

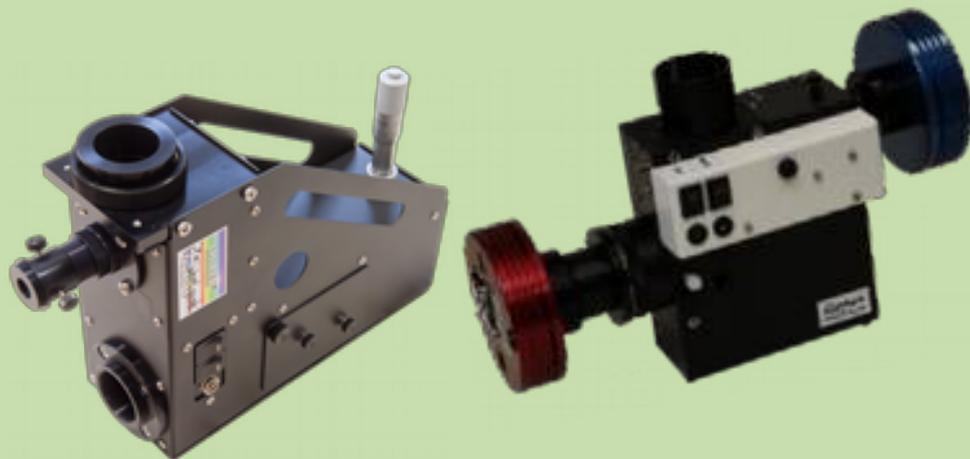


# Basics of spectroscopy

*Sacramento Mountains Spectro Workshop - 2*  
*February 22<sup>nd</sup> - 24<sup>th</sup>, 2019*

**François Cochard**  
francois.cochard@shelyak.com

**Lhires III & LISA**



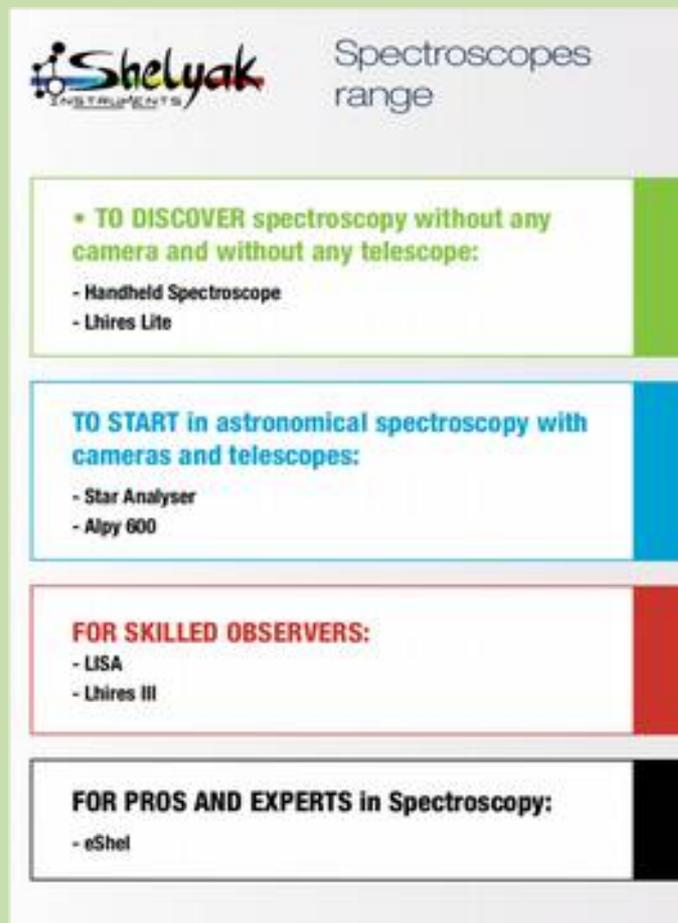
**Eshel**



**Alpy 600 & StarAnalyser**

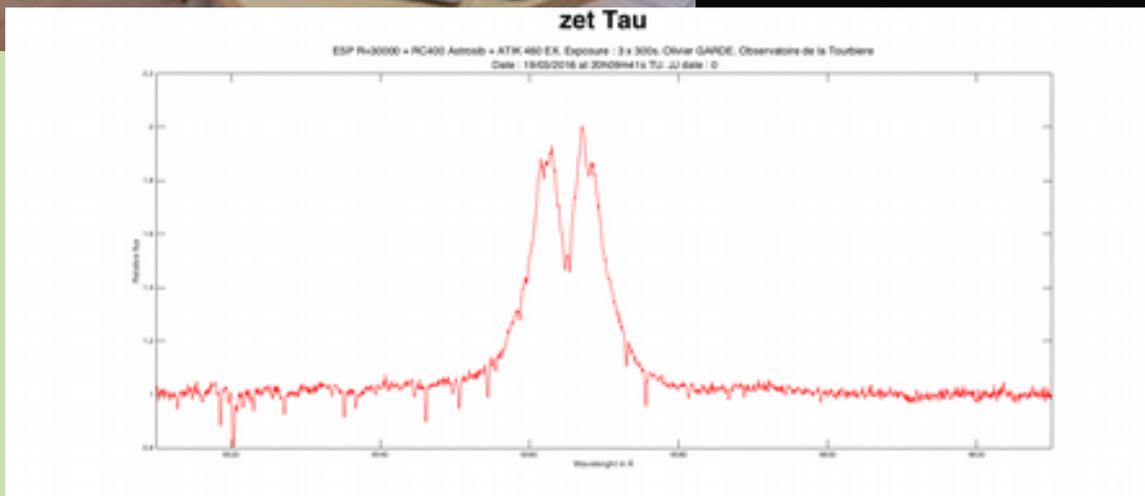
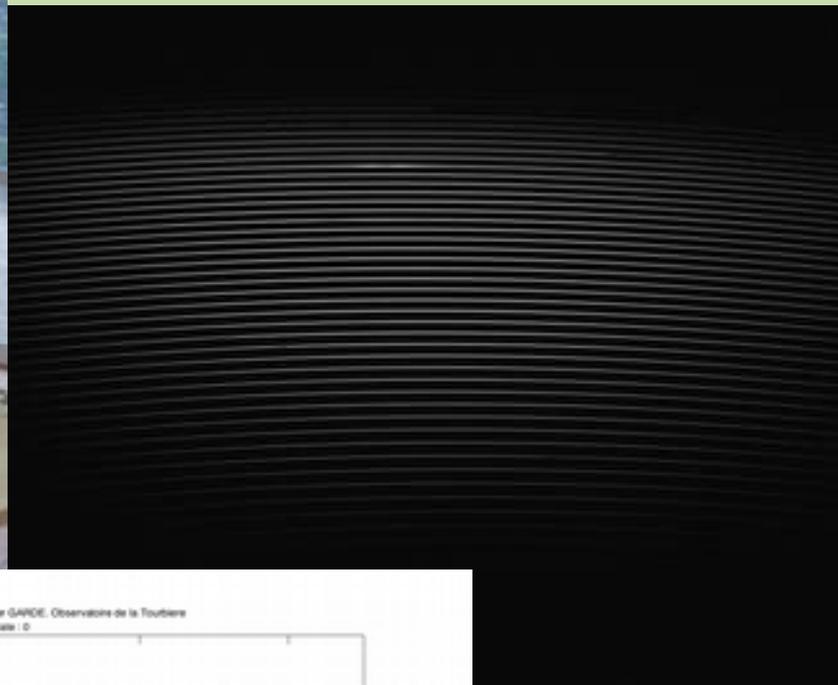
**Handeled spectro & Lhires Lite**

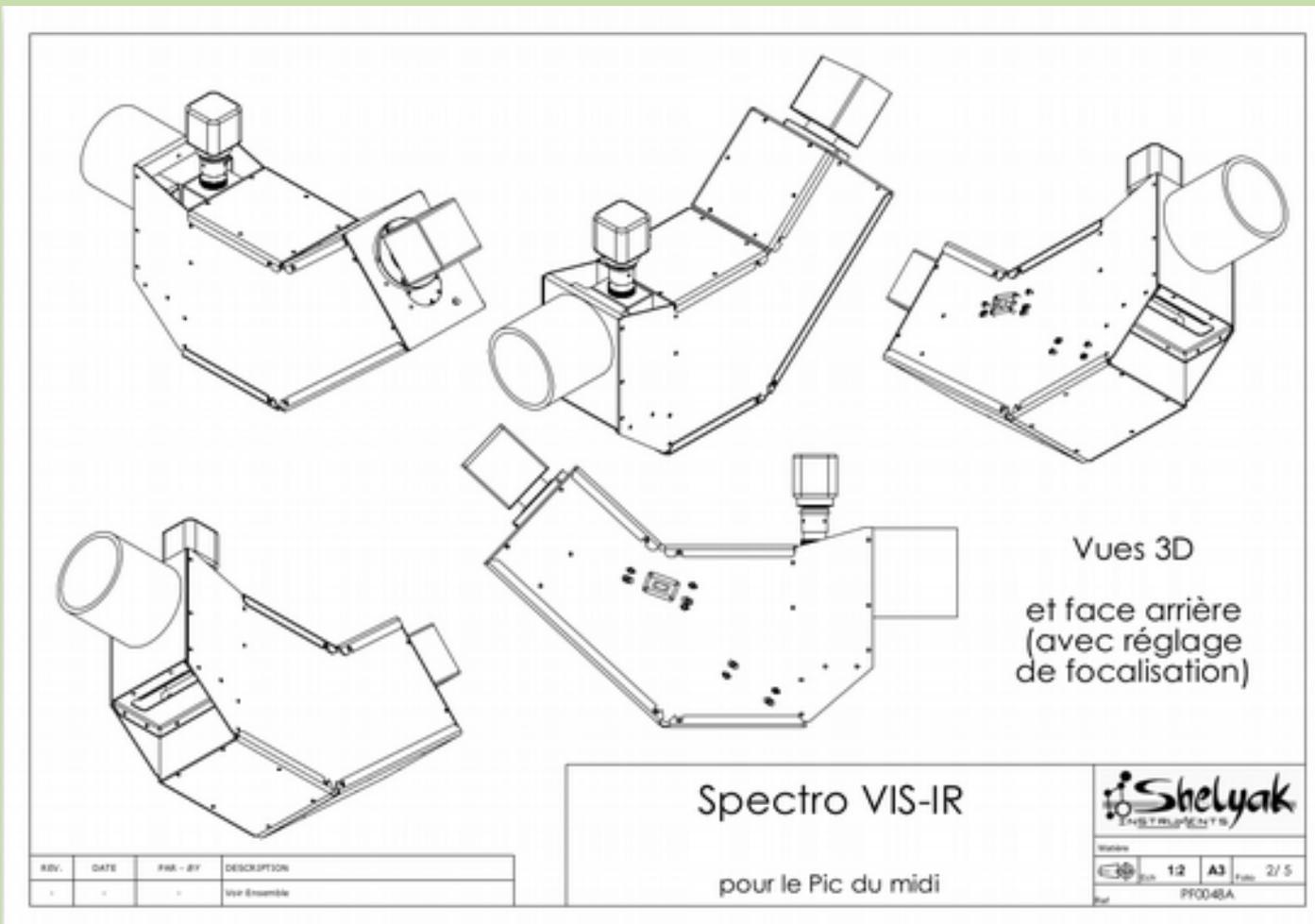




**Shelyak** Spectroscopes  
INSTRUMENTS range

- 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







# Being in contact with Shelyak



SPECTROSCOPY - PRODUCTS - RESSELLERS CONTACT

Astronomical spectroscopy for research, industry, education and leisure



Stars won't look the same

Astronomical spectroscope 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 [LIBRES LIBE](#) discover the spectroscopy without camera and without telescope.

#### TO START

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

#### SKILLED OBSERVERS

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

#### 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](http://www.shelyak.com)



# Basics of spectroscopy

*Sacramento Mountains Spectro Workshop - 2*  
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# Many ways to do Astronomy

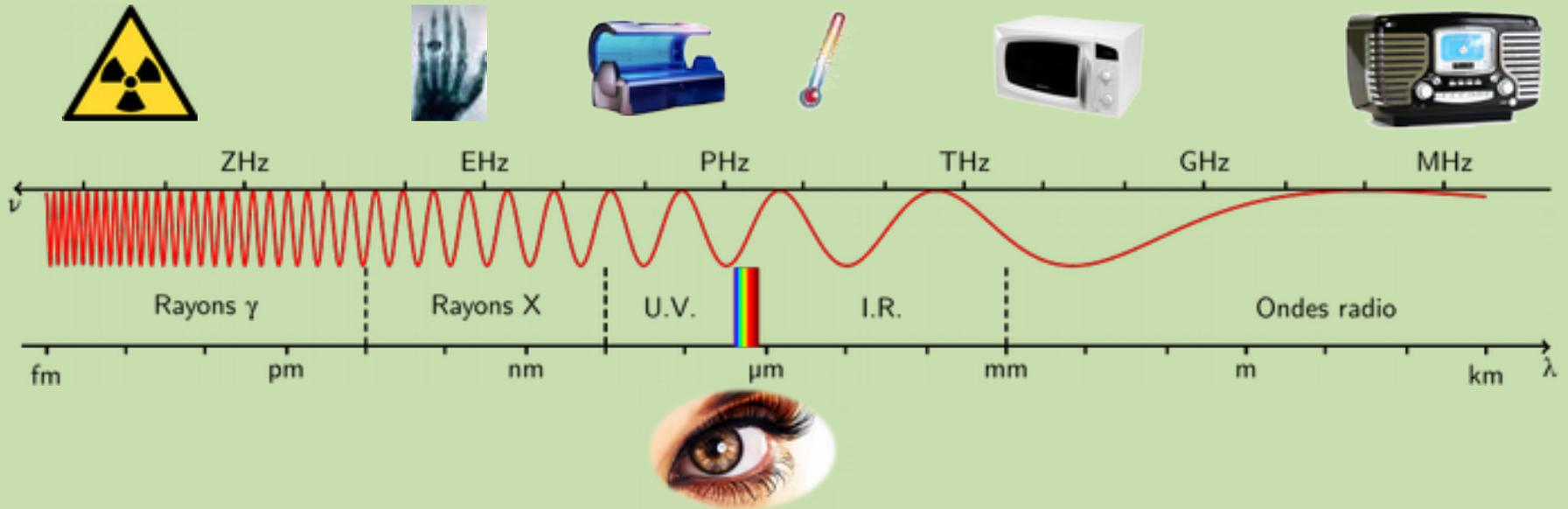
	Contemplate	Measure
<b>Visual</b>	Visual obs.	Variables stars, astrometry
<b>Imaging</b>	Nice pictures	Photometry, astrometry, planetary imaging
<b>Spectroscopy</b>	-	Physical parameters, Chemical composition, Radial velocities
<b>Polarimetry</b>	-	Polarisation (magn. field, diffusion, reflexions)

} Informations not accessible to human eye

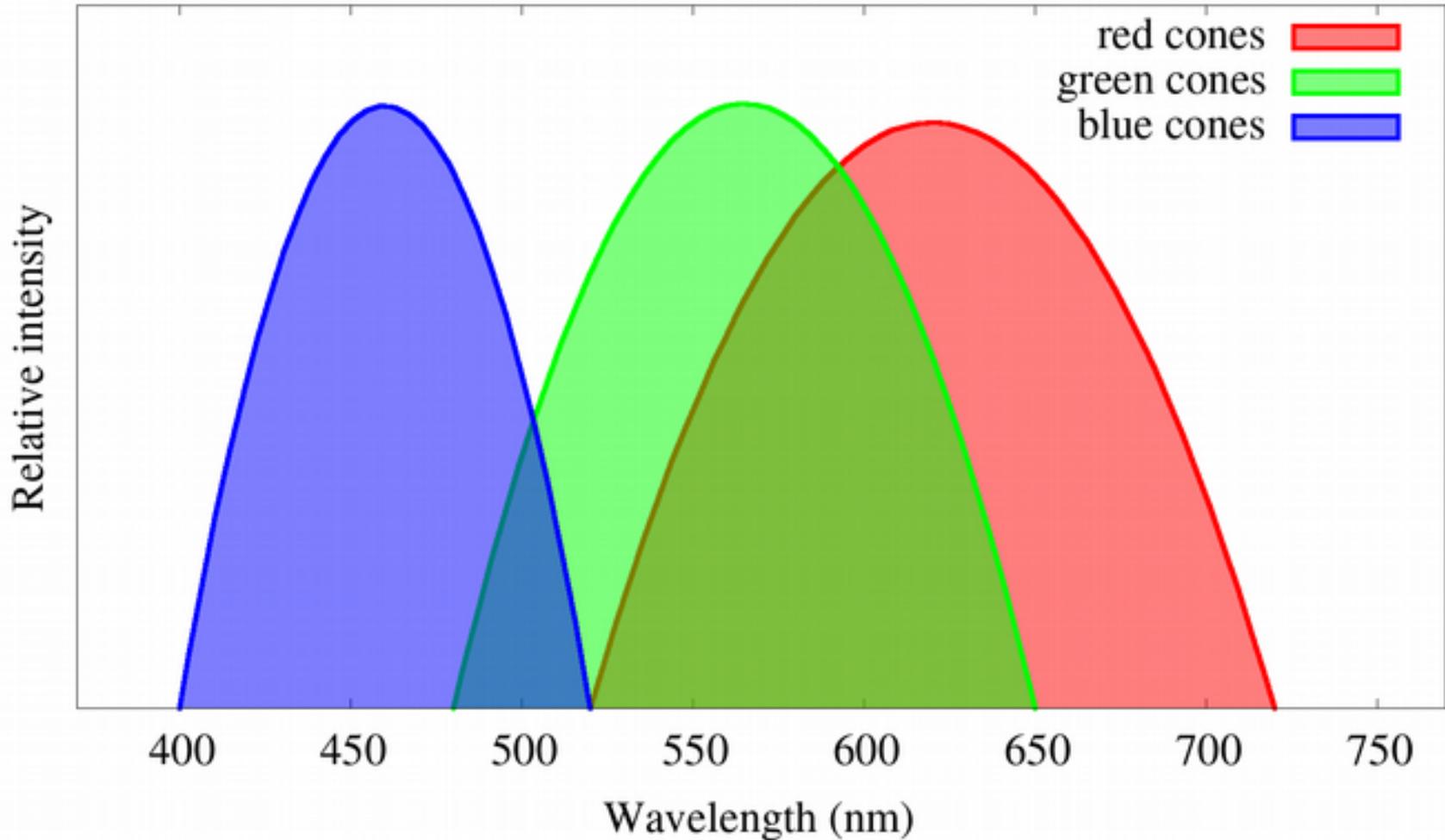
# Spectroscopy

- 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.

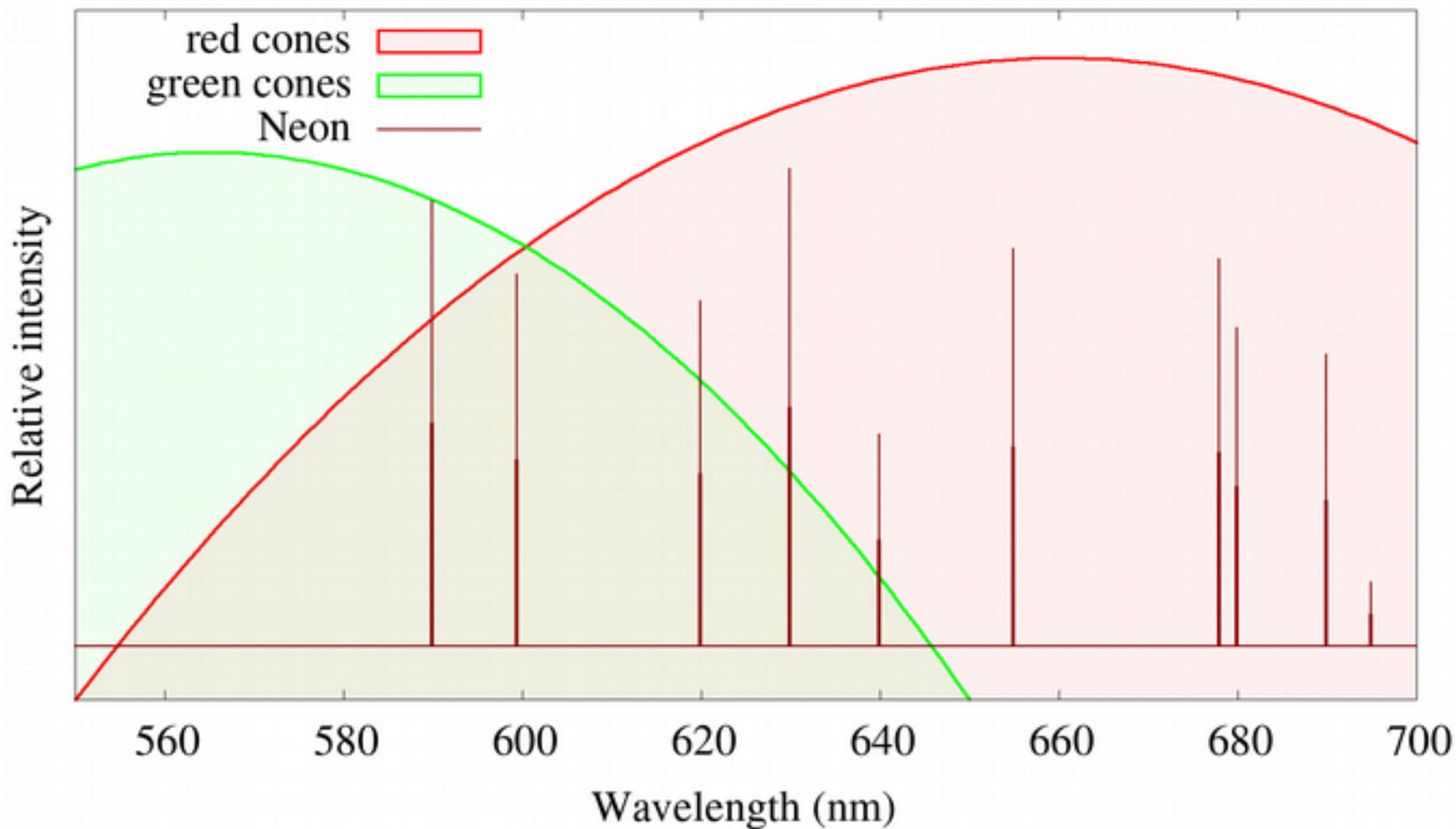
# Light is a wave...



# Eye perception

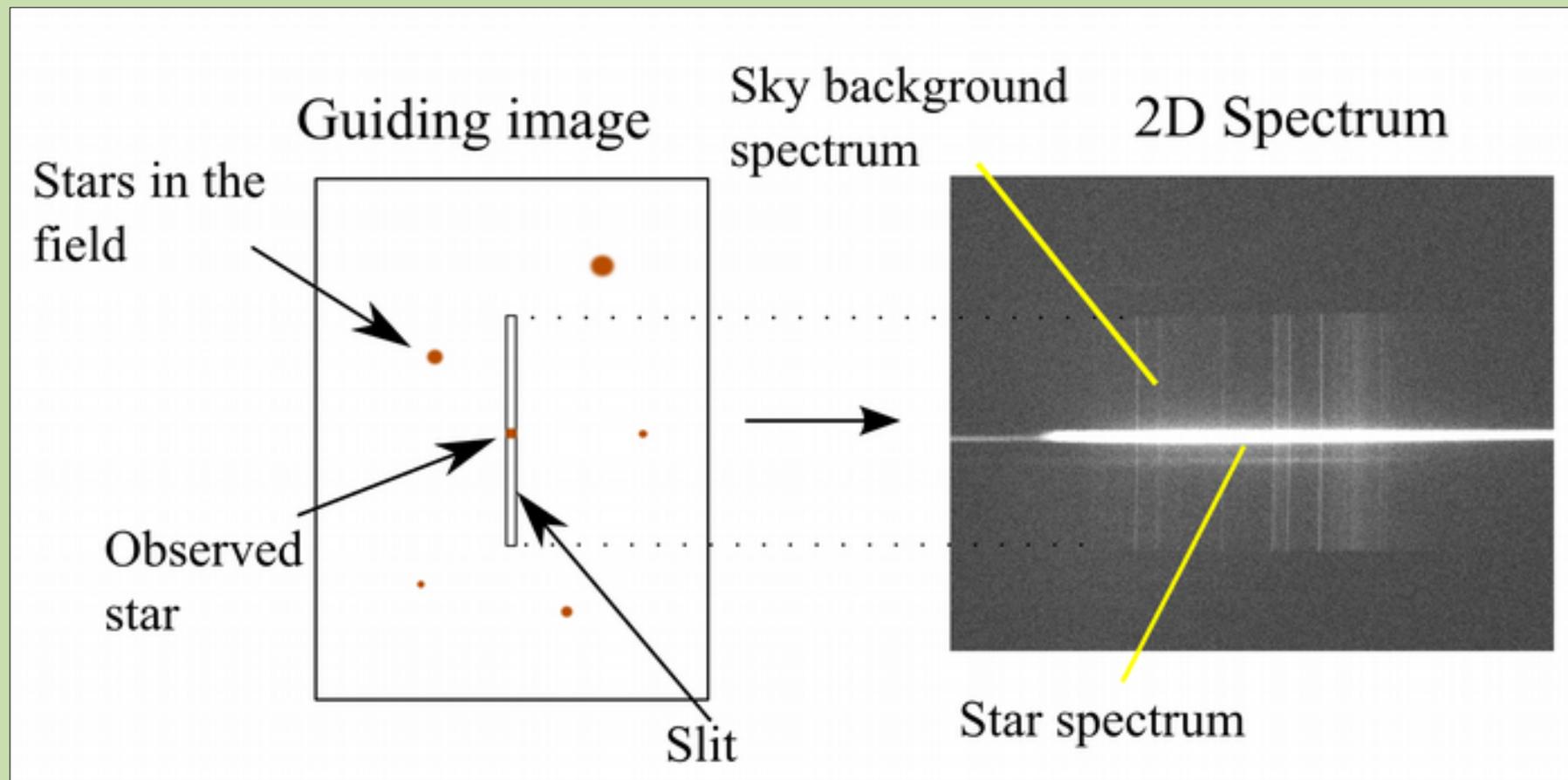


# Perception de l'œil



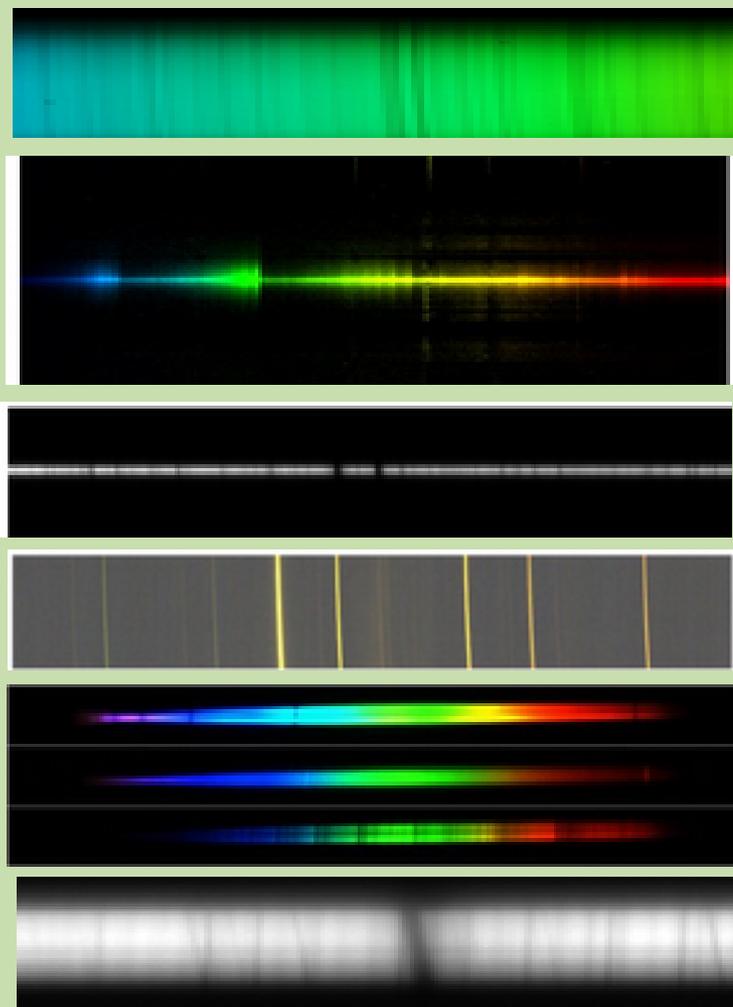
# The instrument



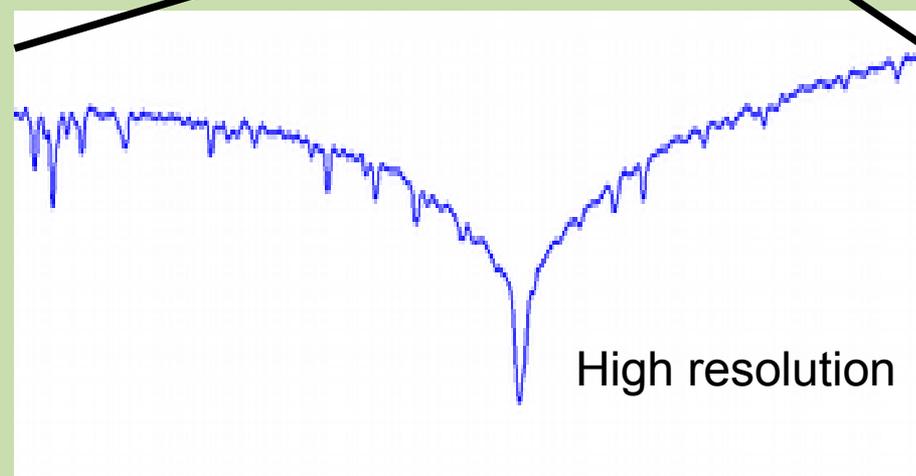
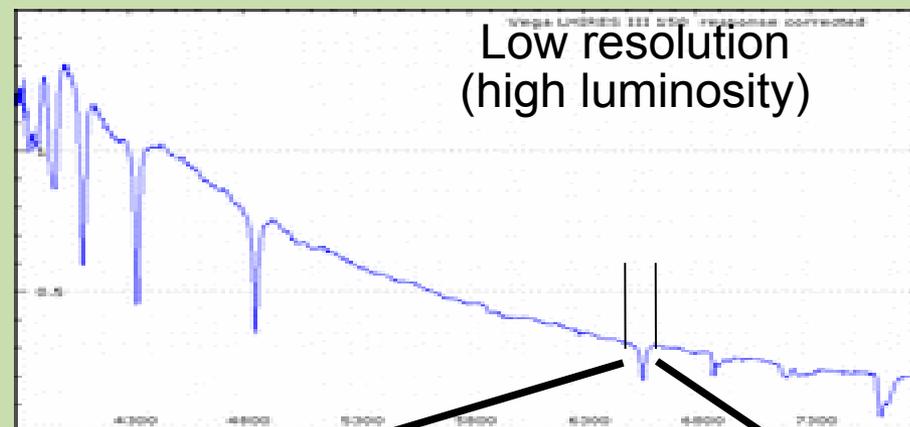


# Some spectra

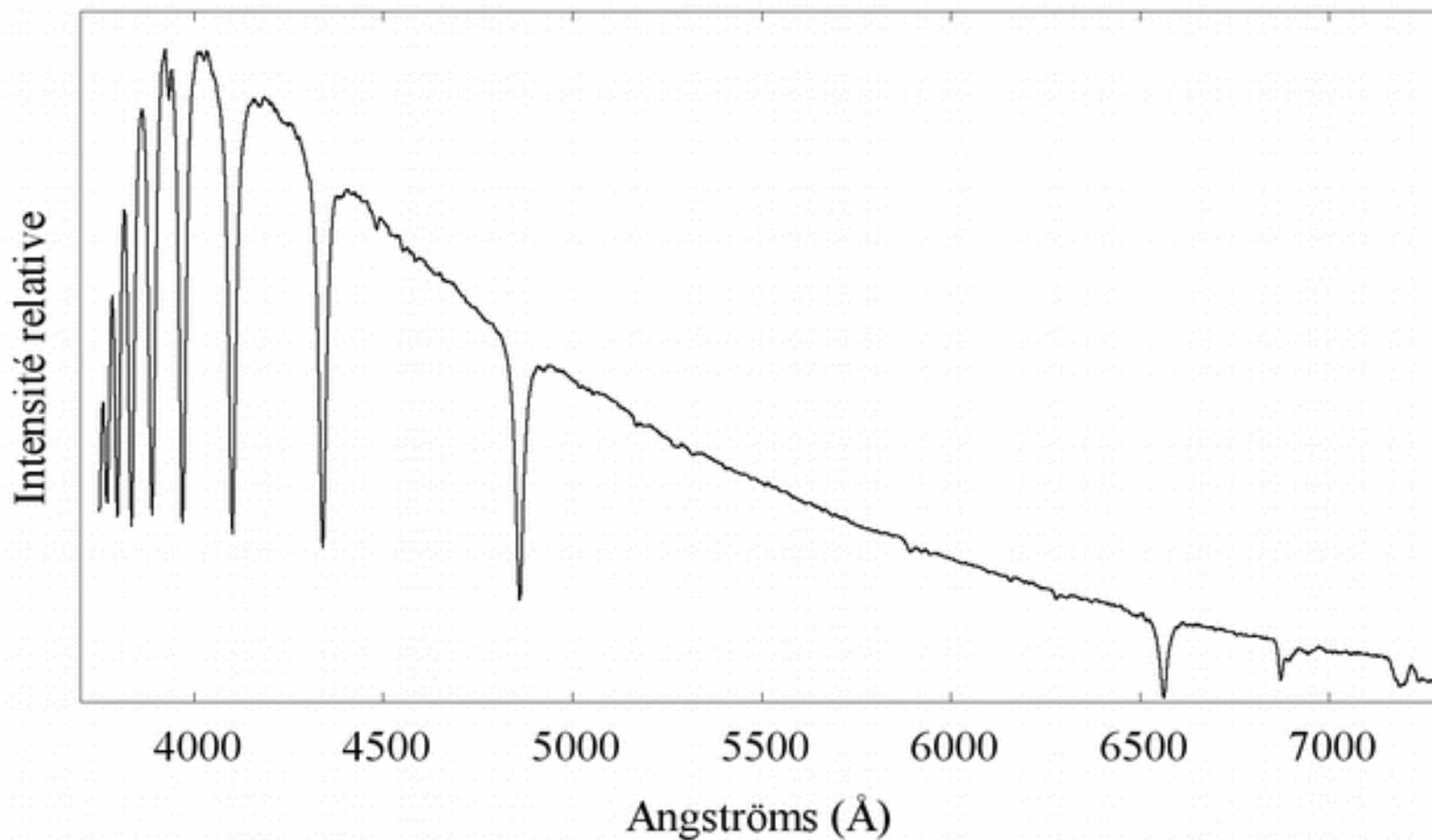
2D images



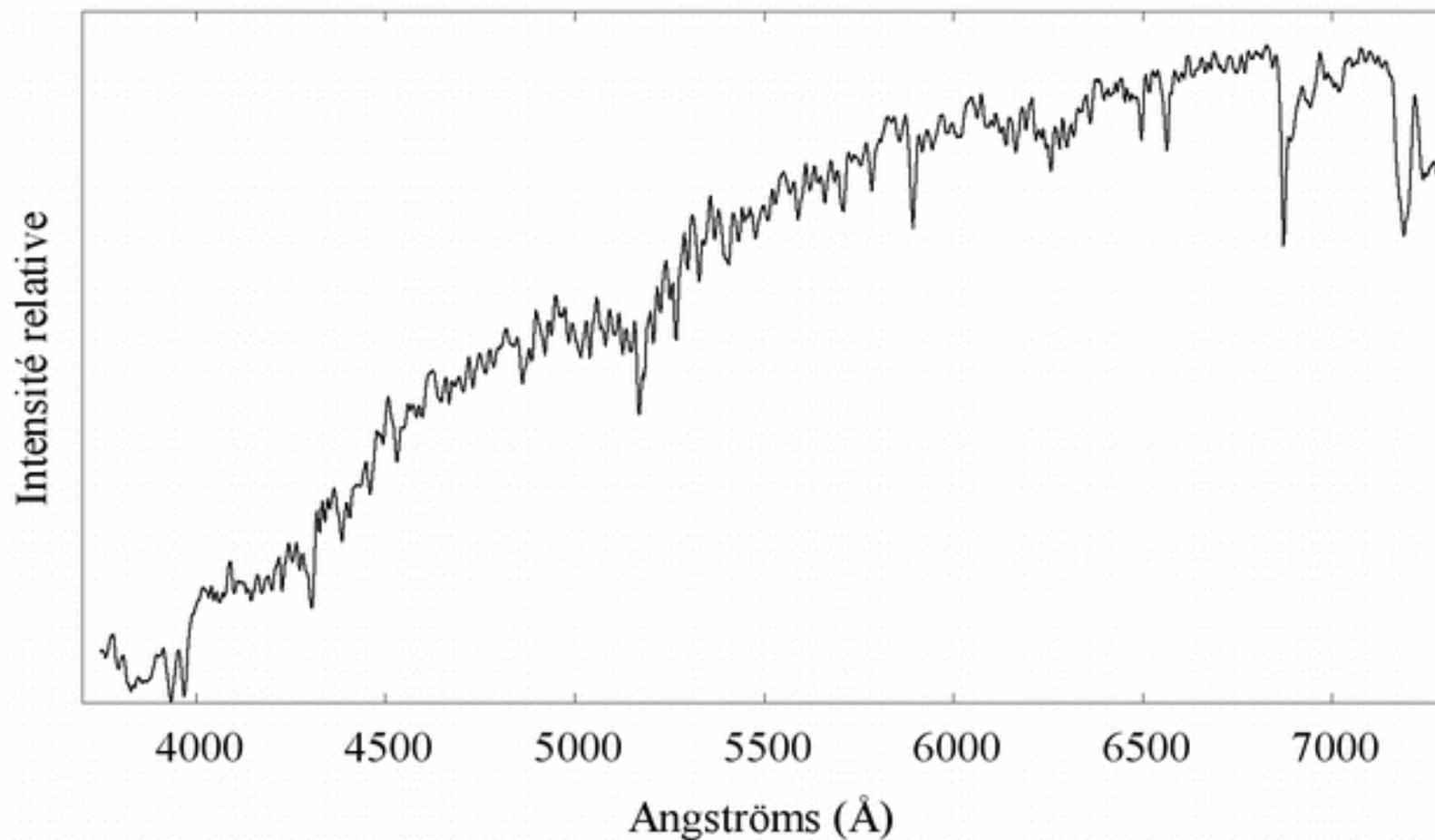
1D profile



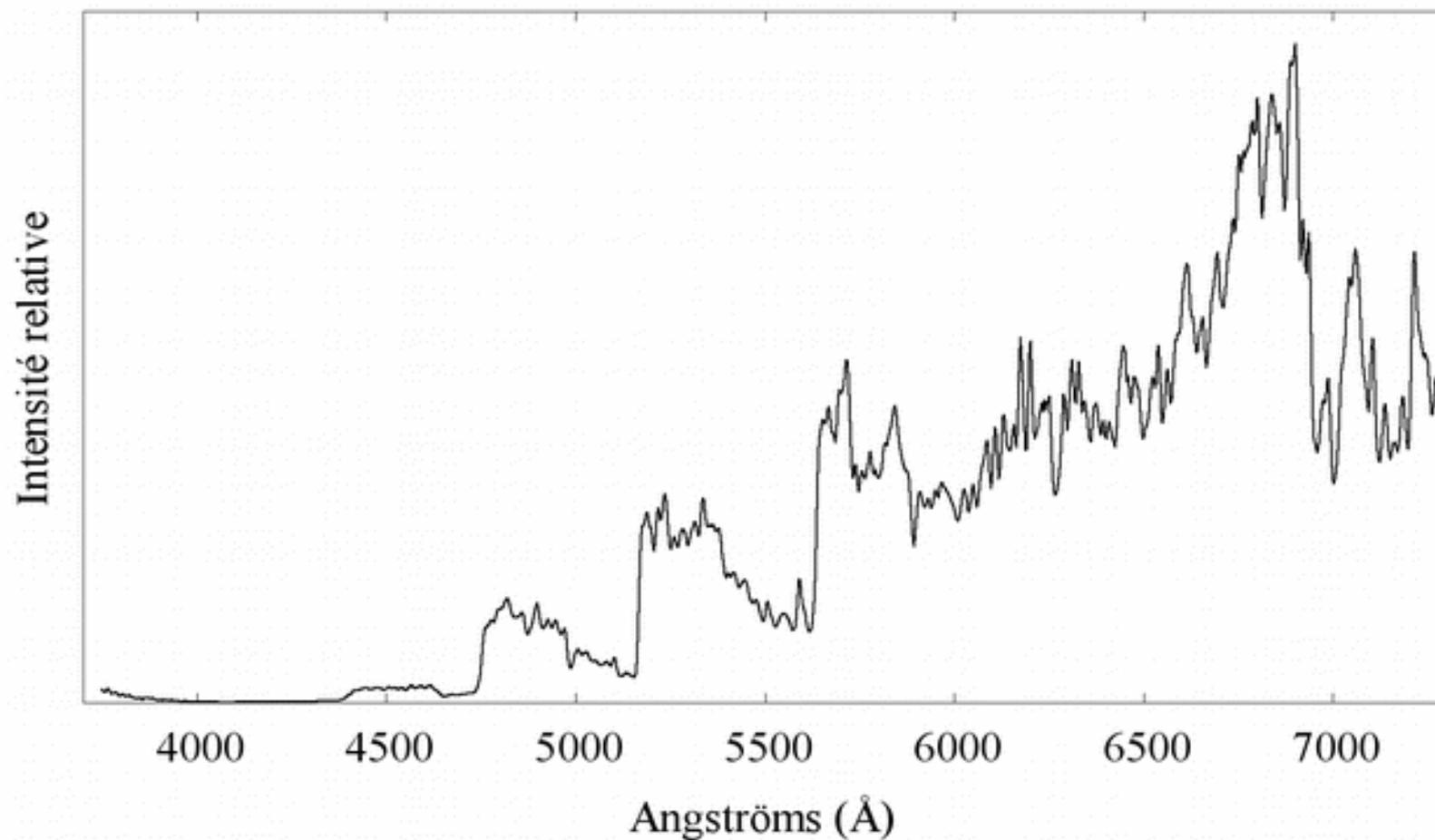
Vega - 20/08/2015 22:00 - C8-Alpy600#094-Atik314 - 7 x 1 s



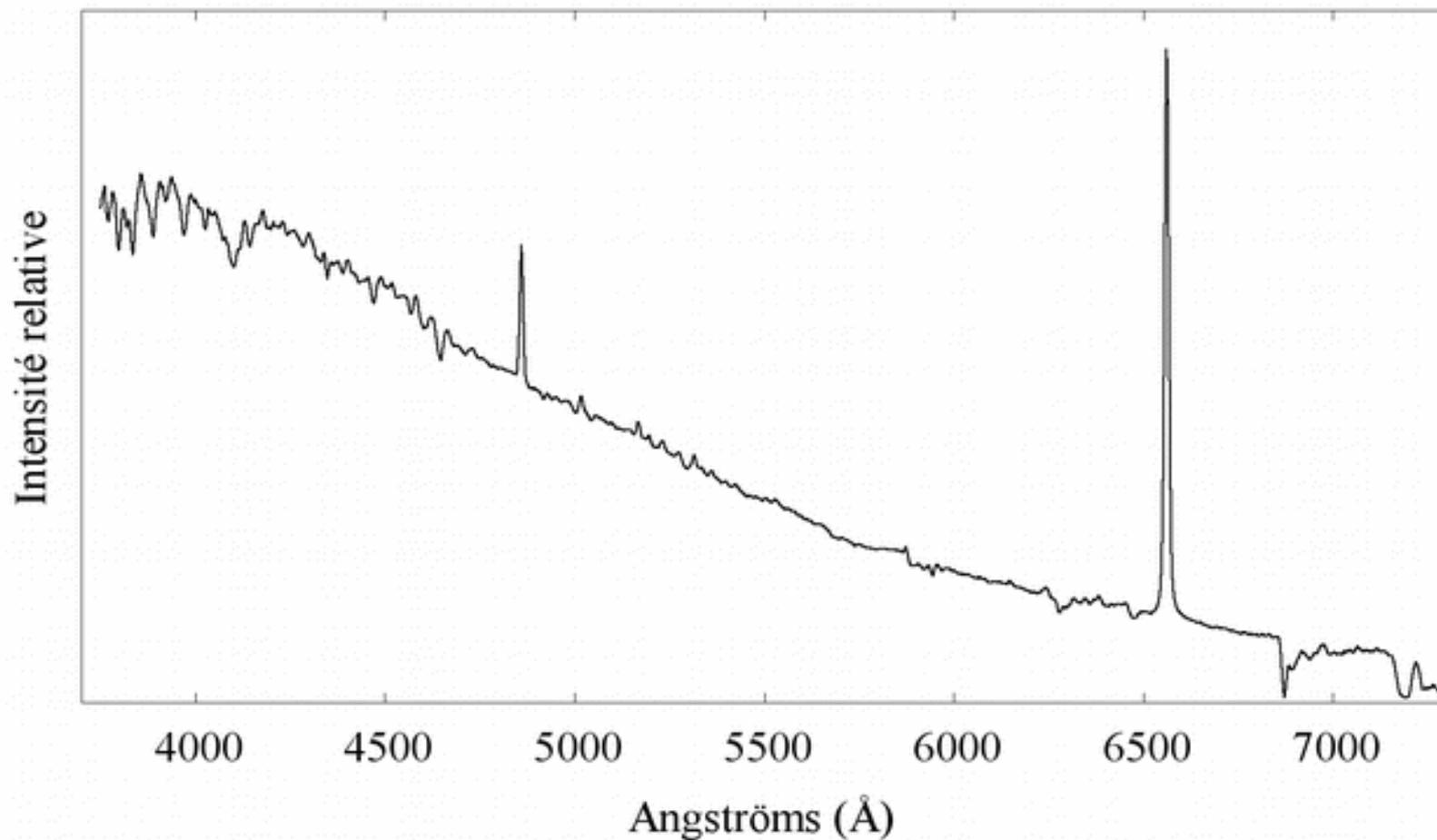
Arcturus - 20/08/2015 21:33 - C8-Alpy600#094-Atik314 - 7 x 1 s



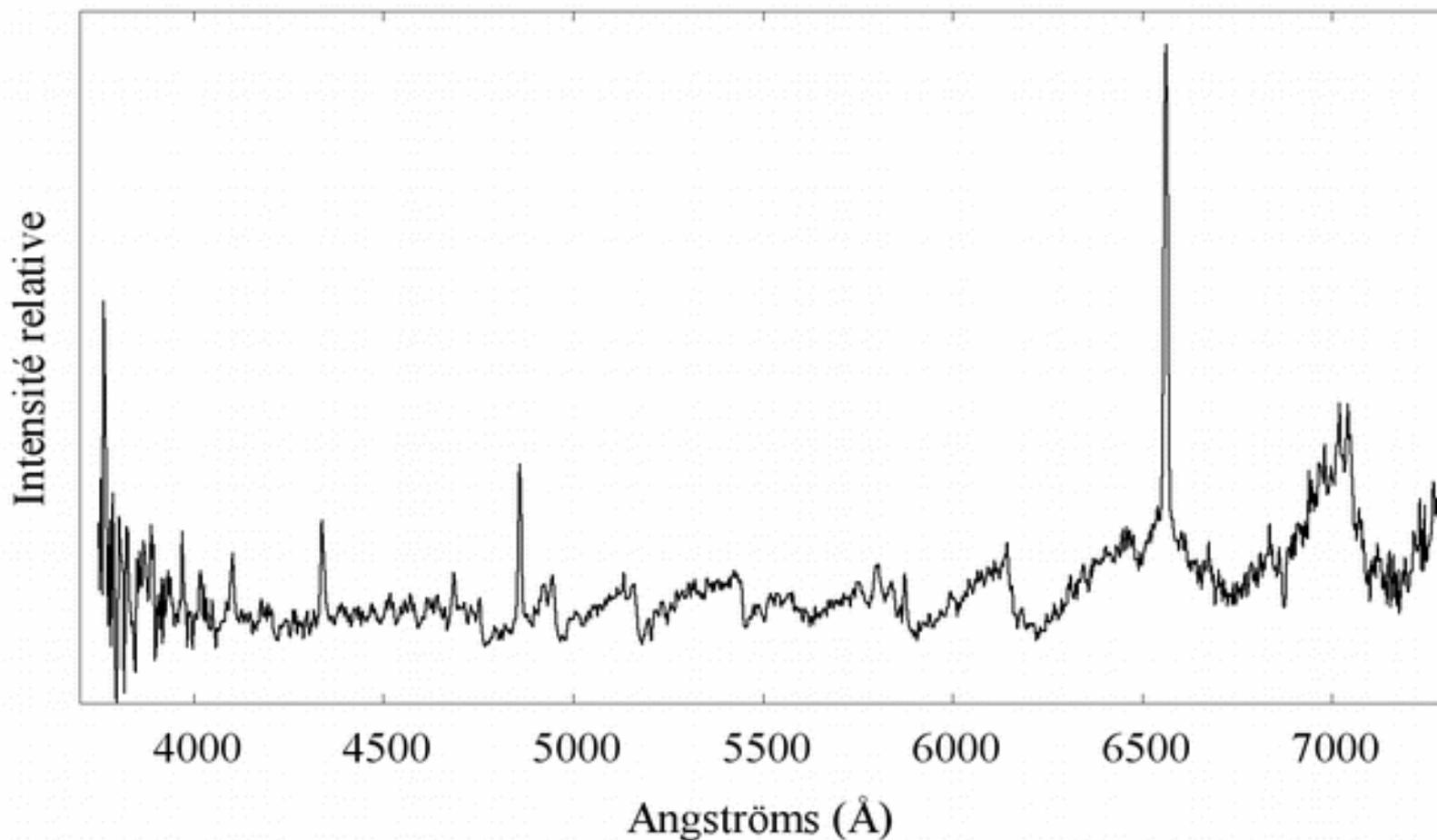
Y Cvn - 20/08/2015 21:47 - C8-Alpy600#094-Atik314 - 7 x 60 s



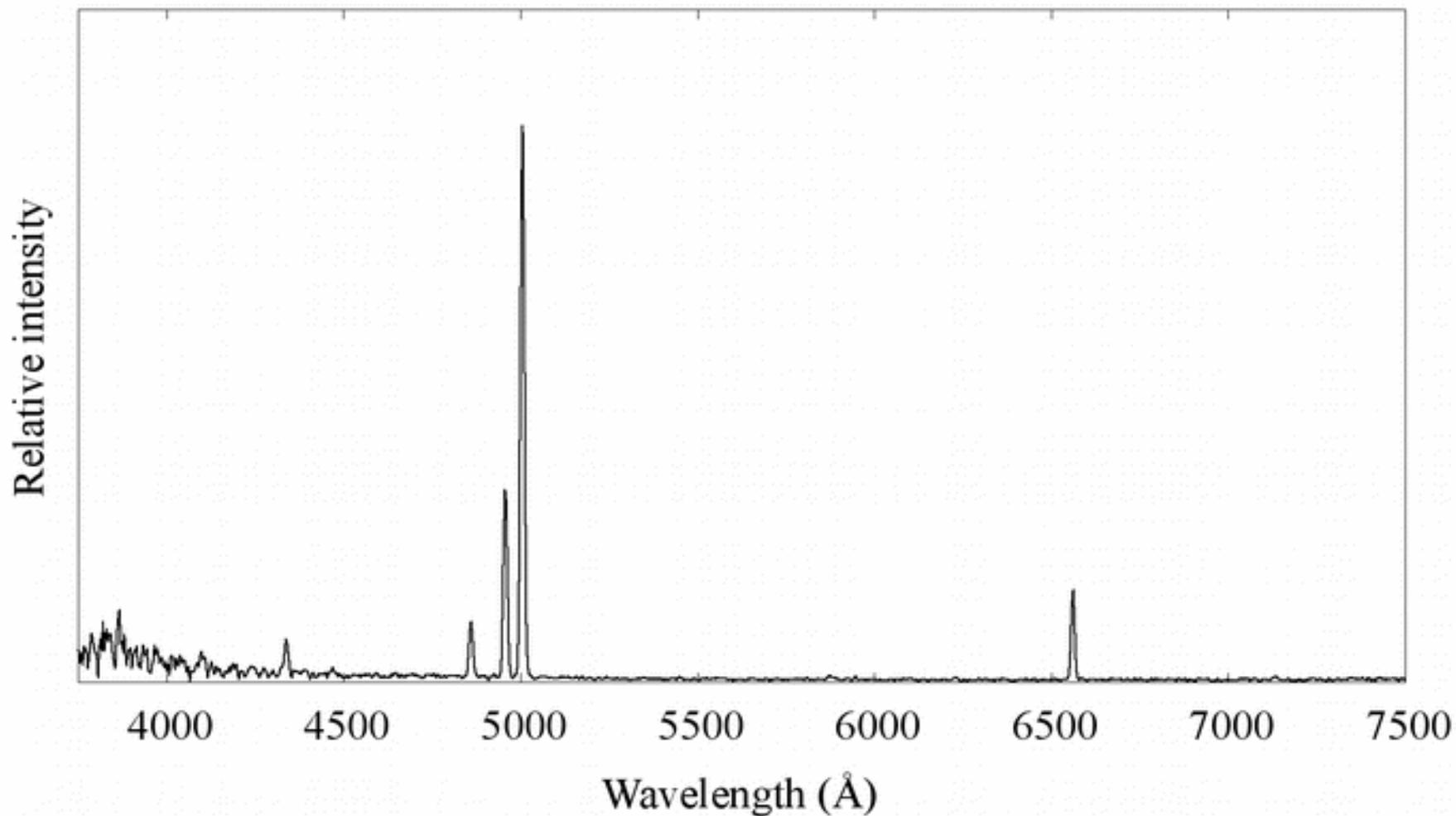
gam Cas - 20/08/2015 22:08 - C8-Alpy600#094-Atik314 - 9 x 5 s



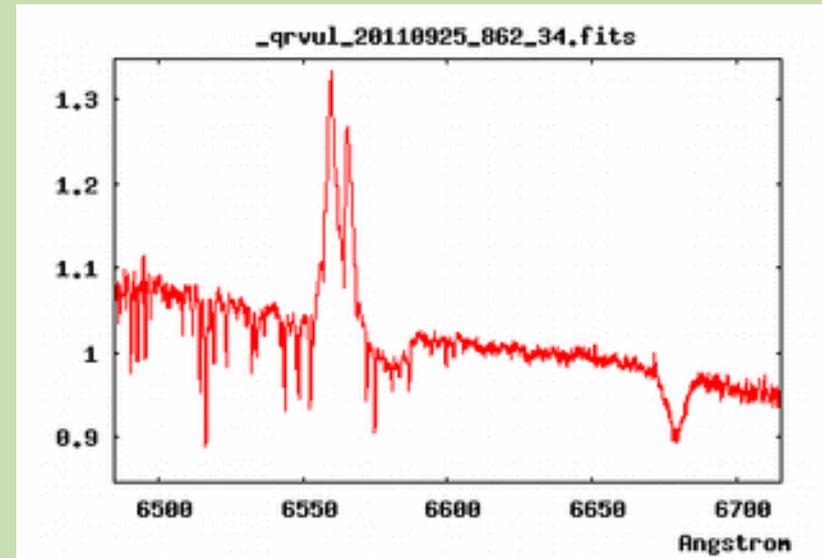
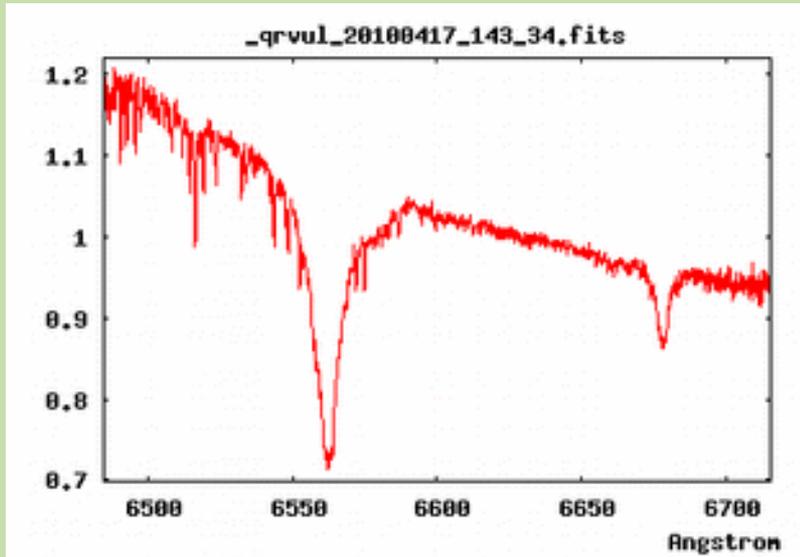
T Crb - 19/08/2015 22:41 - C8-Alpy600#094-Atik314 - 5 x 60 s



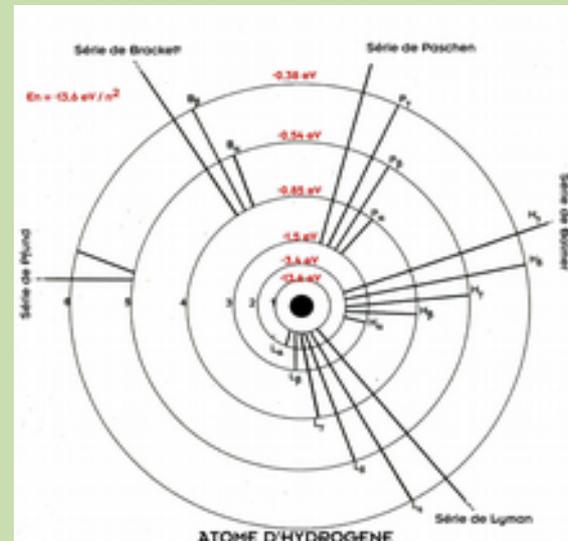
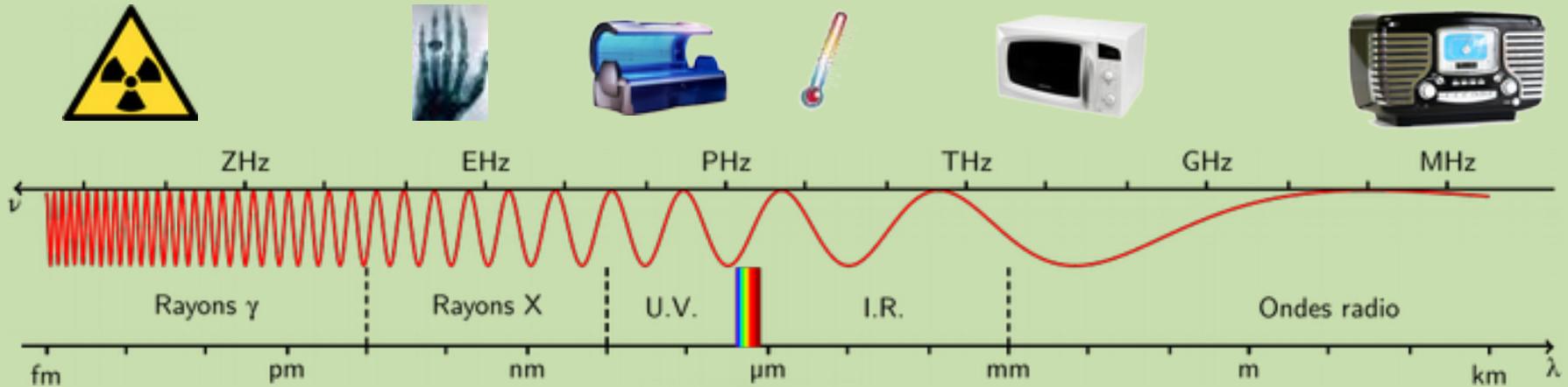
IC3568 - 2018-05-11 - 00:54:33 - Alpy600 NAT 2018



- Outburst !

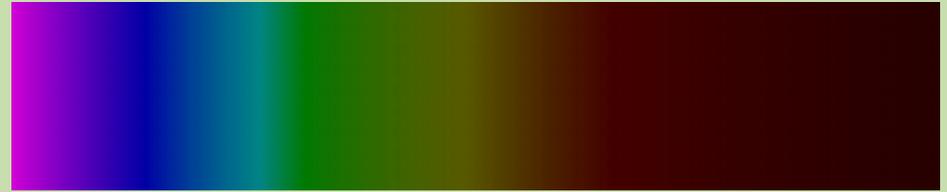


# Light is a wave...

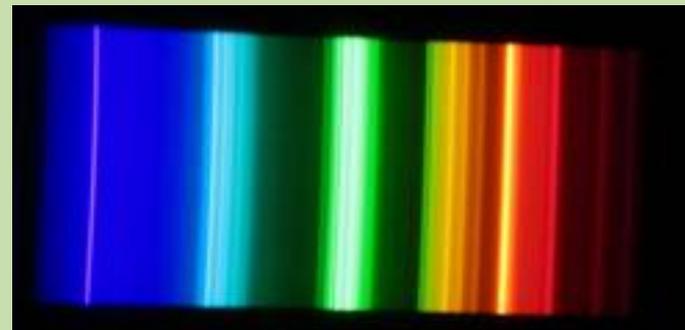
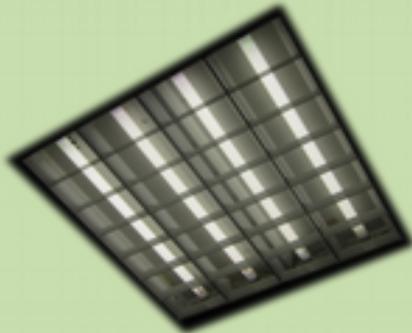


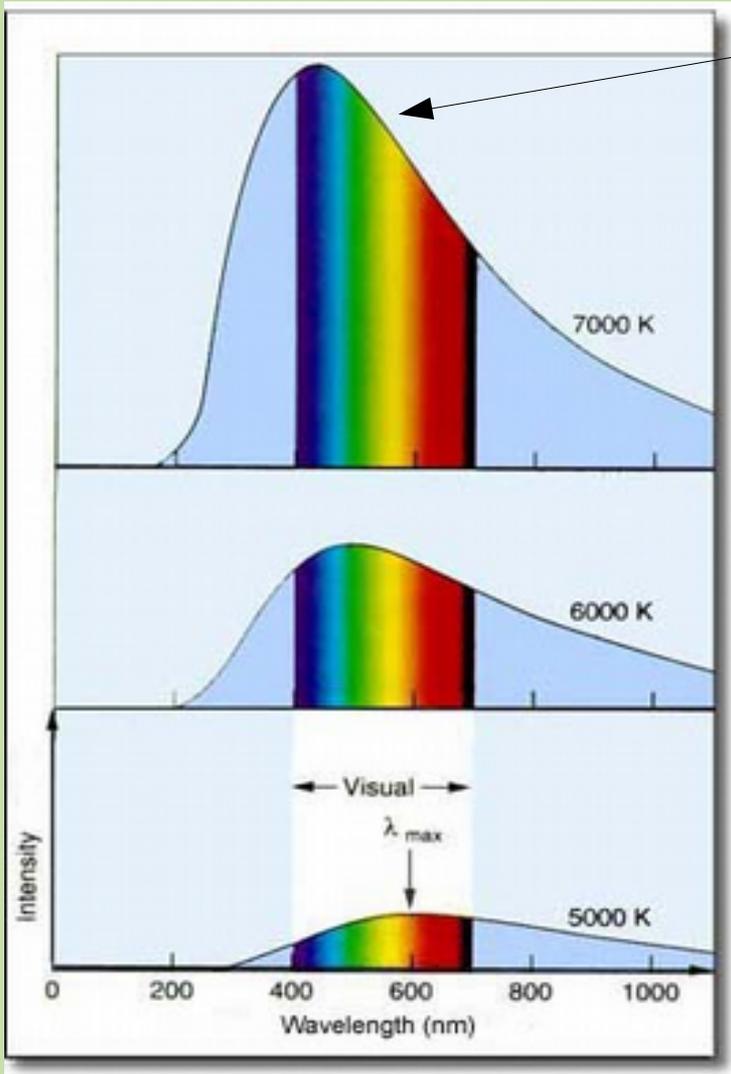
...and a particle!

# Making some light



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



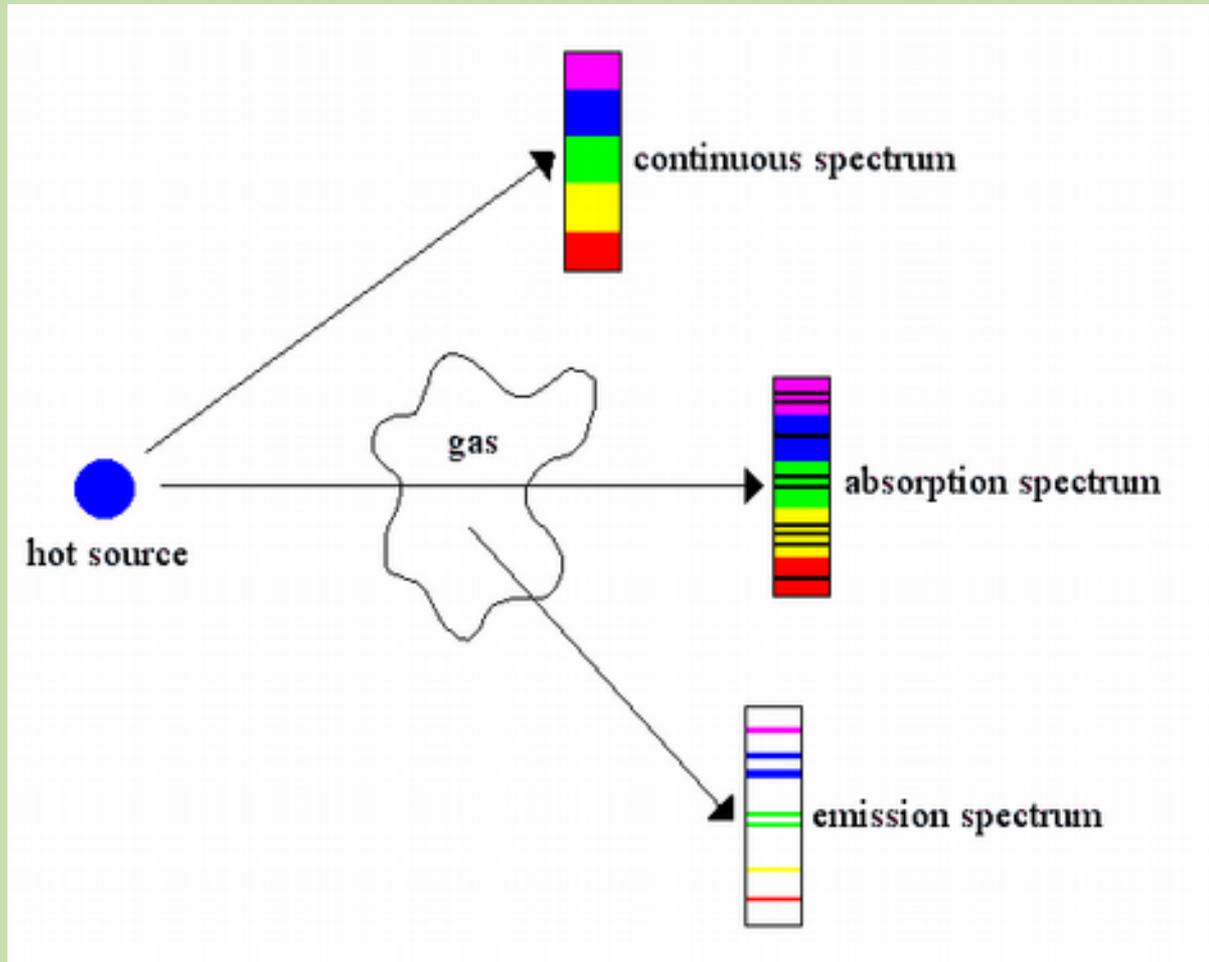


**Visible domain**  
**= 400-700nm (4000A-7000A)**

- **Stefan's law:**  
**Intensity (under the curve)**  
**= Constant \*  $T^4$**
- **Wien' s law:**  
 **$\lambda_{max}$  \* Temperature**  
**= Constant (2900  $\mu\text{m.K}$ )**

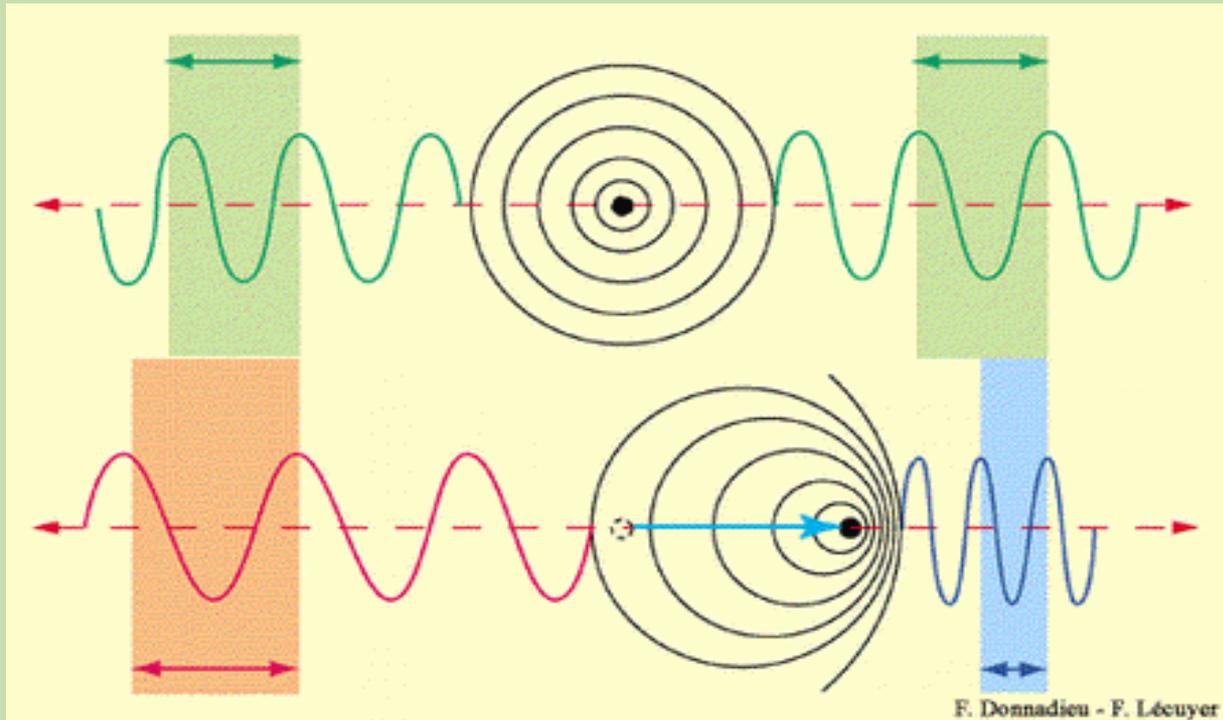
**==>Temperature = Color !!!**

# 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 ( $Vsini$ )**
- **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

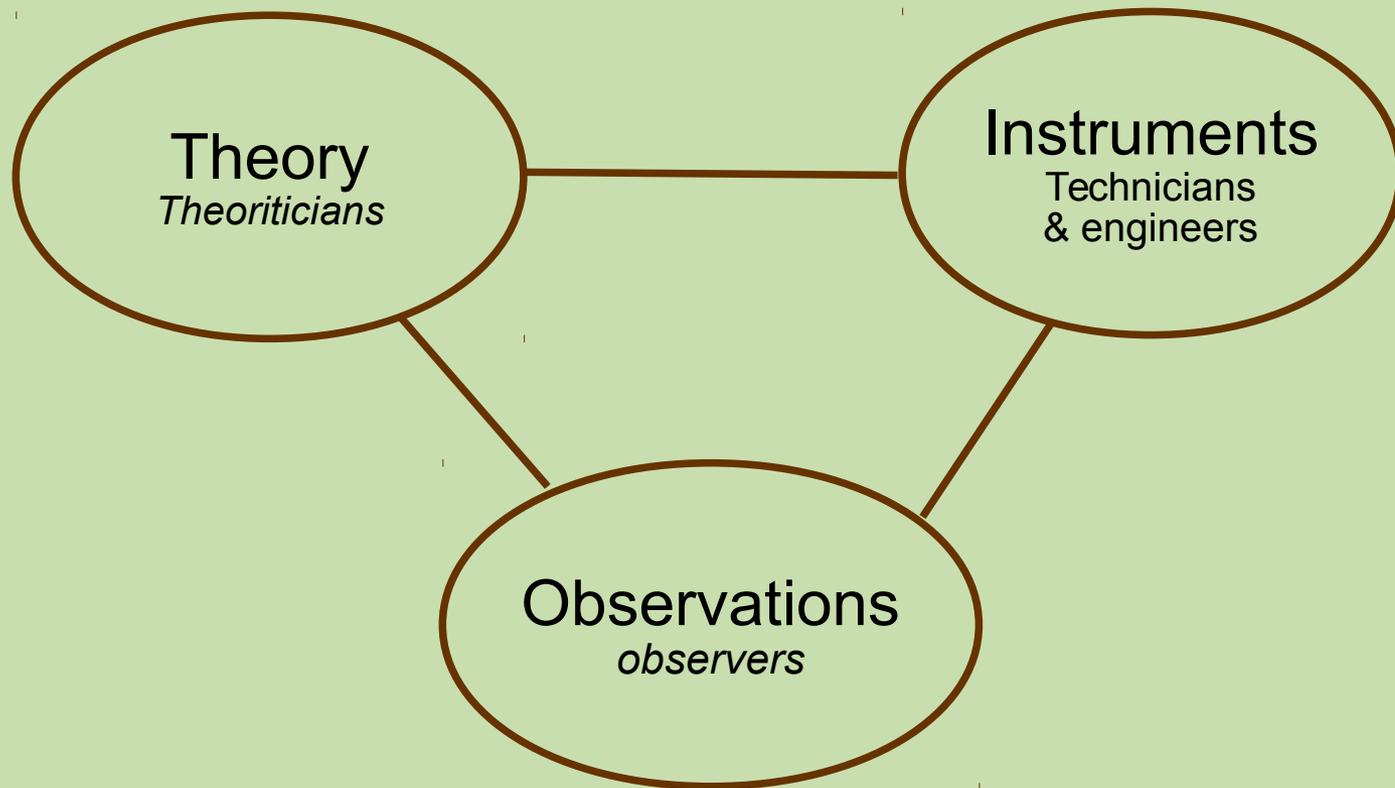
**When we observe all together,  
we become a new kind of instrument !**

Amateurs can do observations  
than pros cannot (anymore)

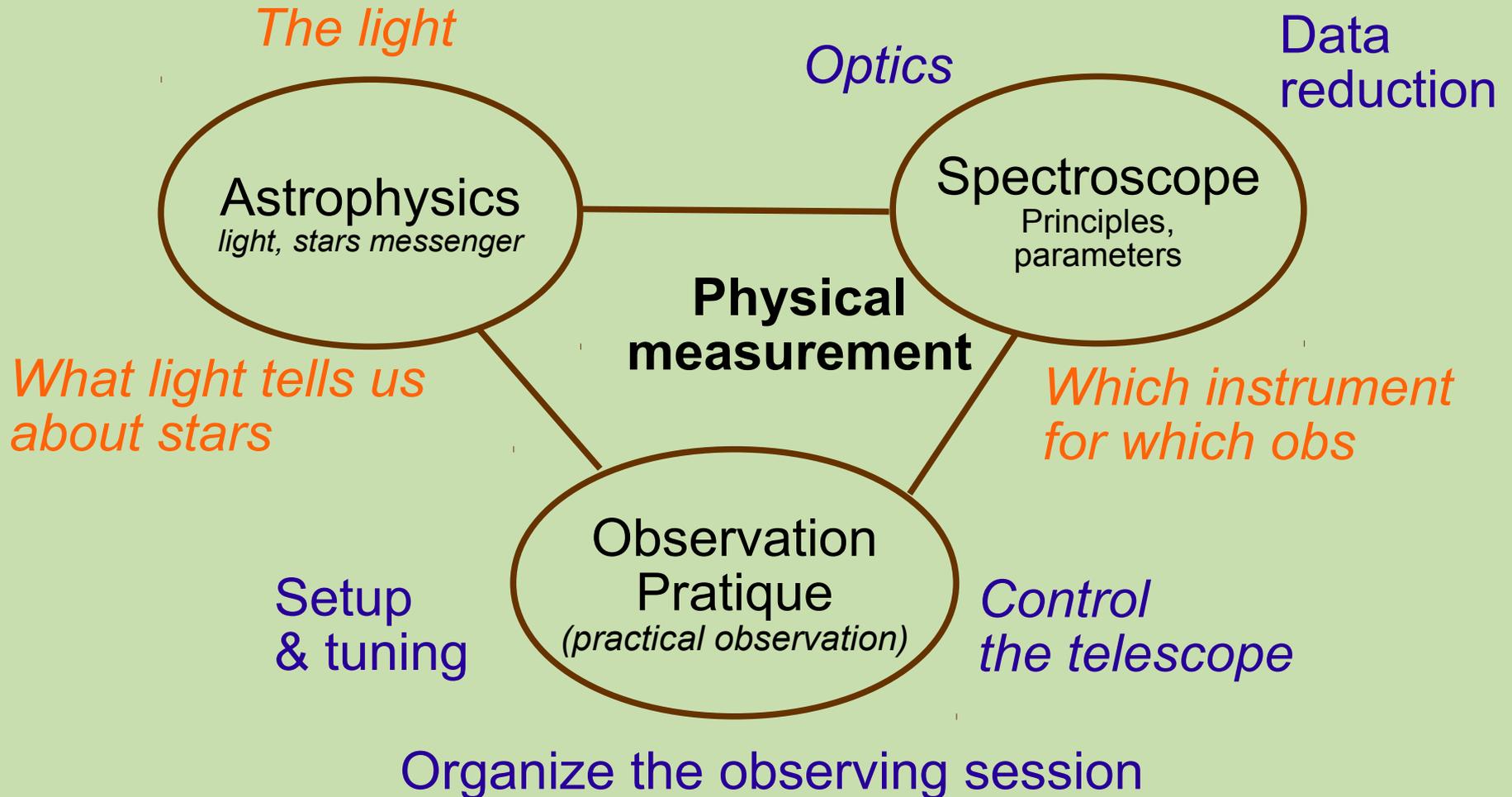
If you want to go fast, walk alone  
But if you want to go far, walk together

*Ratan Tata*

# Astrophysics triptich



# Spectro : a *full* astronomy



*Which observer are you?*

*What is your project ?*



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**Merci !**

*Vous ne verrez  
plus les étoiles  
comme avant !*

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