



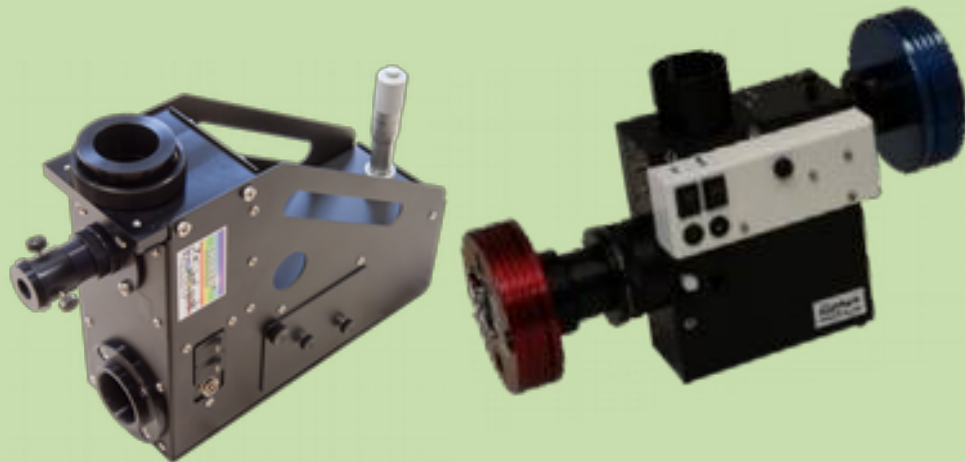
Basics of spectroscopy

Sacramento Mountains Spectro Workshop - 2
February 22nd - 24th, 2019

François Cochard
francois.cochard@shelyak.com

Product range

Lhires III & LISA

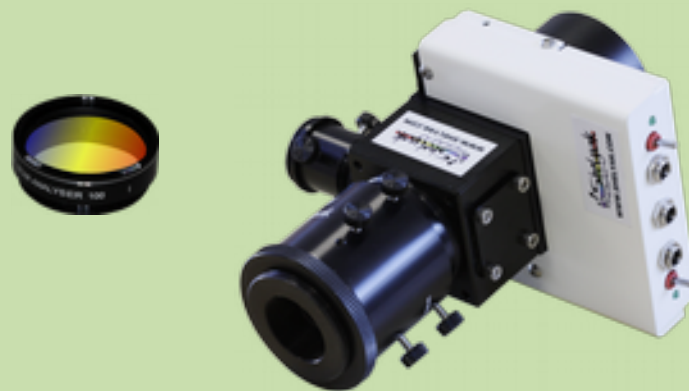


Eshel



Alpy 600 & StarAnalyser

Handeled spectro & Lhires Lite







Spectroscopes range

• **TO DISCOVER** spectroscopy without any camera and without any telescope:

- Handheld Spectroscope
- Lhires Lite

TO START in astronomical spectroscopy with cameras and telescopes:

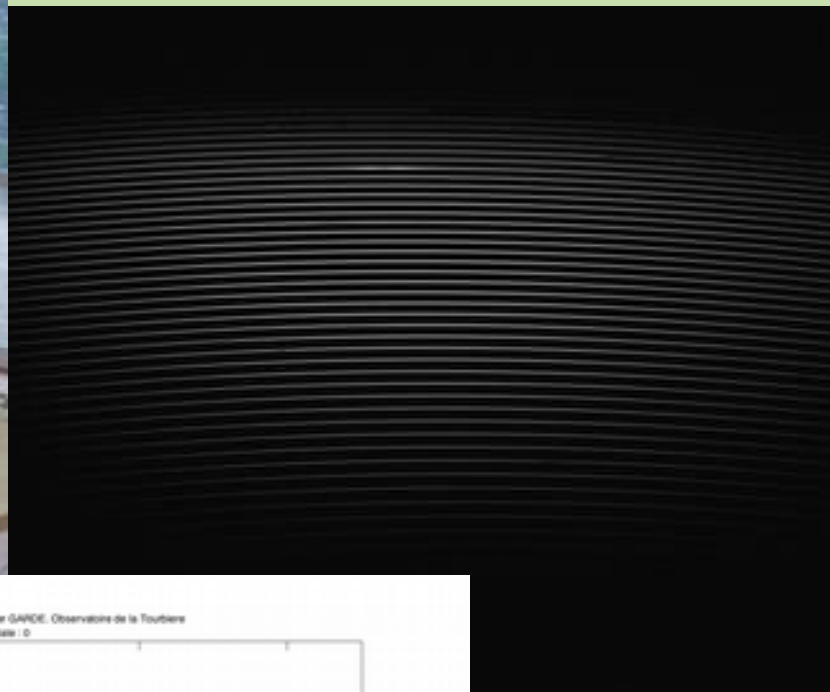
- Star Analyser
- Alpy 600

FOR SKILLED OBSERVERS:

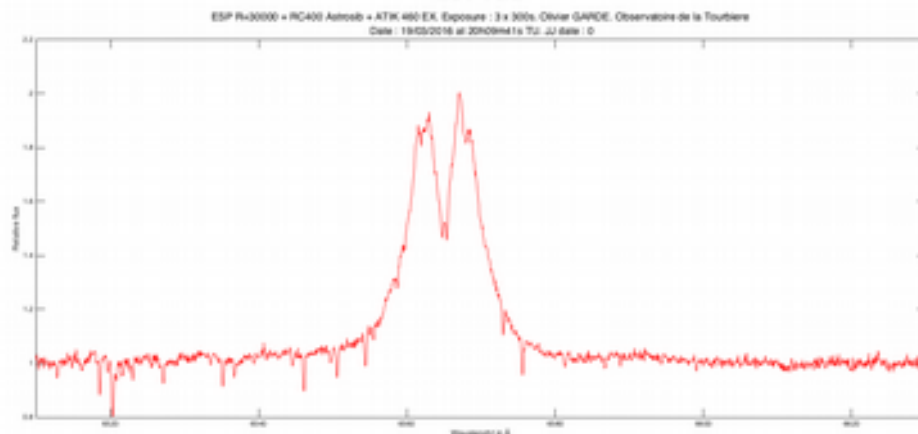
- LISA
- Lhires III

FOR PROS AND EXPERTS in Spectroscopy:

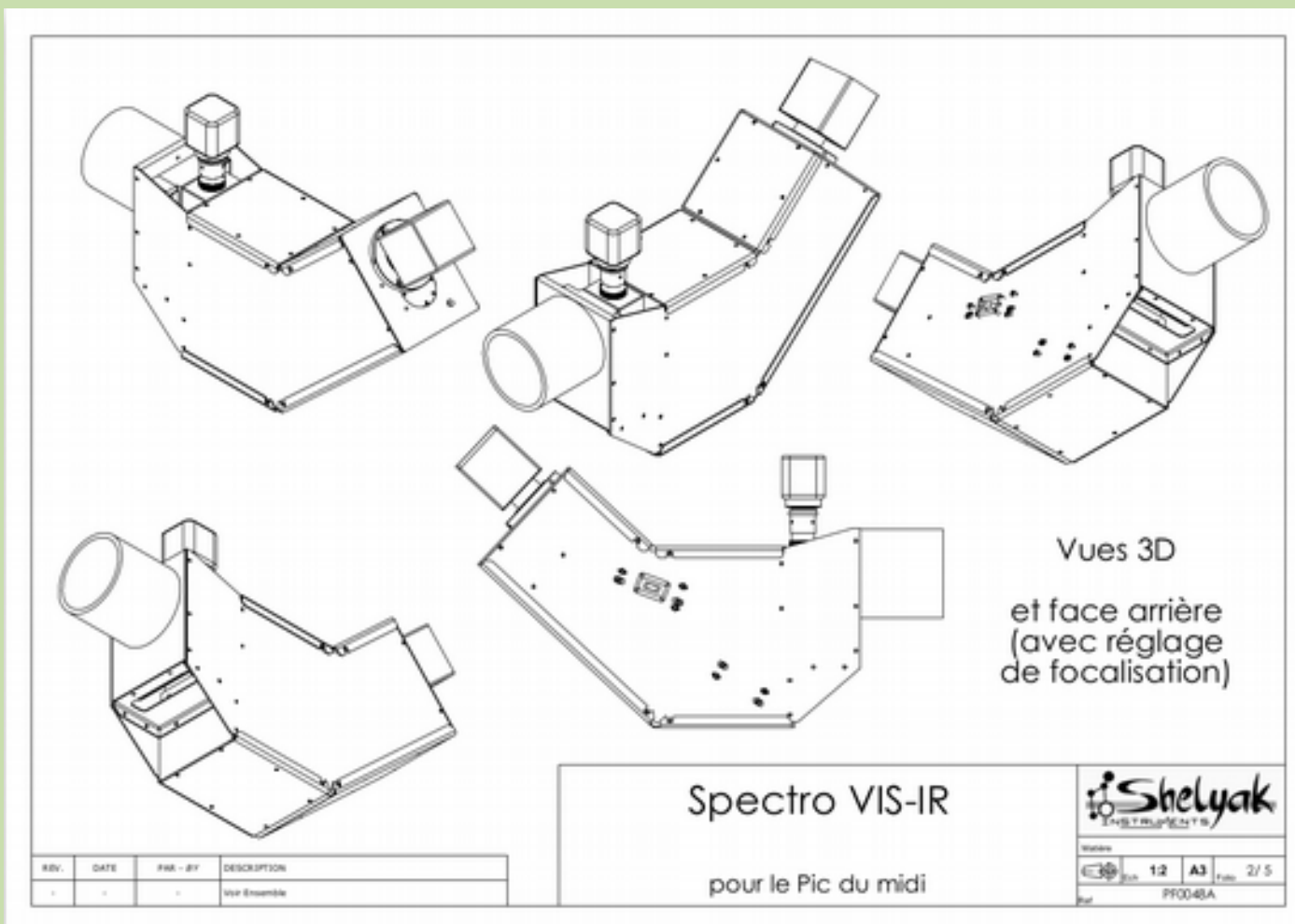
- eShel



zet Tau



SOVAG VIS-SWIR – Pic du Midi





Being in contact with Shelyak



[SPECTROSCOPY](#) [PRODUCTS](#) [RESELLERS](#) [CONTACT](#)

Astronomical spectroscopy for research, industry, education and leisure



Stars won't look the same

Astronomical spectroscopy consists in spreading out the light coming from stars. This is the way to get a high number of informations on them. And this is surprisingly simple – even with a small instrument.

[All about spectroscopy](#)

DISCOVERY

With [handheld spectro](#) and [LINES.LITE](#) discover the spectroscopy without camera and without telescope.

TO START

Start in "spectro" (with camera and telescope) thanks to [Star Analyser](#) and [Apy.500](#)

SKILLED OBSERVERS

With [LISA](#) study the celestial objects of low intensity. Access radial speeds with [LINES.30](#)

PROS AND EXPERTS

With the [SHEL](#), the pros and the confirmed astronomers go on a hunt for exoplanets.

and also [cameras](#), [systems for observation](#), [accessories](#) ...

[view in a browser](#)



Astronomical spectroscopy
for research, industry, education and leisure

Newsletter 2019 #1

Happy New Year
2019



www.shelyak.com



Basics of spectroscopy

Sacramento Mountains Spectro Workshop - 2
February 22nd - 24th, 2019

François Cochard
francois.cochard@shelyak.com

Many ways to do Astronomy

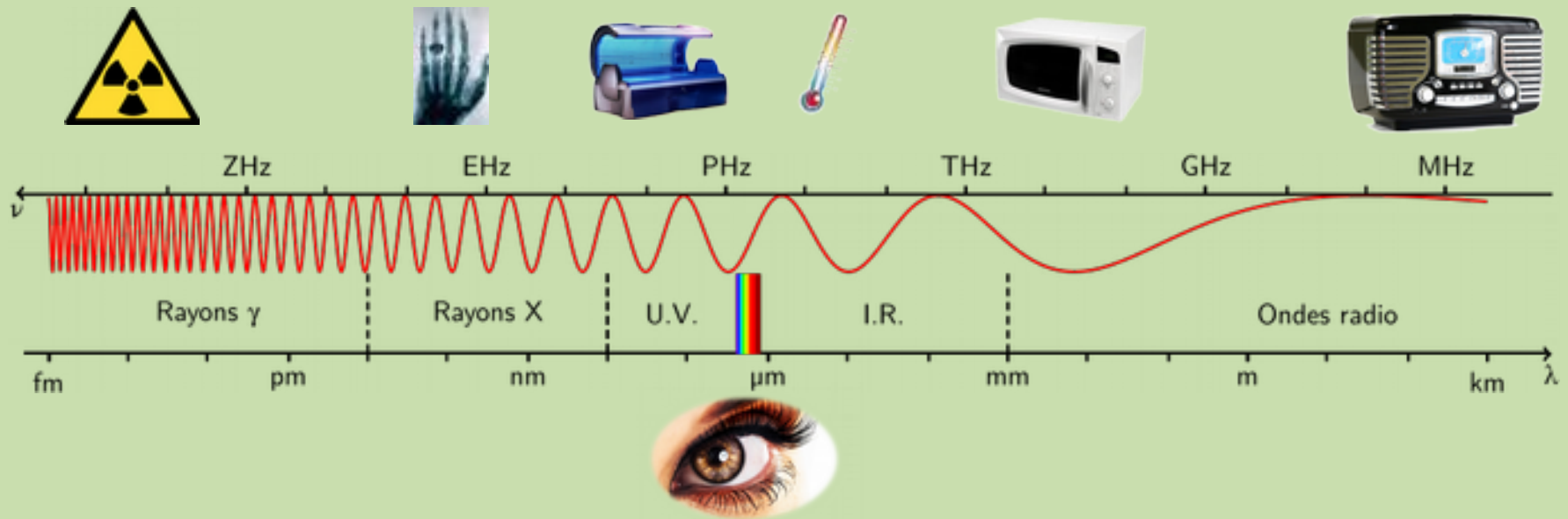
	Contemplate	Measure
Visual	Visual obs.	Variables stars, astrometry
Imaging	Nice pictures	Photometry, astrometry, planetary imaging
Spectroscopy	-	Physical parameters, Chemical composition, Radial velocities
Polarimetry	-	Polarisation (magn. field, diffusion, reflexions)

Informations
not accessible
to human eye

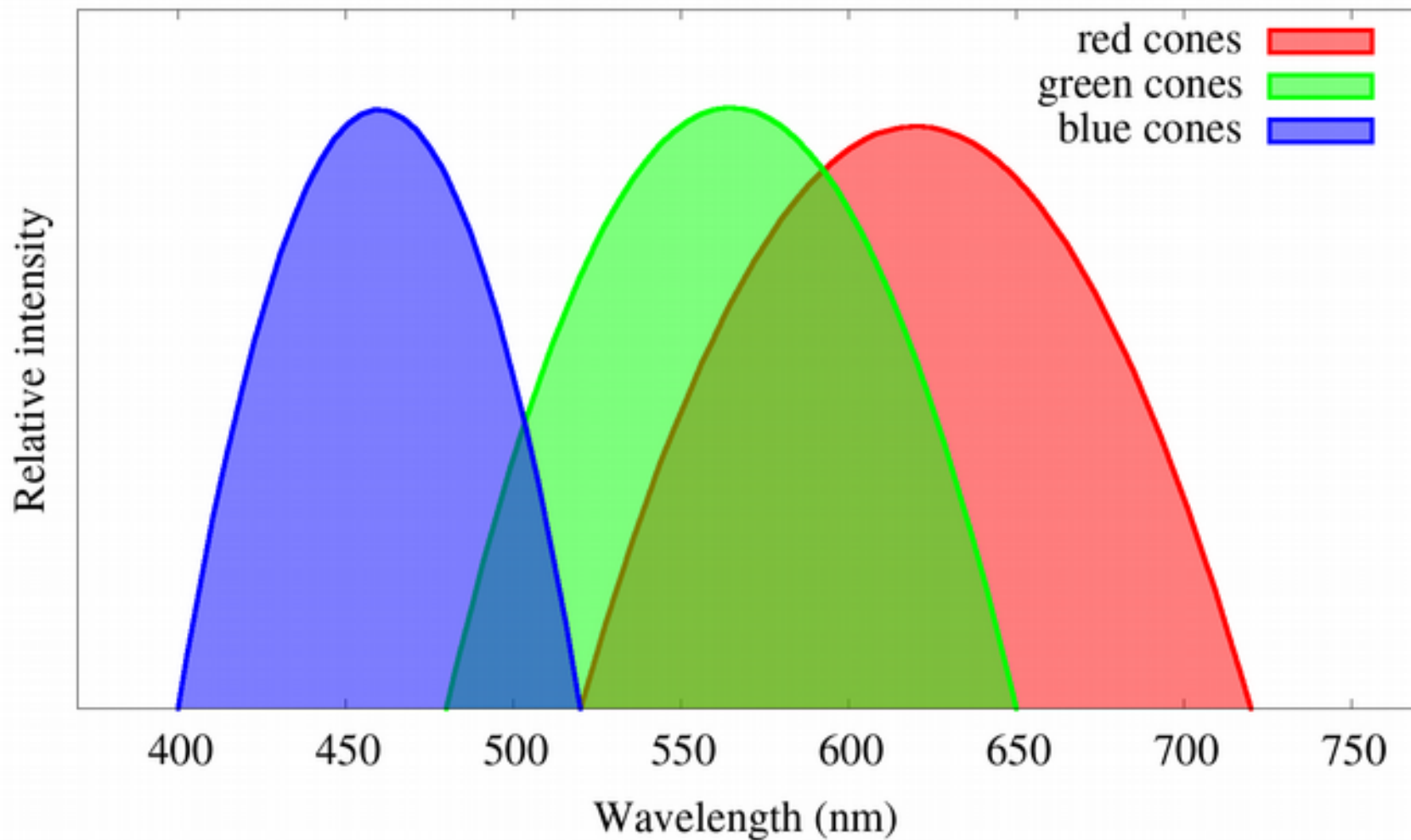
Spectroscopy

- The light contains more information than the eye (or a CCD) can perceive.
- A spectrum is a detailed decomposition of the light energy vs wavelength (or color).
- The function of a spectroscope is to convert the wavelength (color) to a geometric position of an imaging sensor.

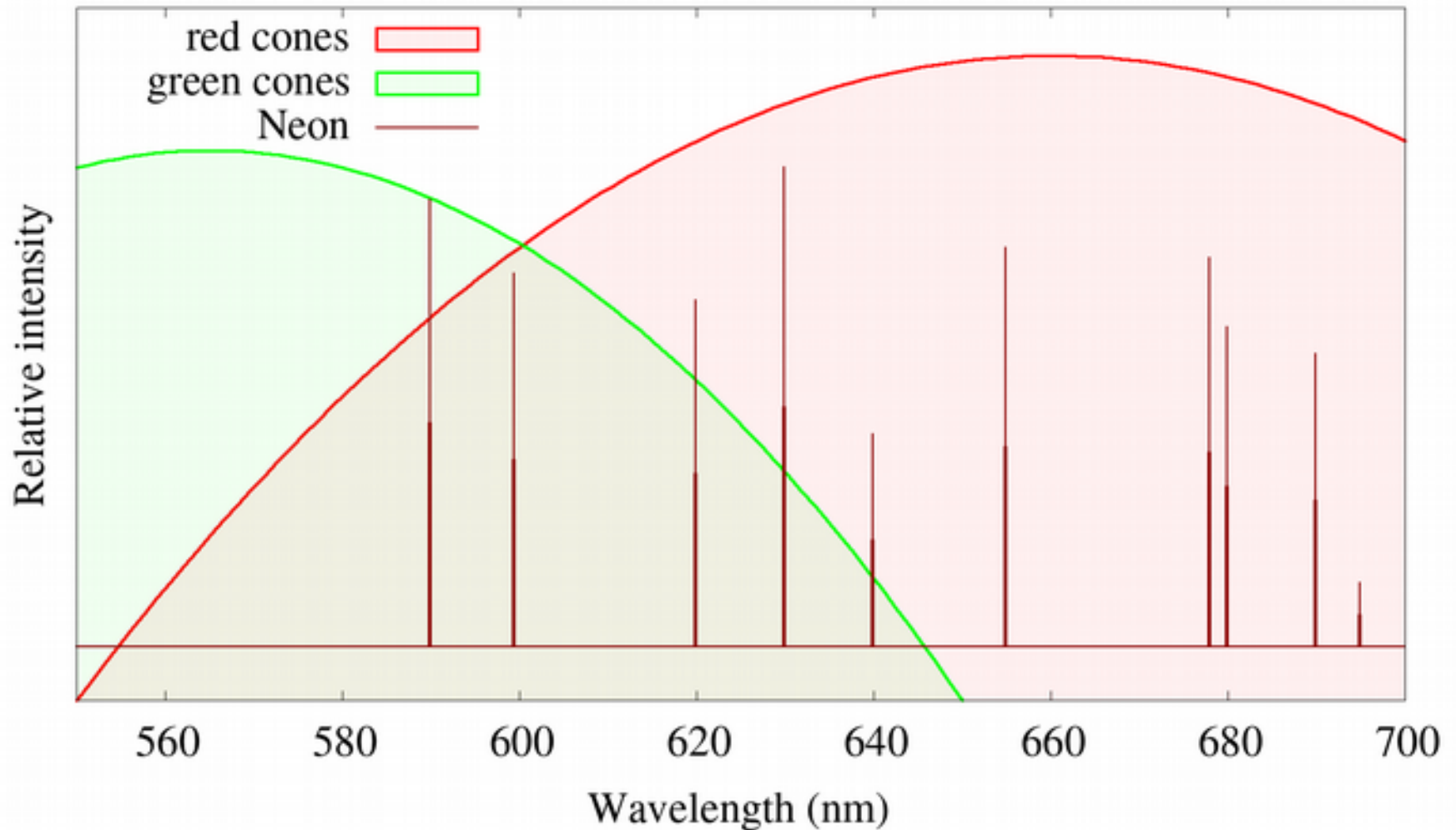
Light is a wave...



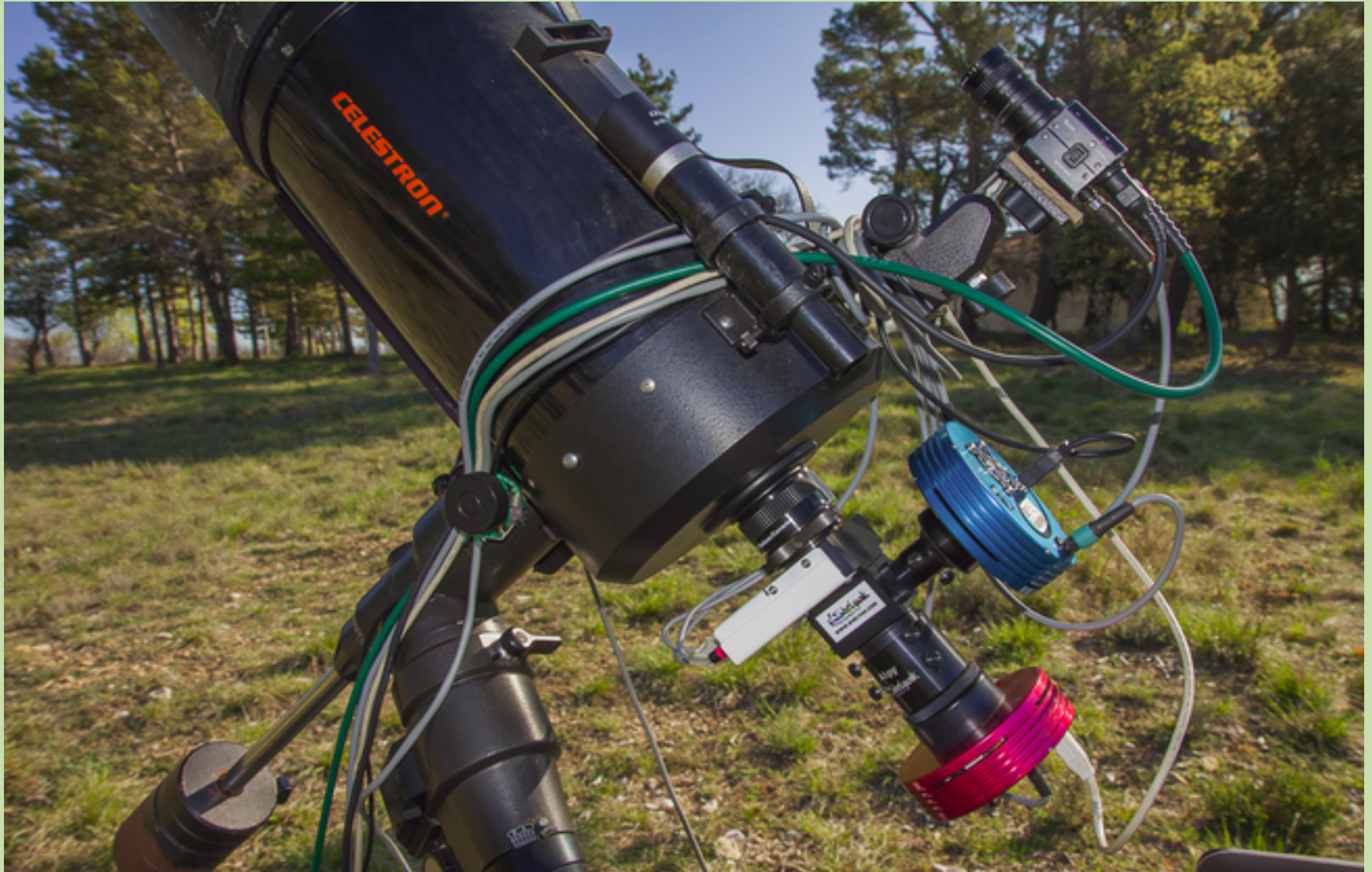
Eye perception

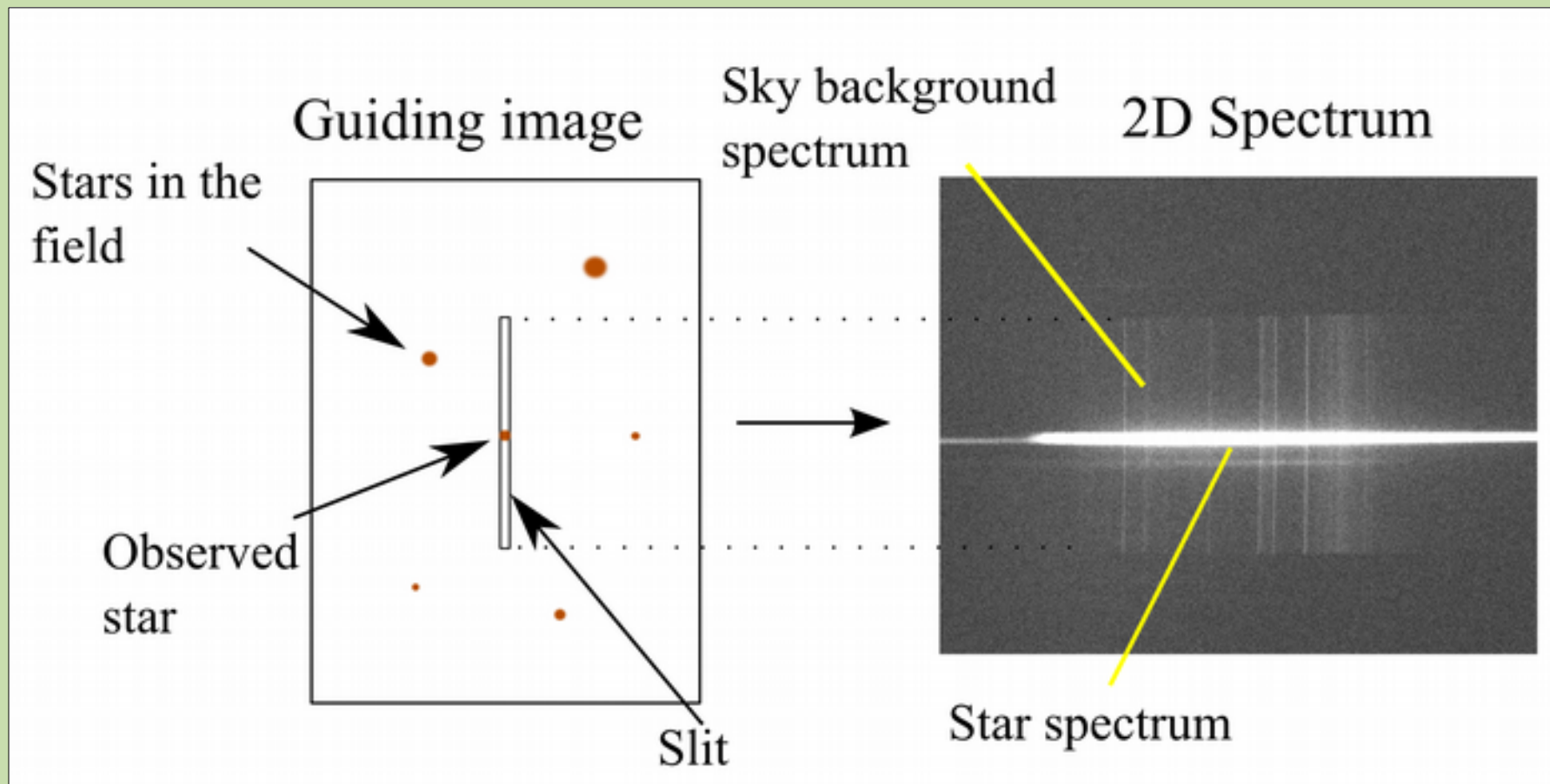


Perception de l'œil



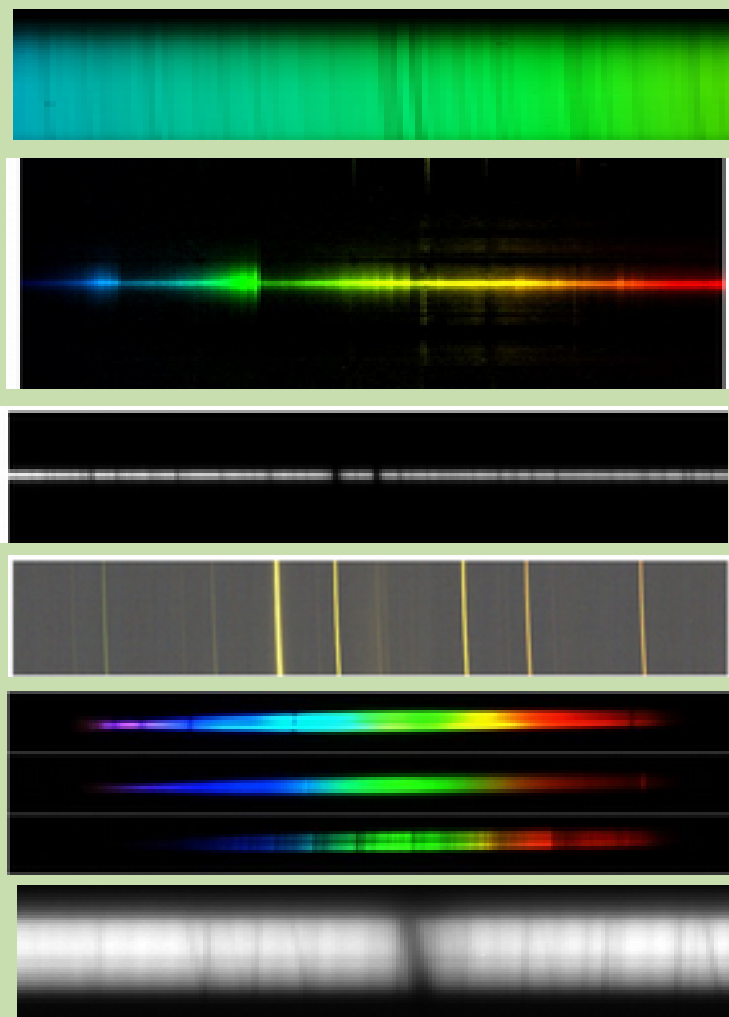
The instrument



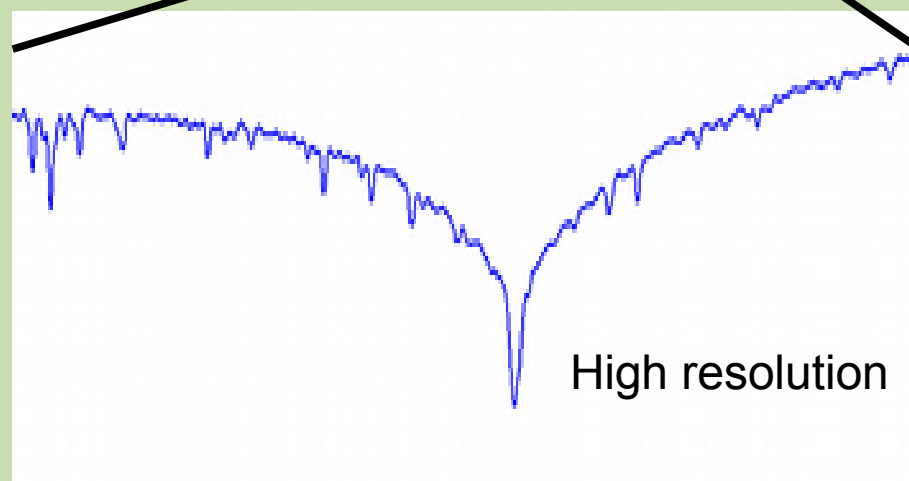
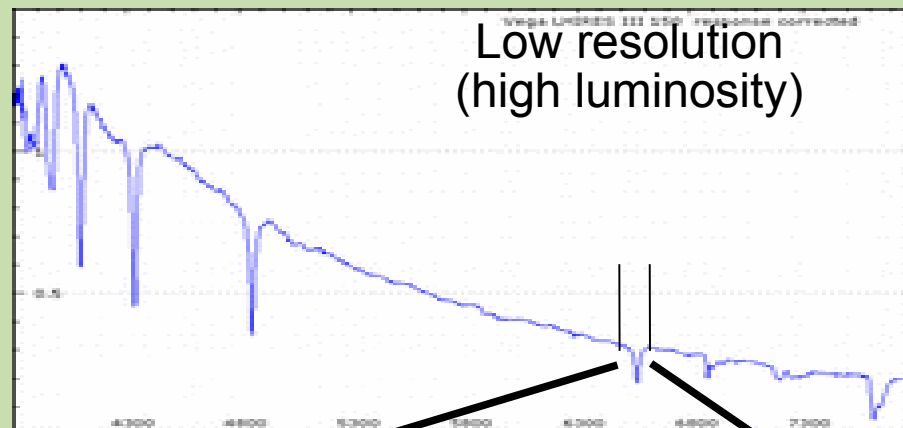


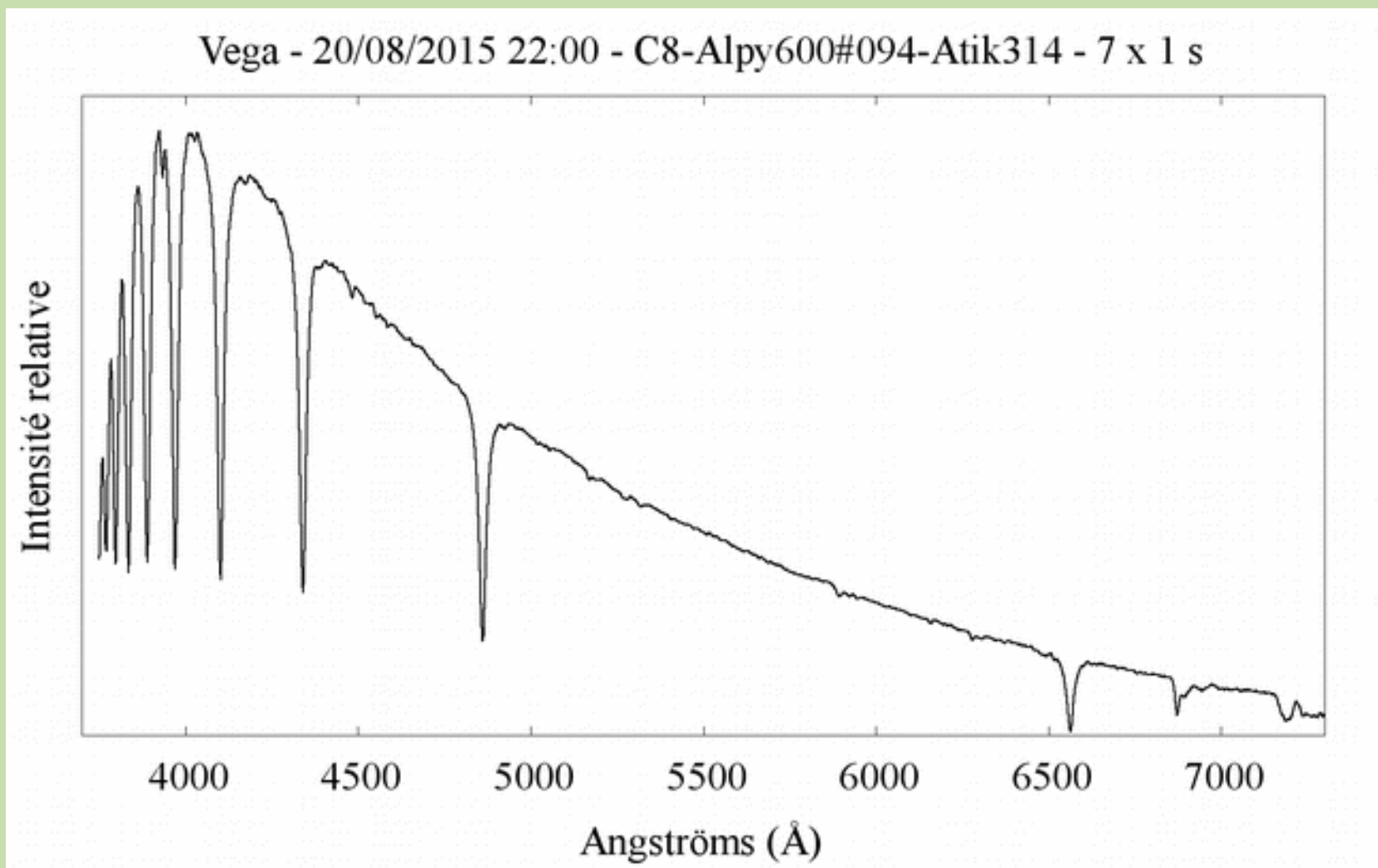
Some spectra

2D images

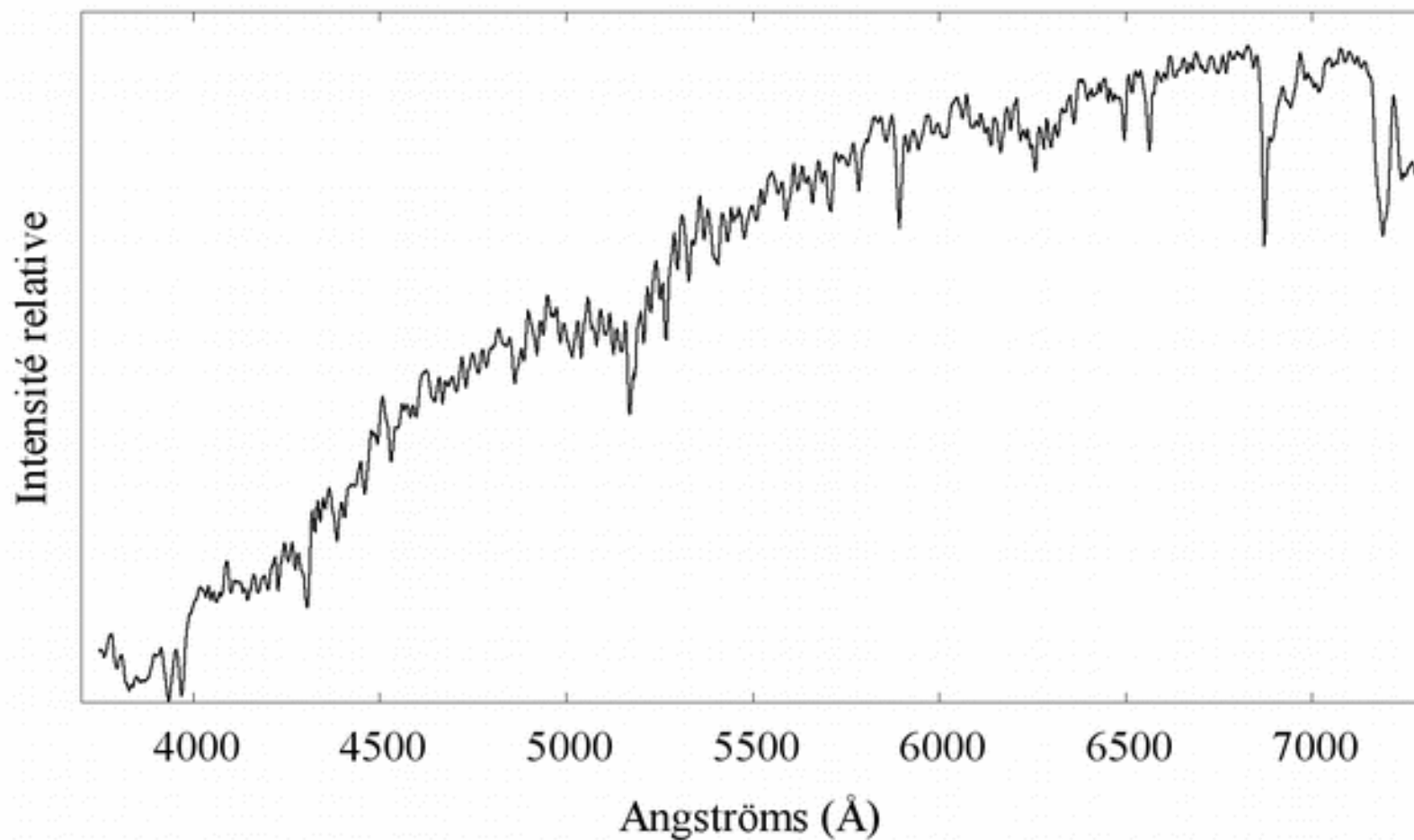


1D profile

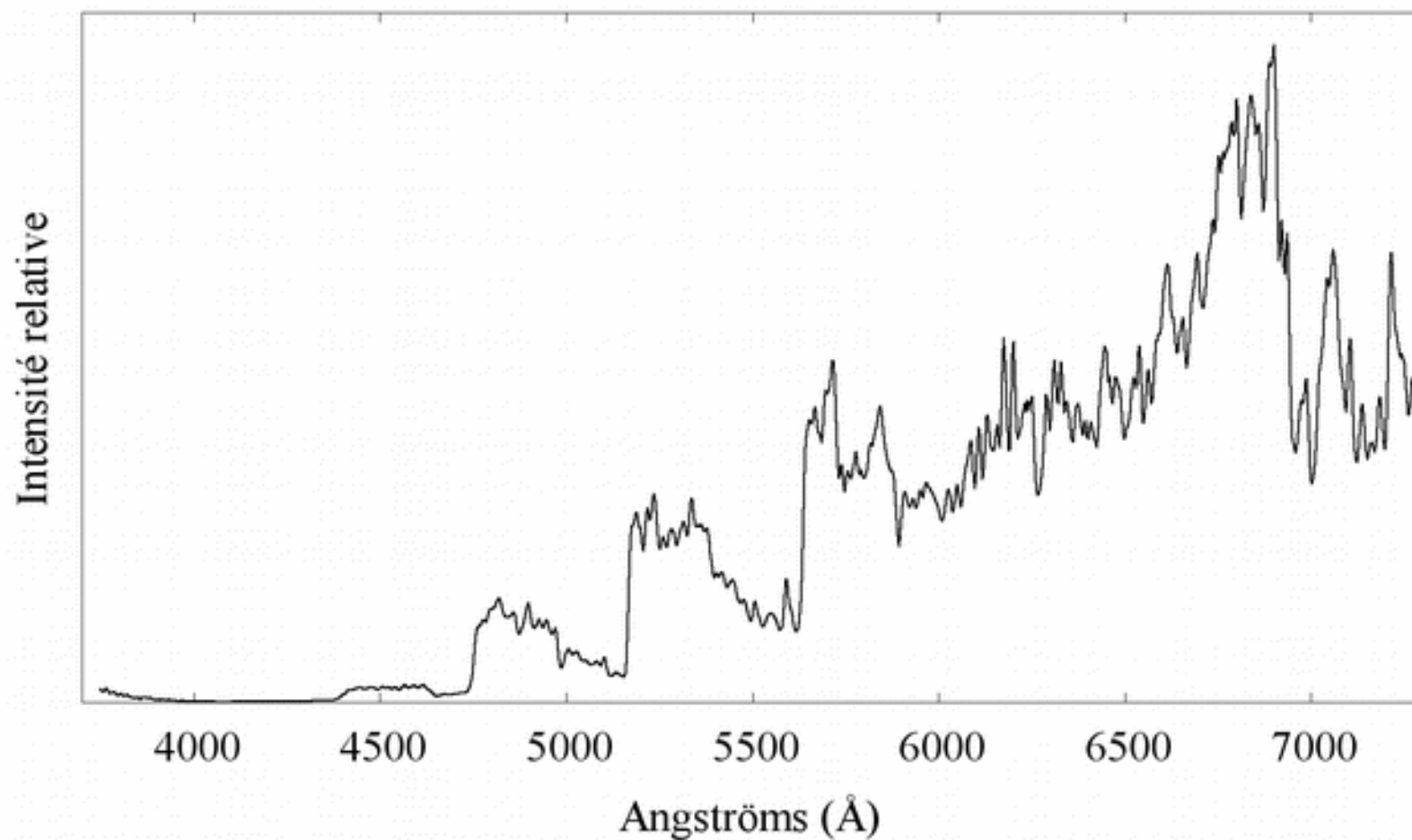




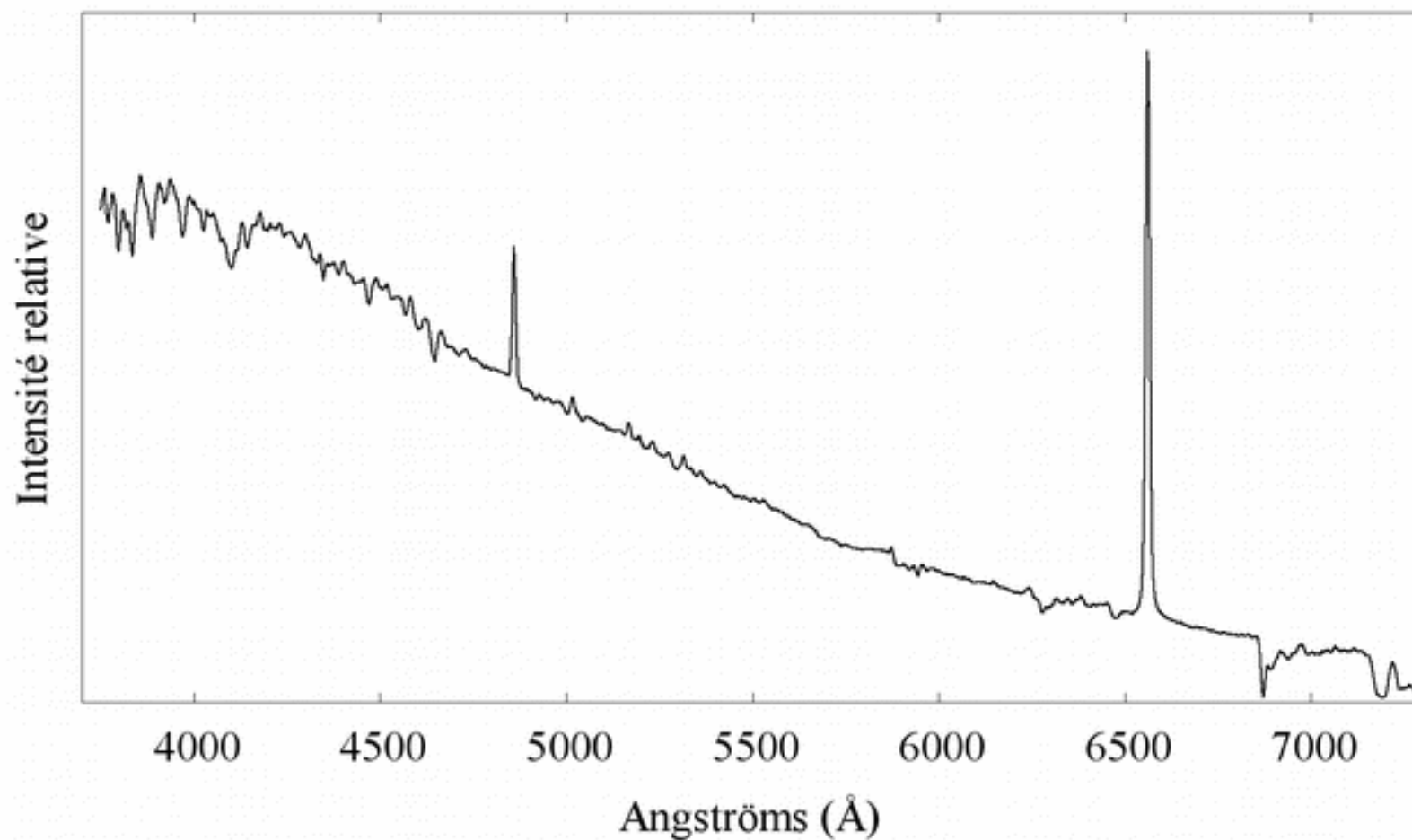
Arcturus - 20/08/2015 21:33 - C8-Alpy600#094-Atik314 - 7 x 1 s



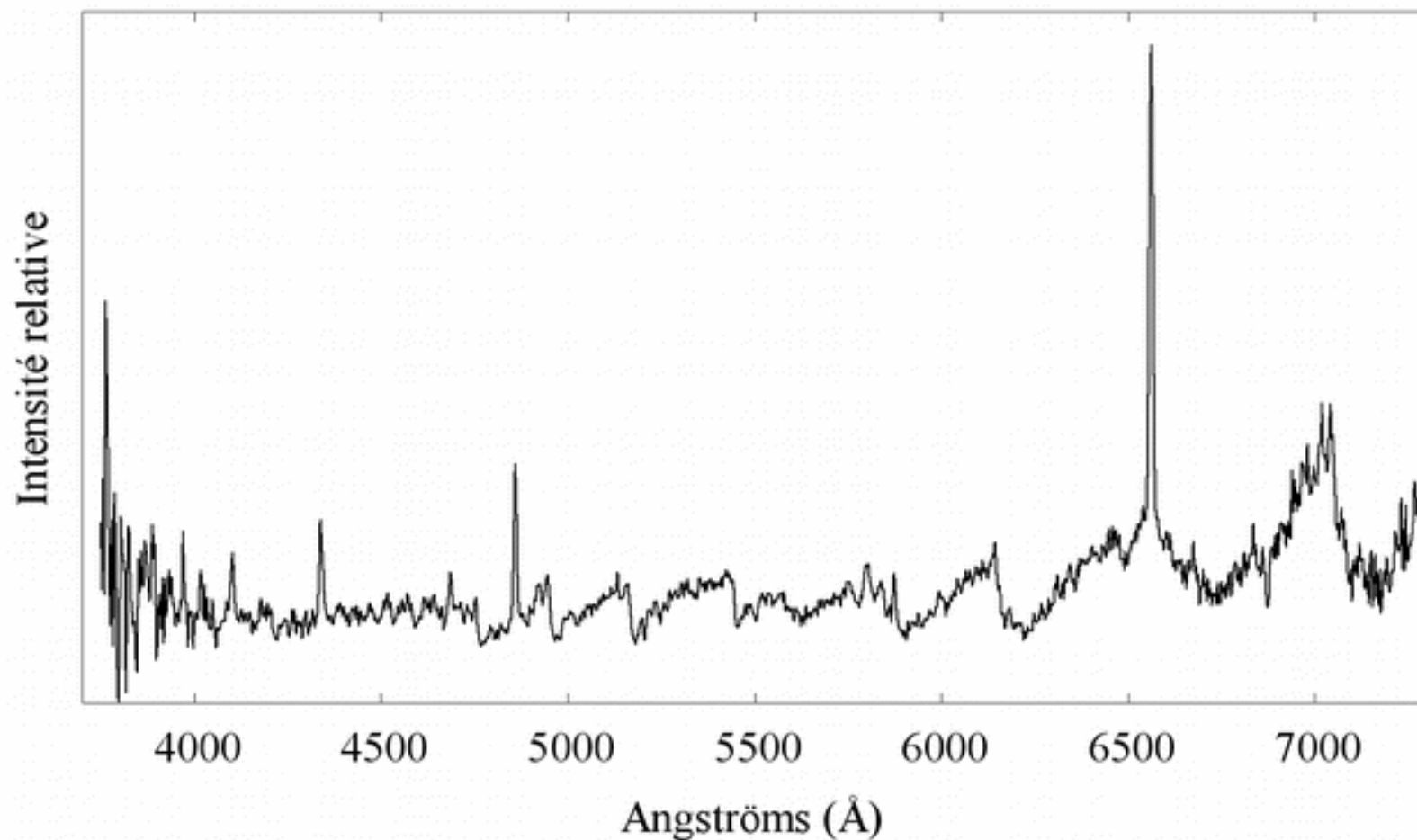
Y Cvn - 20/08/2015 21:47 - C8-Alpy600#094-Atik314 - 7 x 60 s



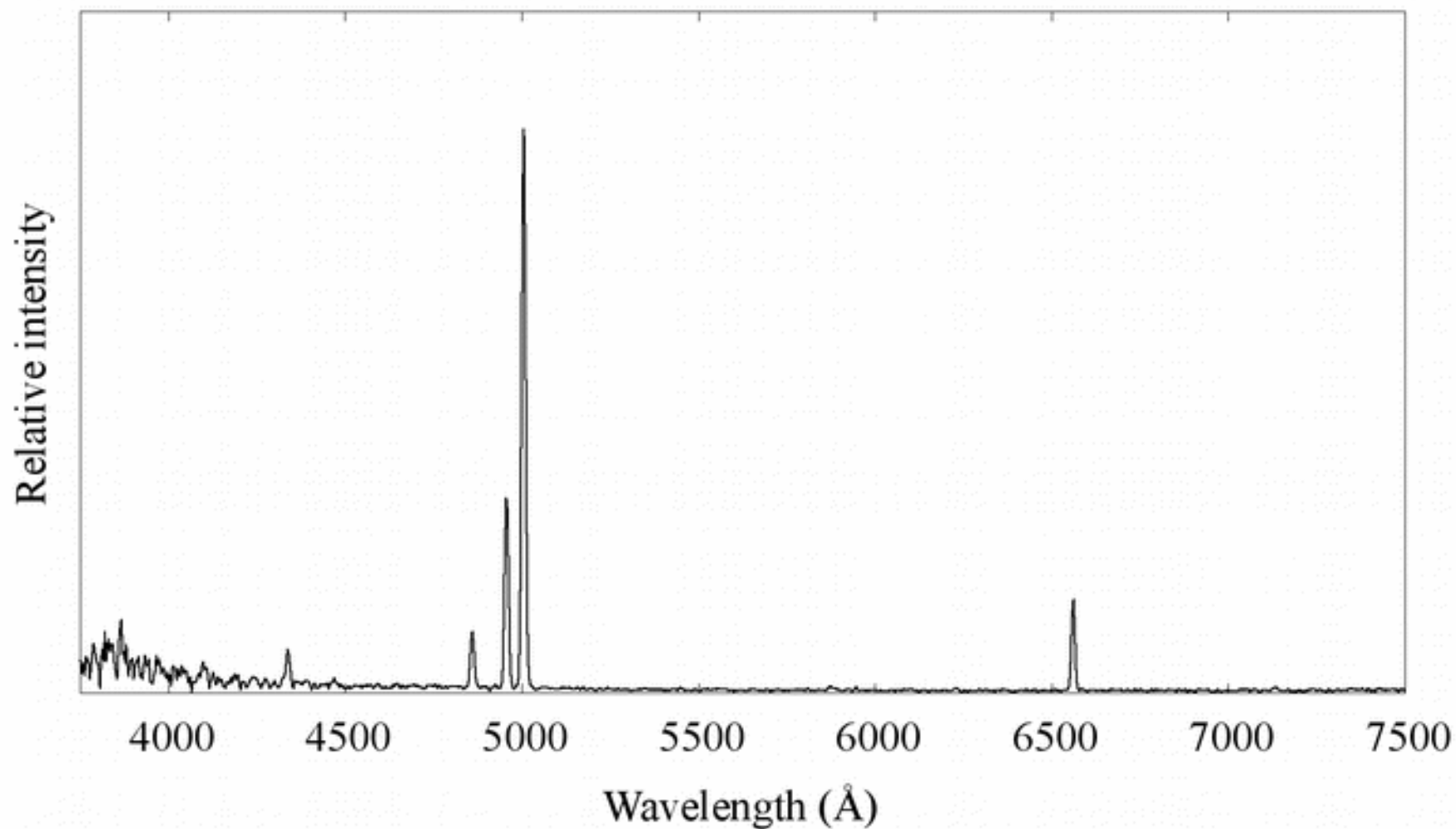
gam Cas - 20/08/2015 22:08 - C8-Alpy600#094-Atik314 - 9 x 5 s



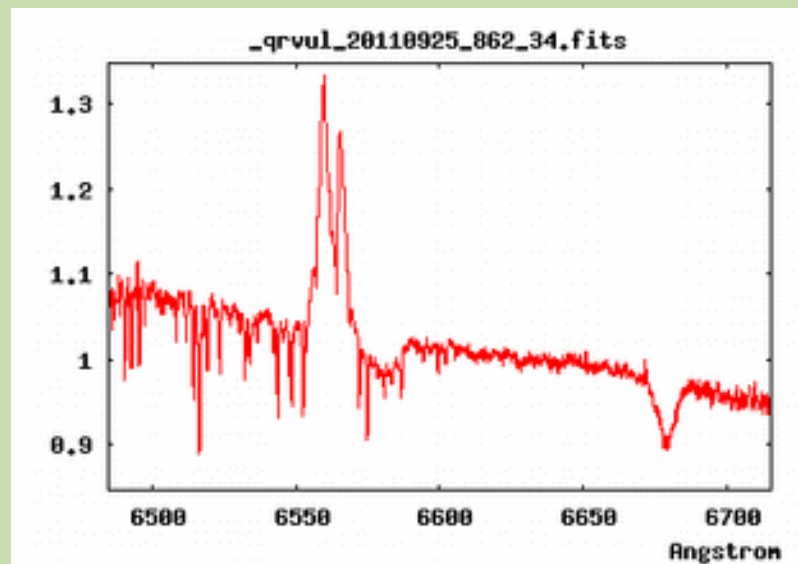
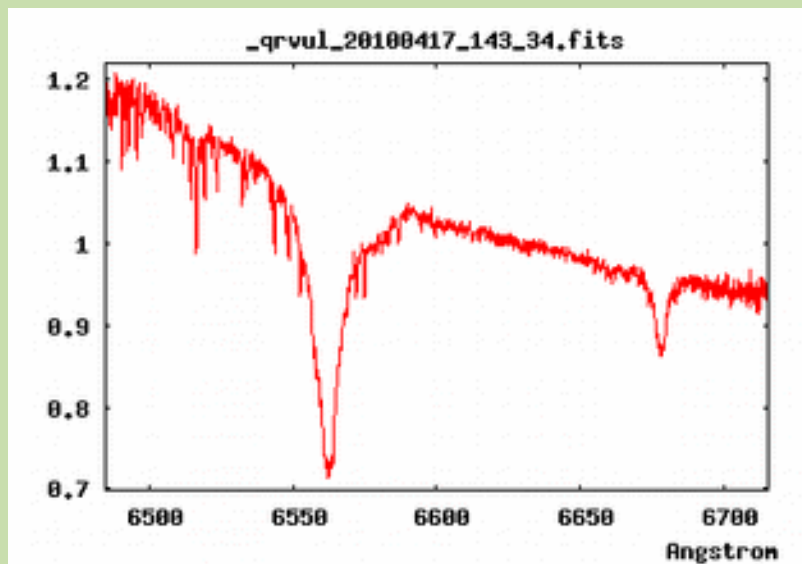
T Crb - 19/08/2015 22:41 - C8-Alpy600#094-Atik314 - 5 x 60 s



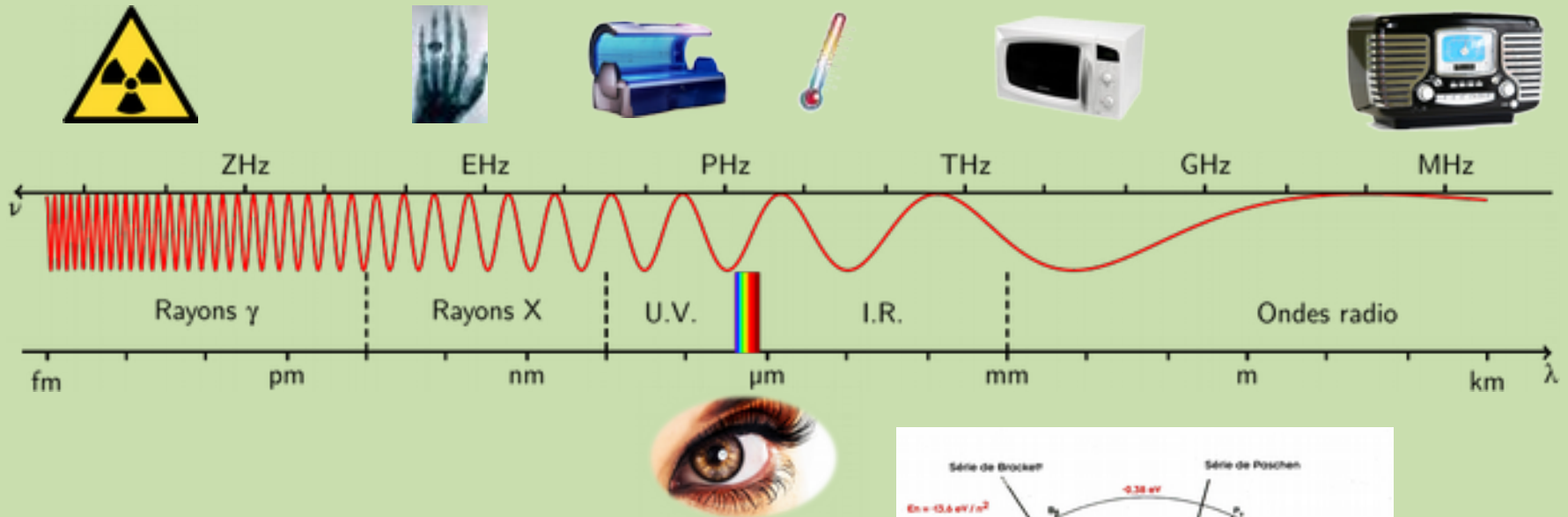
IC3568 - 2018-05-11 - 00:54:33 - Alpy600 NAT 2018



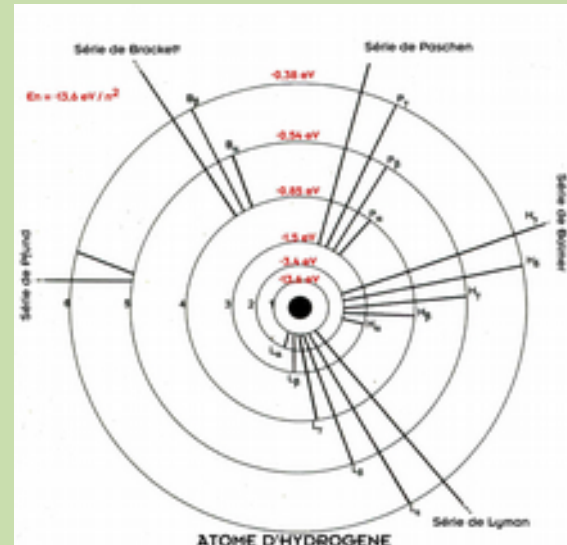
- Outburst !



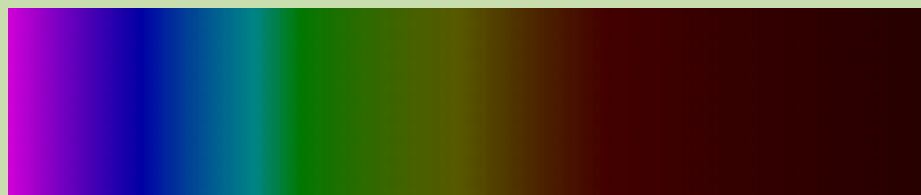
Light is a wave...



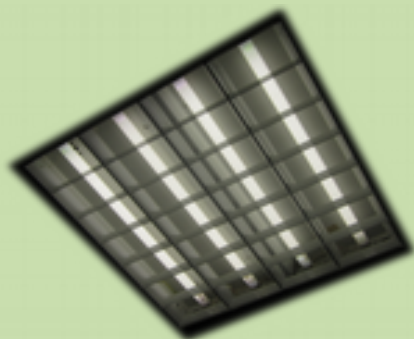
...and a
particle!



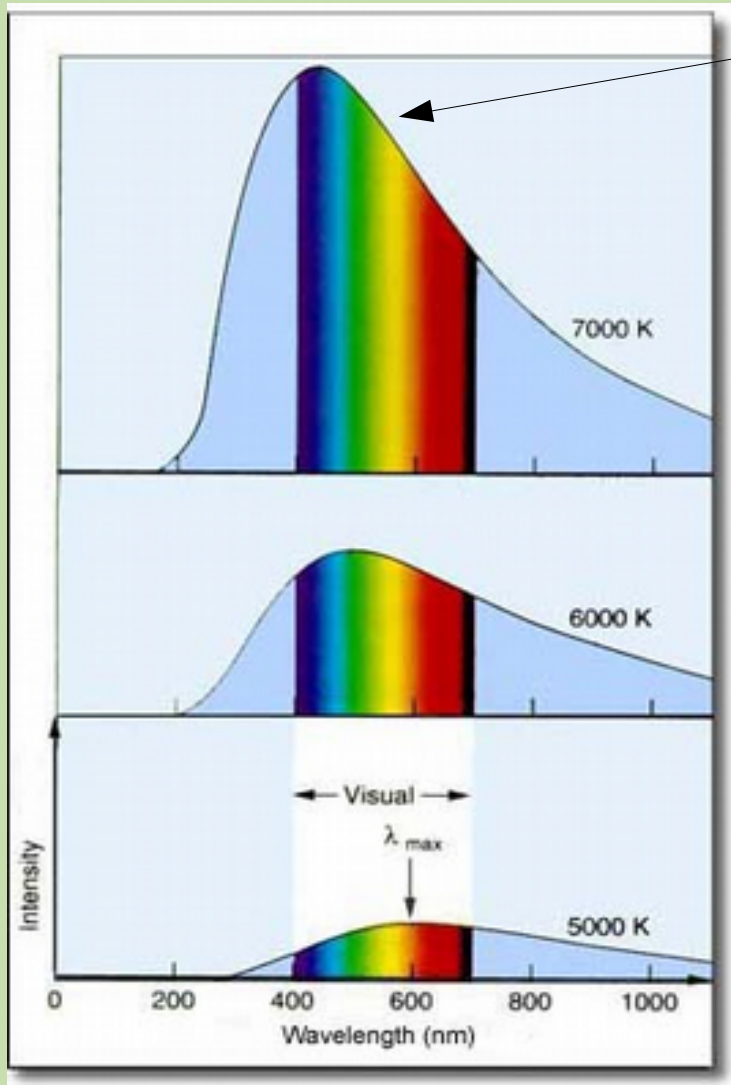
Making some light



- 1 – By heating a material
- 2 – By exciting atoms



Planck profile



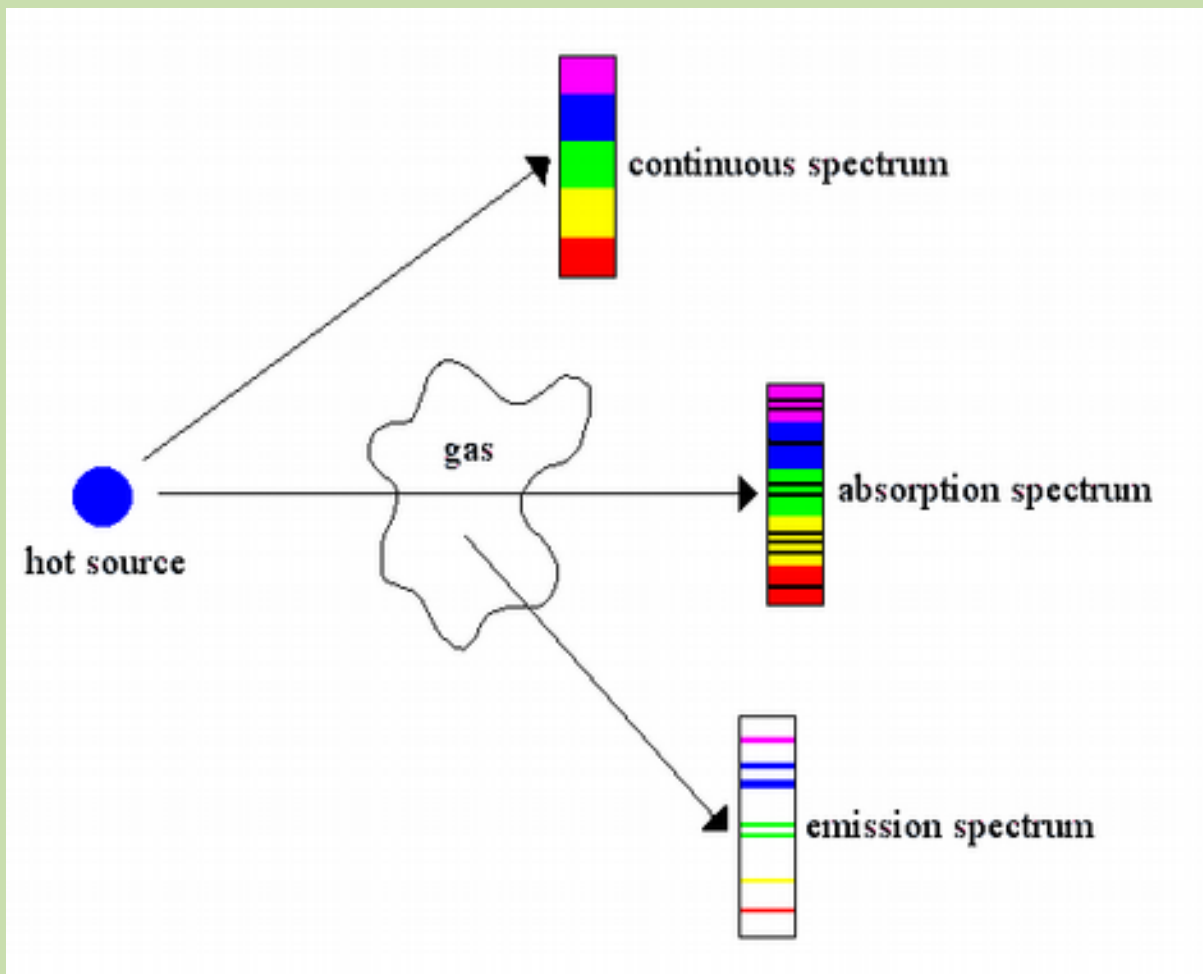
Visible domain
= 400-700nm (4000A-7000A)

➤ **Stefan's law:**
Intensity (under the curve)
= Constant * T^4

➤ **Wien's law:**
 λ_{max} * Temperature
= Constant (2900 $\mu\text{m.K}$)

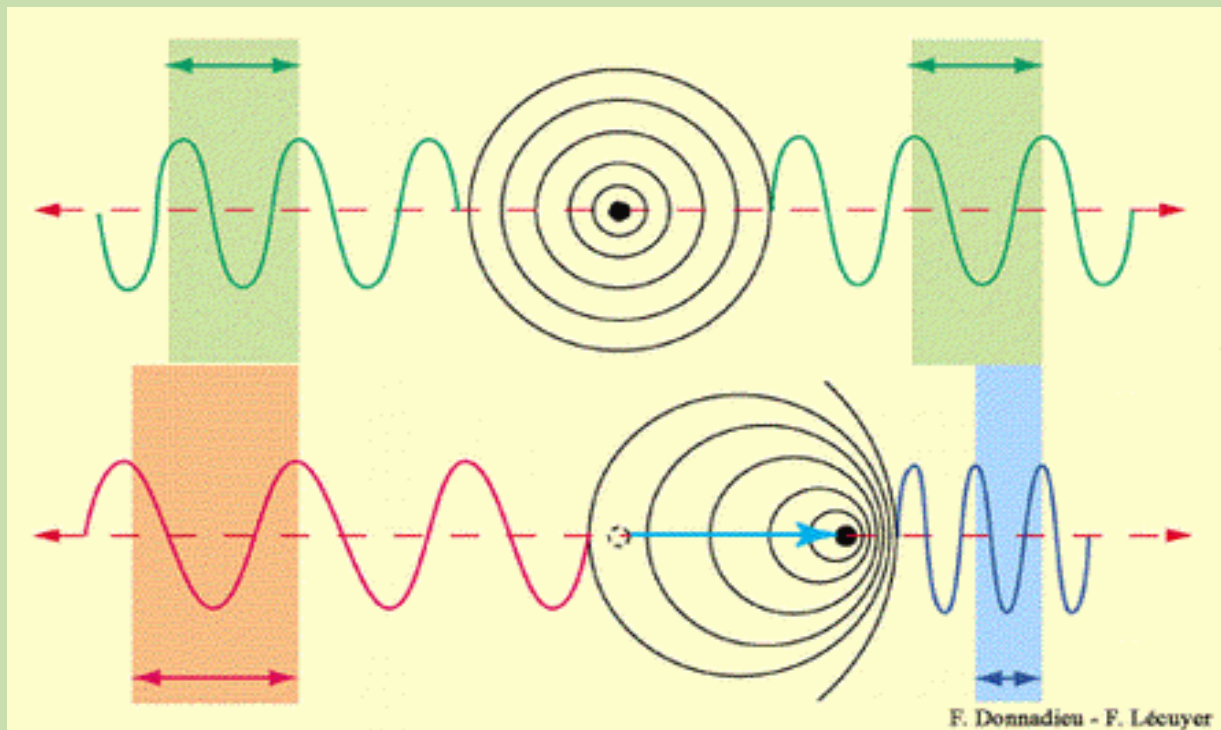
==> Temperature = Color !!!

Kirchhoff's laws



Source : <http://abyss.uoregon.edu/~js/ast122/lectures/lec05.html>

Doppler effect



Universe expansion
=
Red shift

$$\frac{(\Delta \lambda)}{\lambda} = \frac{v}{c}$$

The light coming from a star

- Is made in its core, by nuclear fusion
- Crosses all layers of the star
- Crosses discs, envelopes, if any
- Crosses the interstellar medium
- Can be shifted by Doppler effect
 - Atomic movement
 - Star rotation
 - Binaries rotations
 - Proper movement
 - ...
- Special cases : nebulae

What is in a spectrum ?

- The general profile
- Absorption lines
- Emission lines
- Line width (V_{ini})
- Line profiles
- Lines shifting
- Evolution over the time

**Doing spectroscopy is
switching
from contemplating
to understanding the
universe**

**Spectroscopy is a universal tool
It can make many different observations**

Different objects

- Stars (many types)
- Nebulae
- Galaxies
- Planets & Asteroids
- Exoplanets
- Interstellar dust

Some are bright... some are not !

Different programs

- Long term (BeSS, RR Lyrae...)
- Campaigns (del Sco, eps Aur...)
- Events (Nova Del 2013...)
- Random observations (B or Be?...)

Different goals

- Personal studies (discovery)
- Education & training
- Science

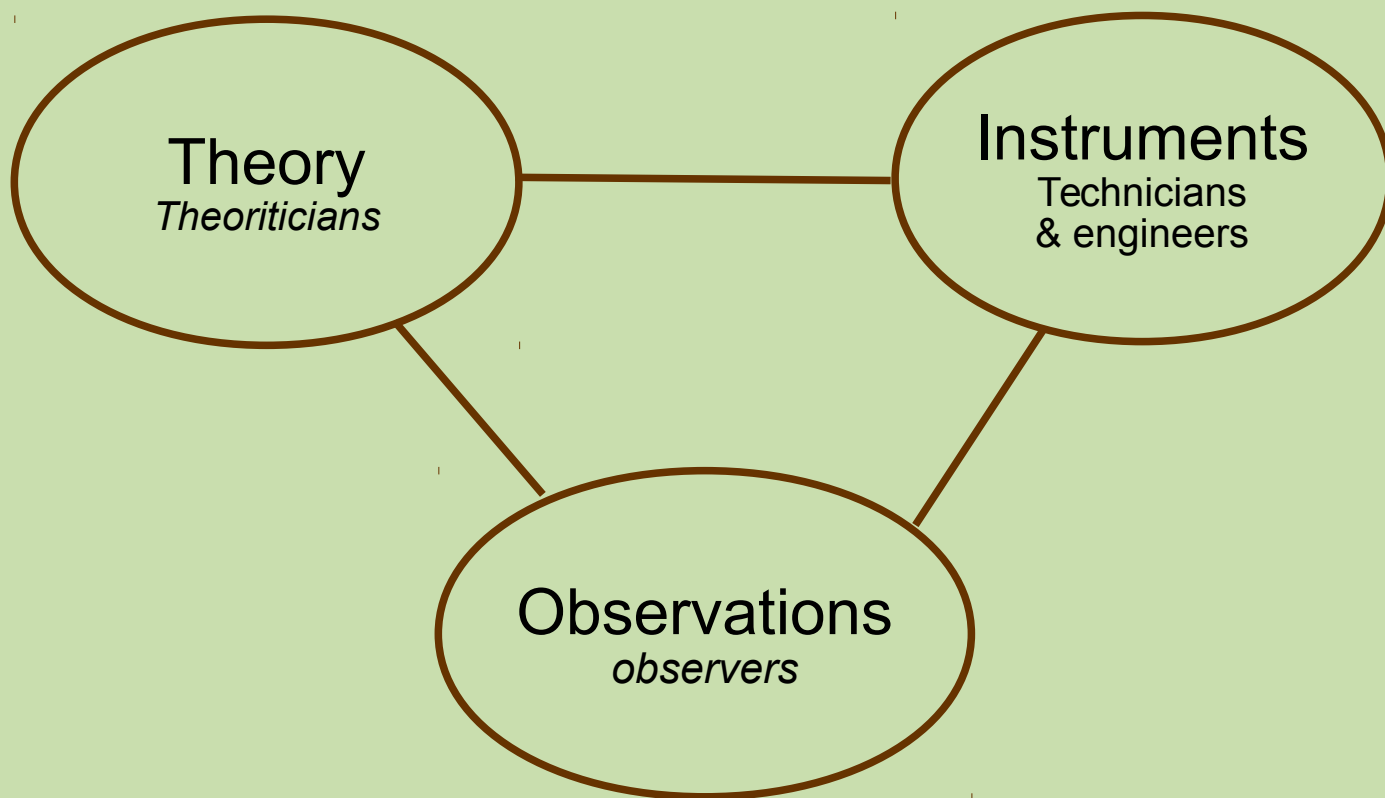
**When we observe all together,
we become a new kind of instrument !**

Amateurs can do observations
than pros cannot (anymore)

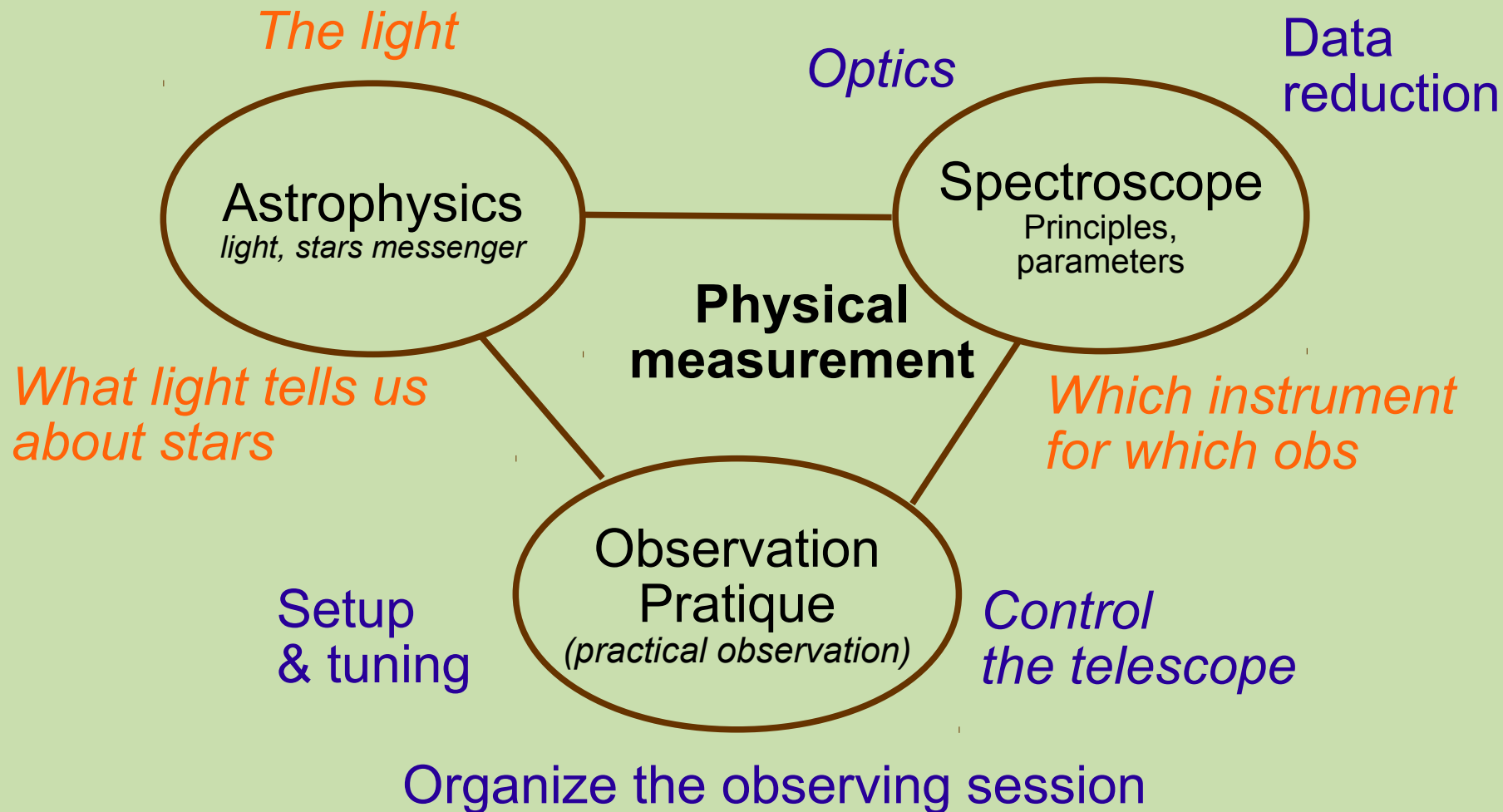
If you want to go fast, walk alone
But if you want to go far, walk together

Ratan Tata

Astrophysics triptich



Spectro : a *full* astronomy



Which observer are you?

What is your project ?



Available now !

EDP Sciences
260 pages
ISBN 978-2-7598-2026-9



Merci !

*Vous ne verrez
plus les étoiles
comme avant !*

Shelyak Instruments

Tél.: 04.76.41.36.81

<http://www.shelyak.com>

Email:

francois.cochard@shelyak.com