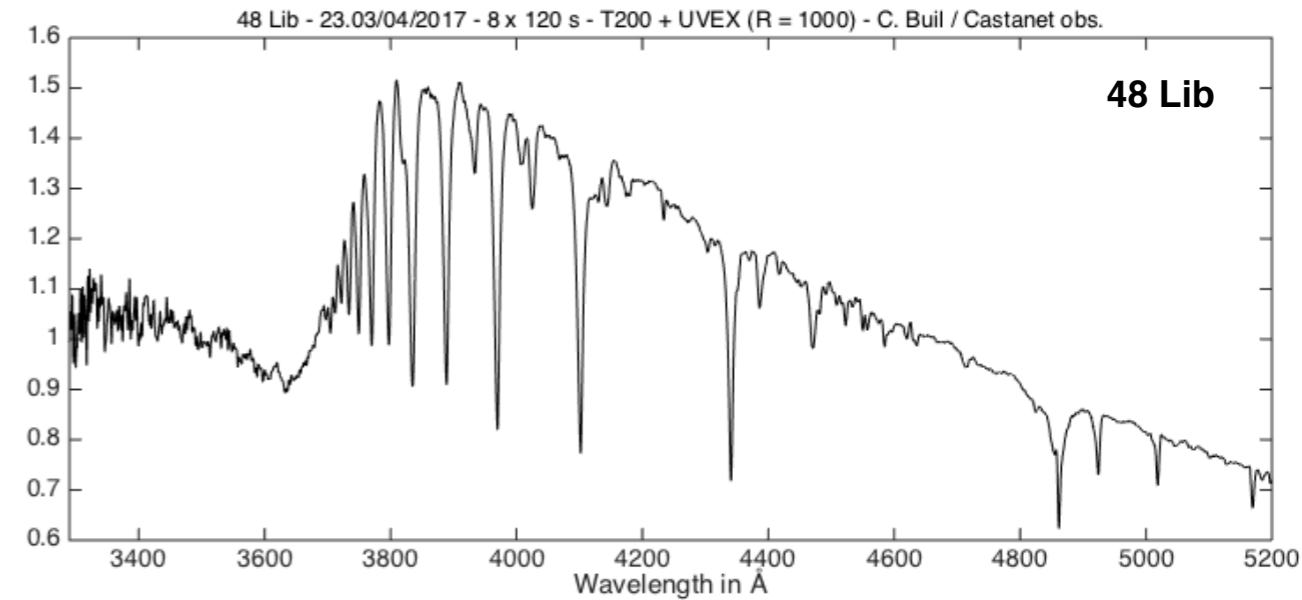
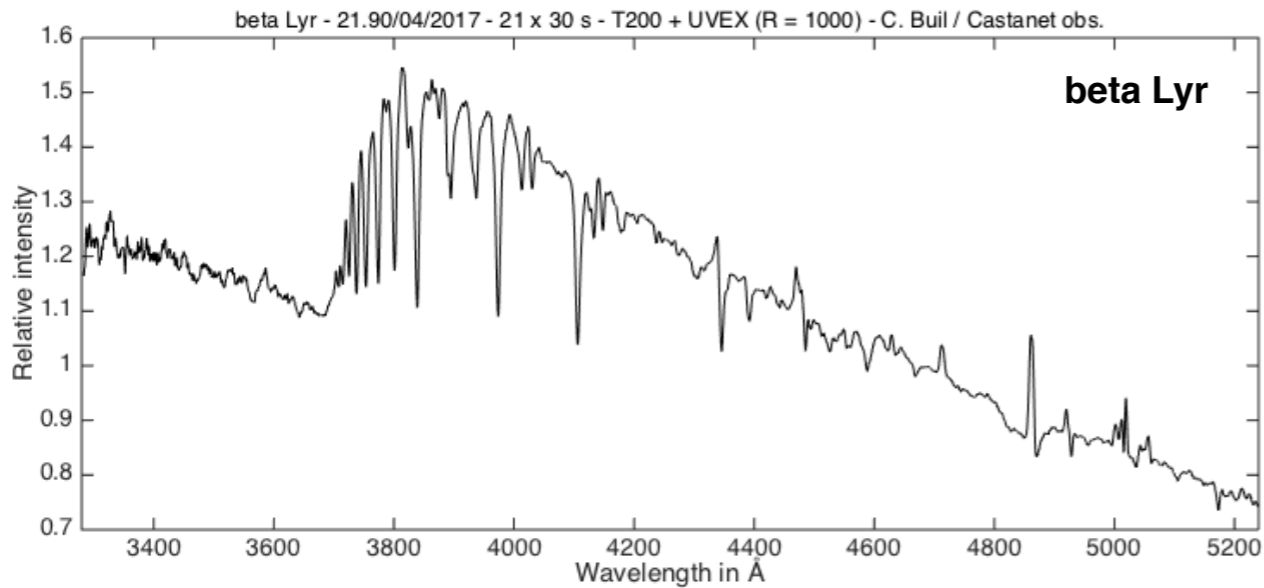
Symbiotic star Z And

Sample of spectra - near UV observations (2/4)

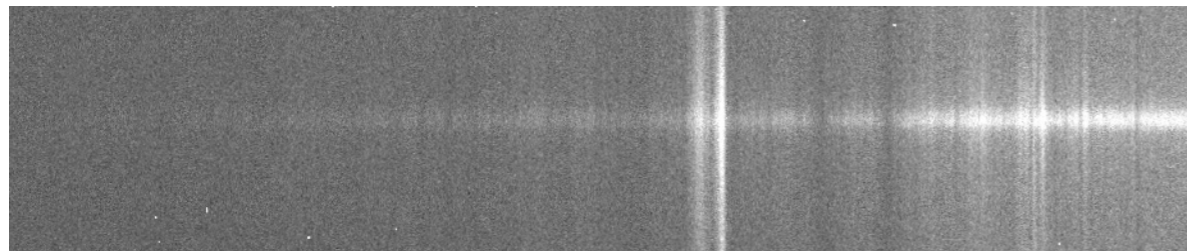
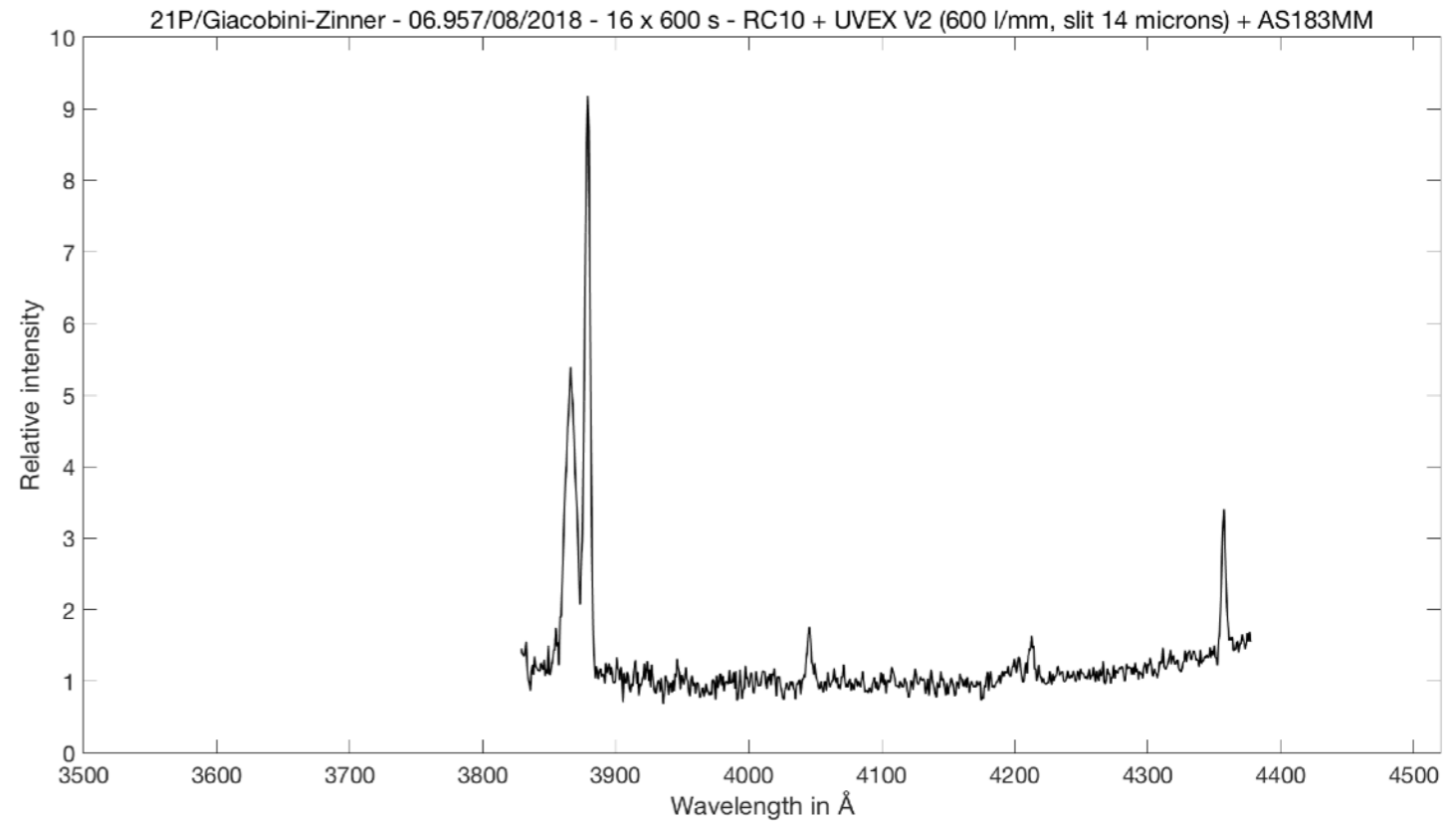


Symbiotic star VEND47

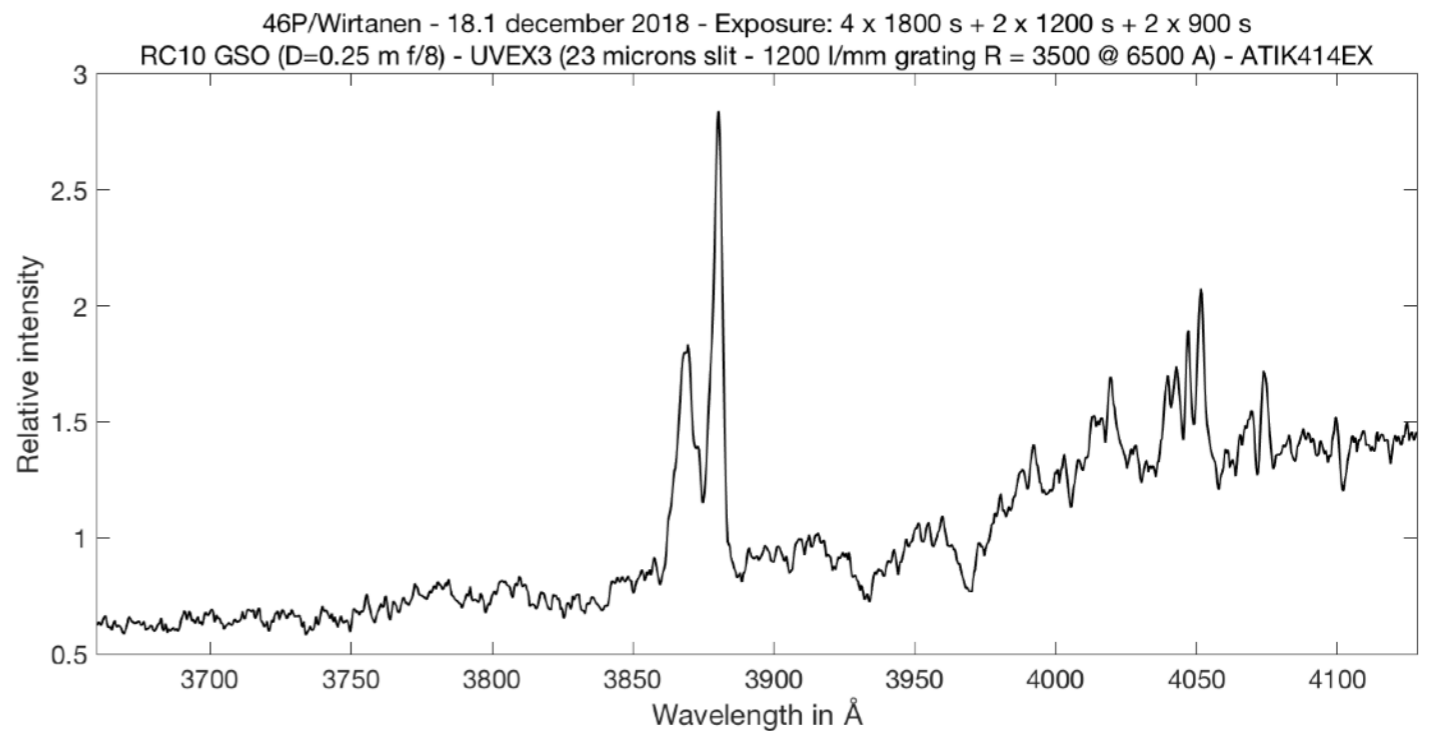
Sample of spectra - near UV observations (3/4) - Be stars



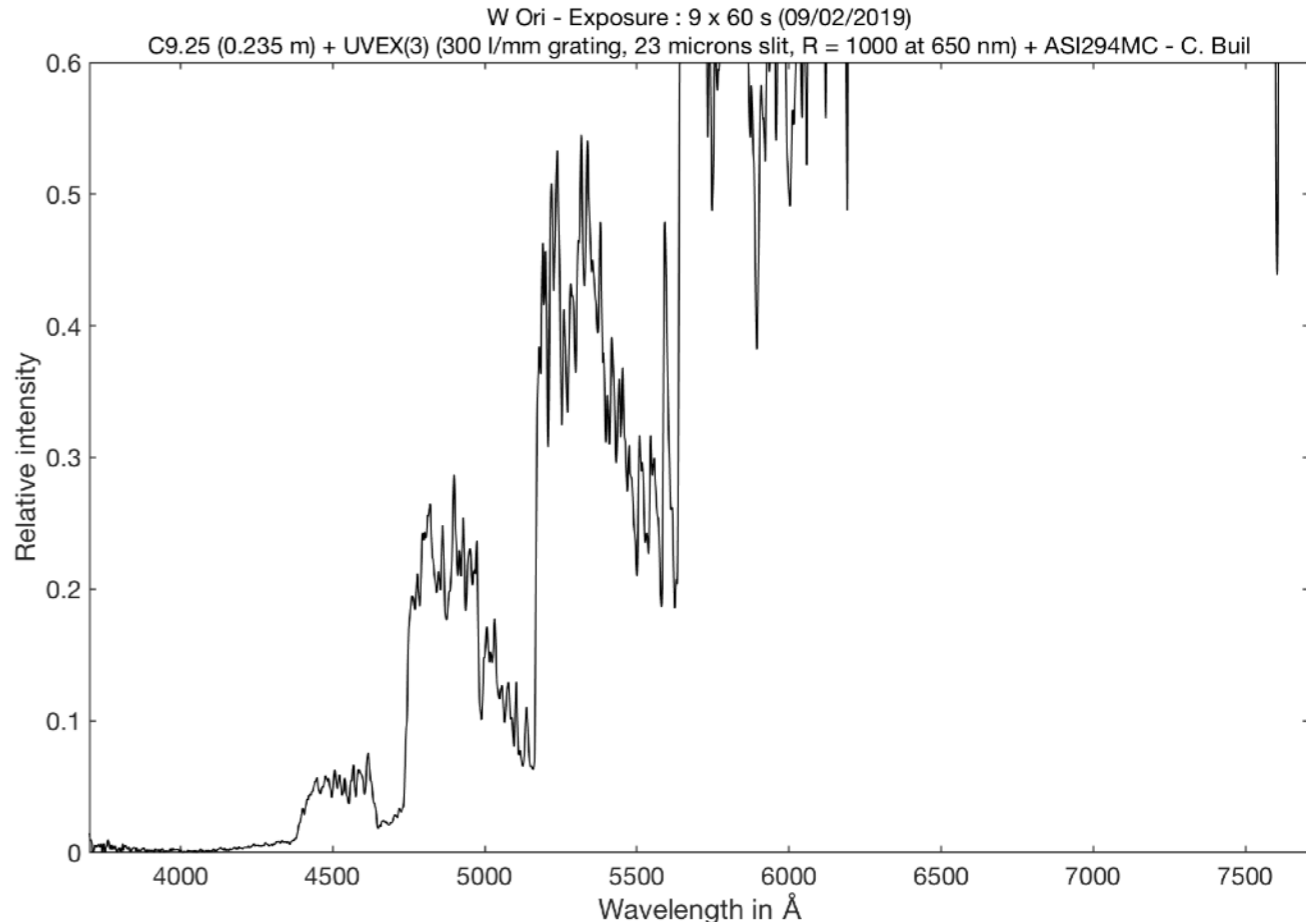
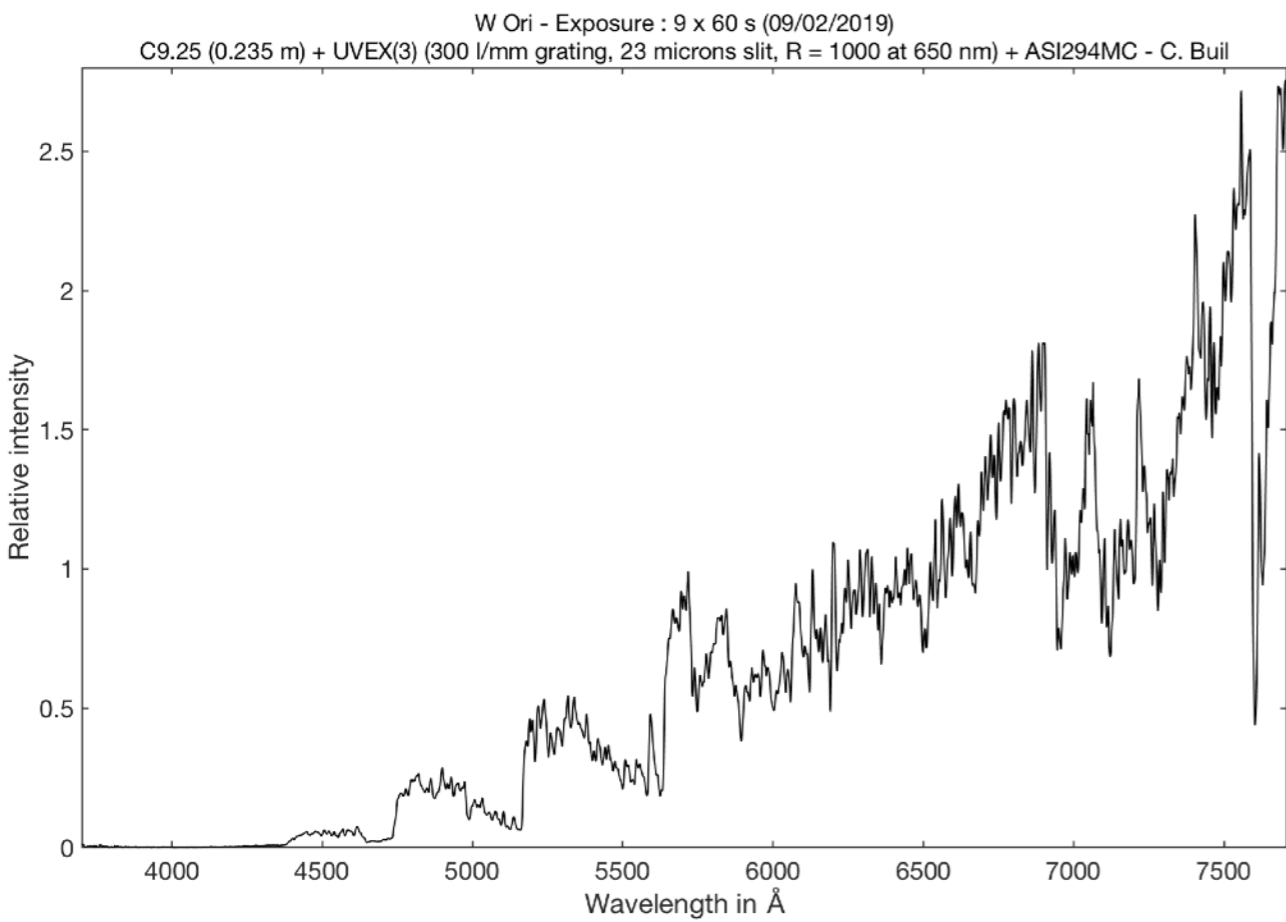
Comet 21P/Giacobini-Zinner



Comet 46P/Wirtanen

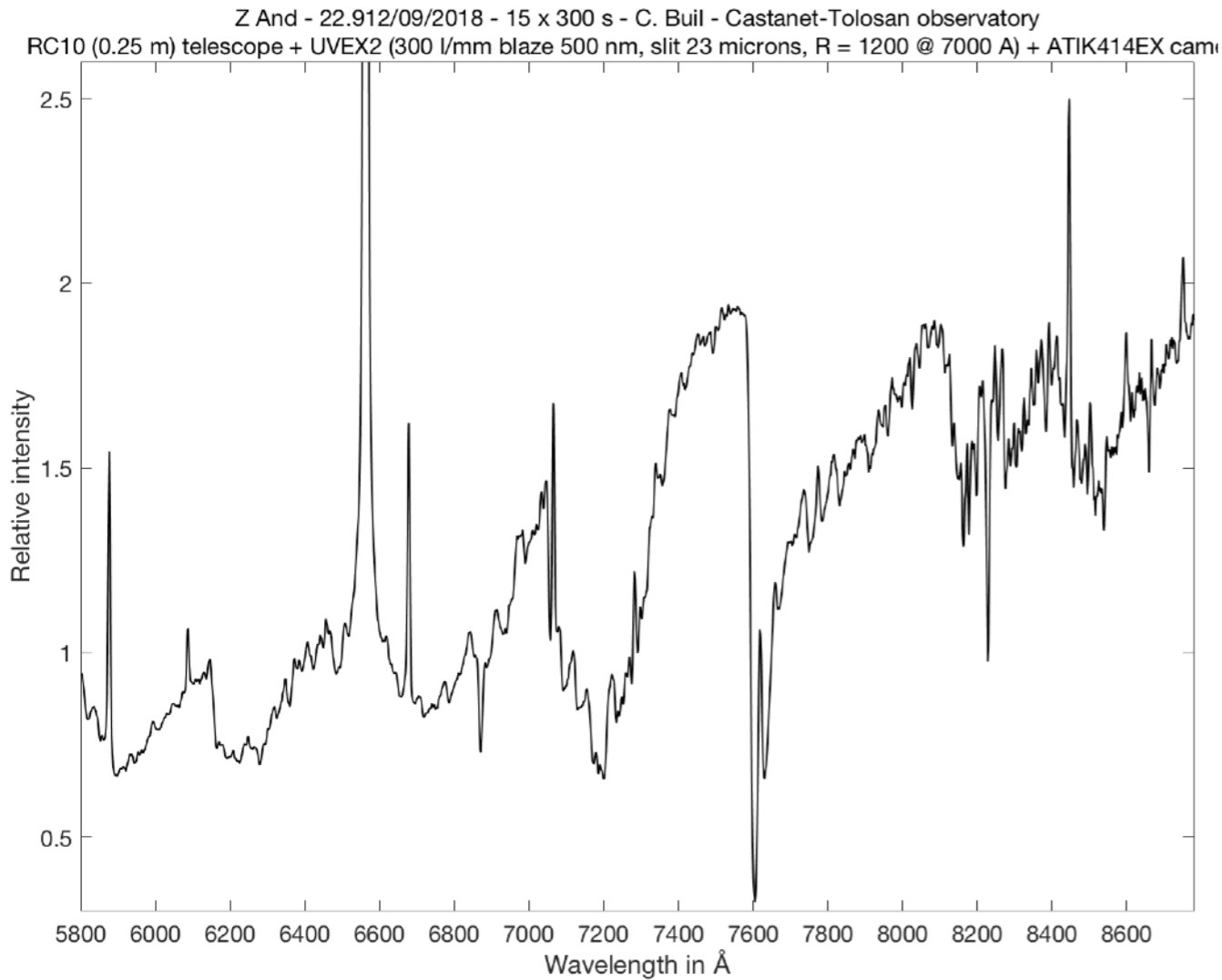


Sample of spectra - visible observations

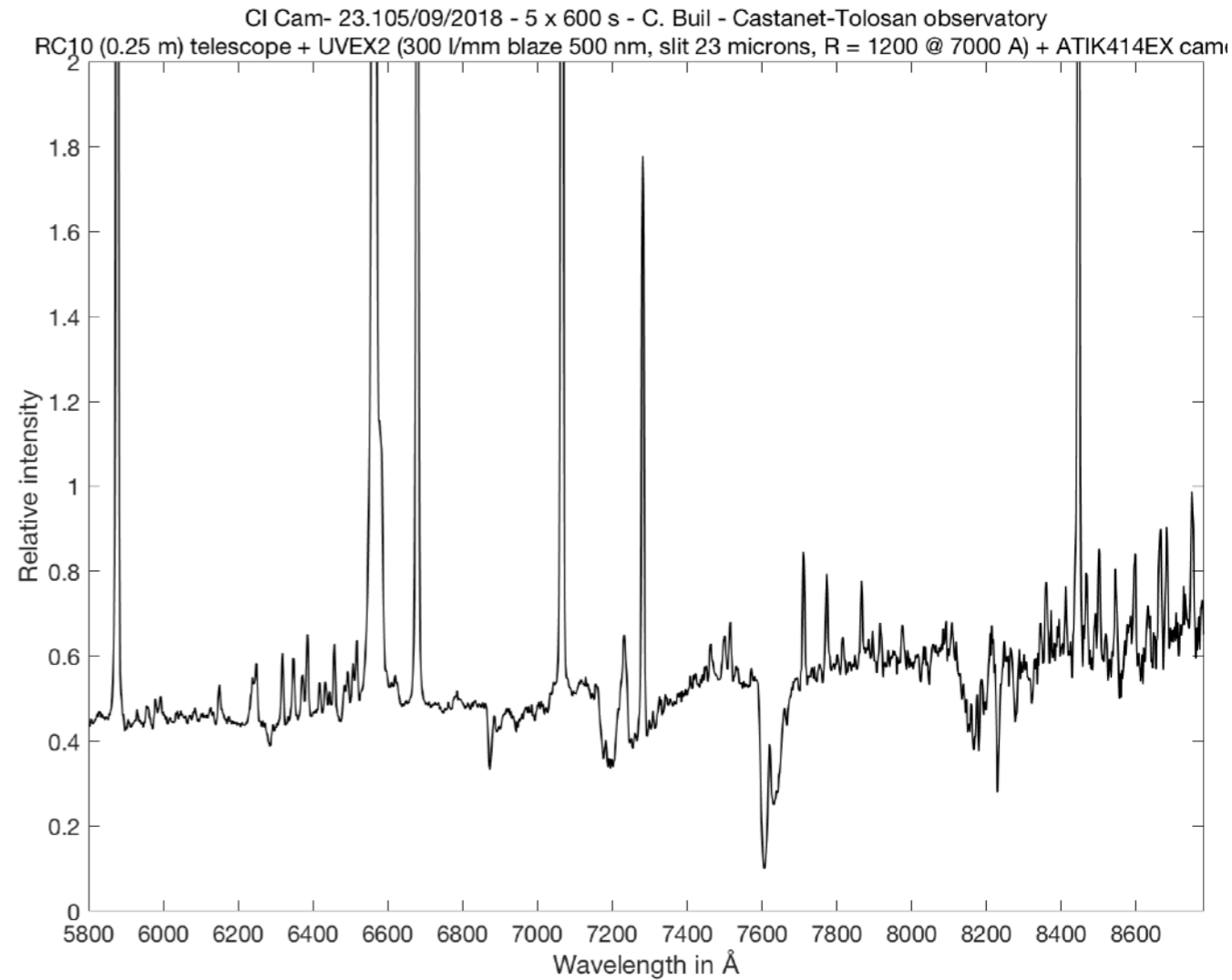


Carbon star W Ori

The other name of UVEX can be IREX (InfraRed Explorer)



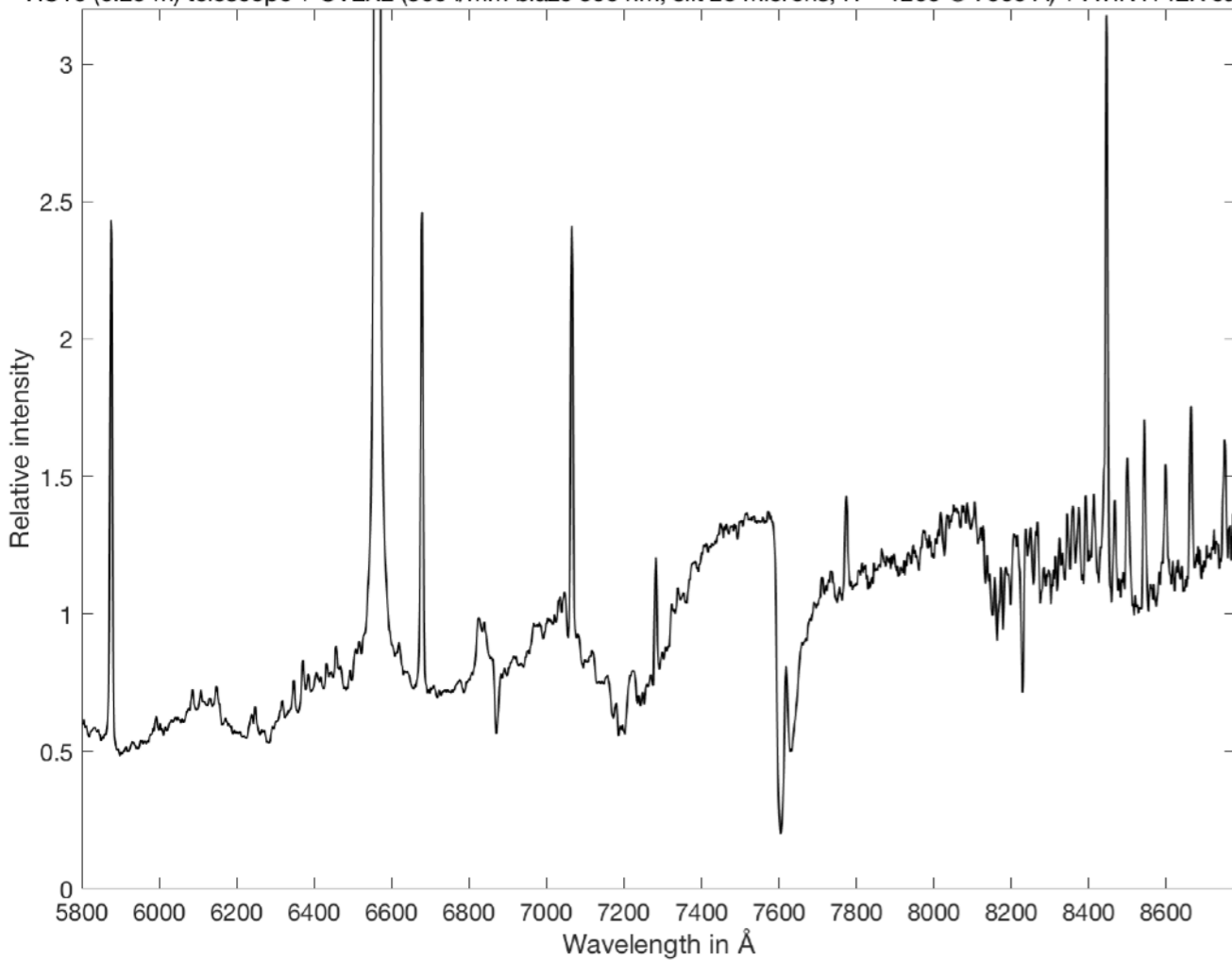
Symbiotic star Z And



B[e] star CI Cam

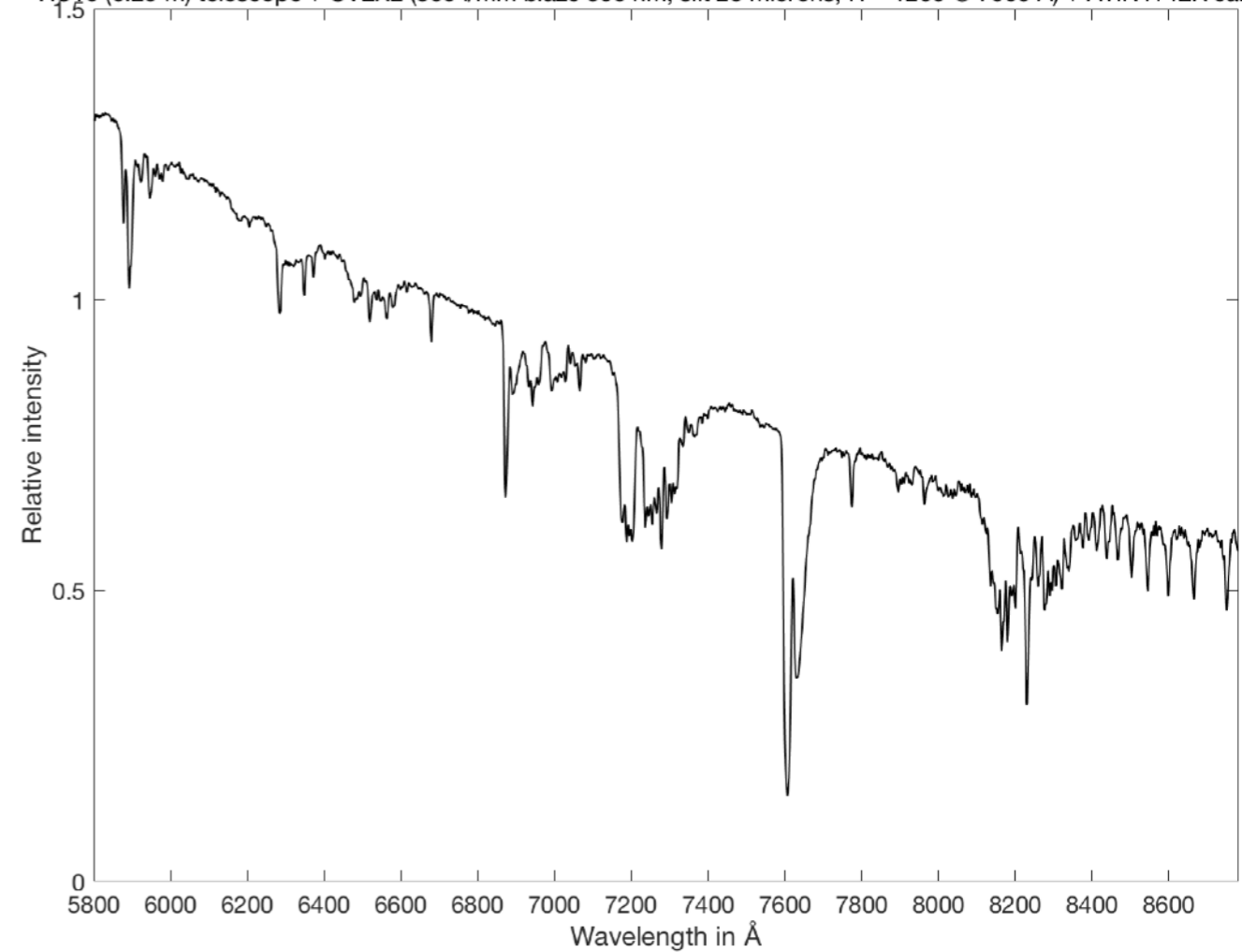
Sample of spectra - near infrared observations (2/2)

VEND47 (j195442+172212) - 22.808/09/2018 - 5 x 600 s + 2 x 450 s - C. Buil - Castanet-Tolosan observatory
RC10 (0.25 m) telescope + UVEX2 (300 l/mm blaze 500 nm, slit 23 microns, R = 1200 @ 7000 Å) + ATIK414EX camera



Symbiotic star VEND47

HD13267- 23.047/09/2018 - 4 x 180 s - C. Buil - Castanet-Tolosan observatory
RC10 (0.25 m) telescope + UVEX2 (300 l/mm blaze 500 nm, slit 23 microns, R = 1200 @ 7000 Å) + ATIK414EX camera

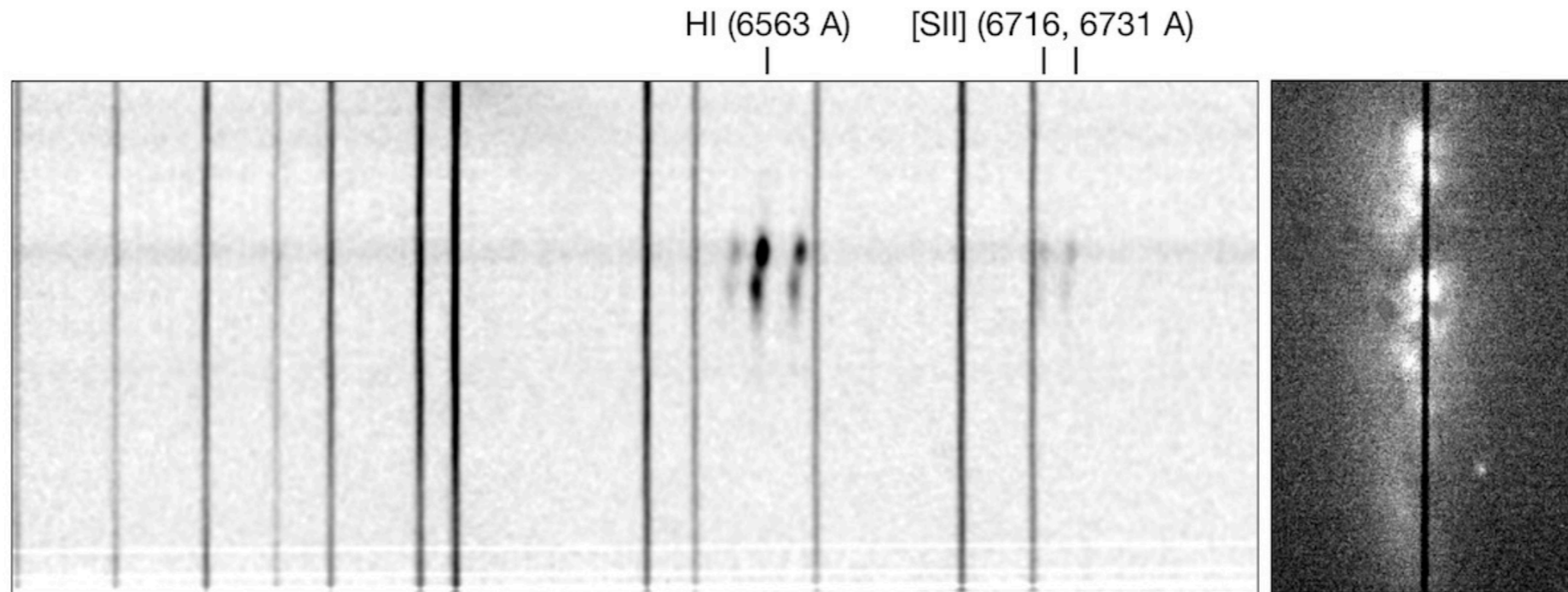
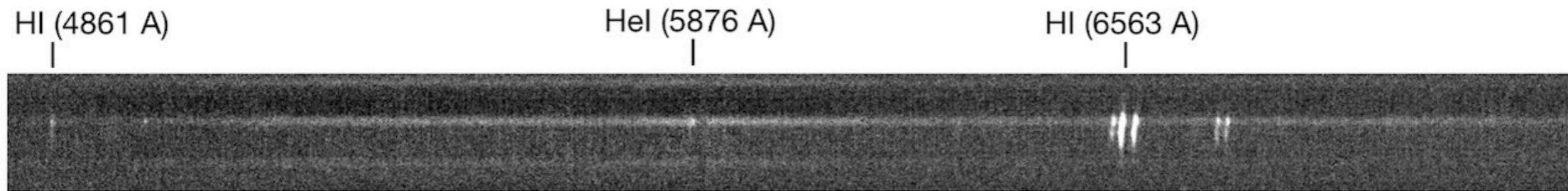


B5Ia star HD 13267

Distant object spectroscopy

Messier 82 core spectrum

UVEX(3) - 600 grooves/mm grating - 23 microns slit - Color CMOS camera ASI294MC -
10-inch RC telescope - City background



[SII] (6548, 6583 A)

Measured PTV wind velocity: 140 km/s

↑
Calibration neon lines



Thank you for your attention !

