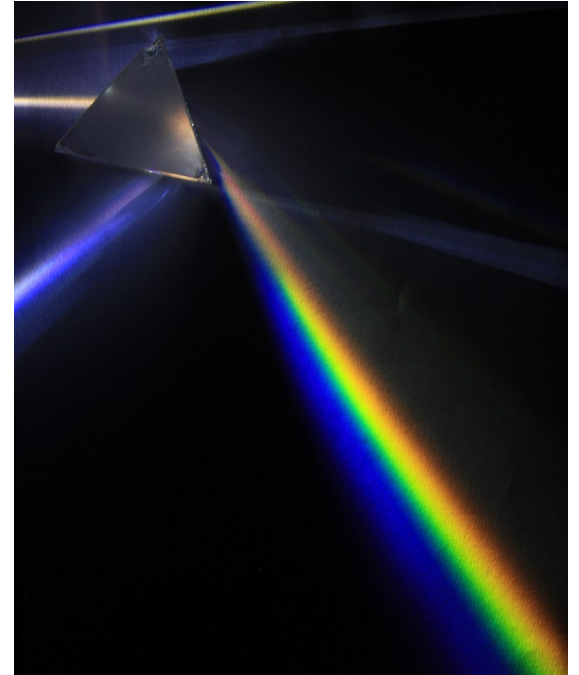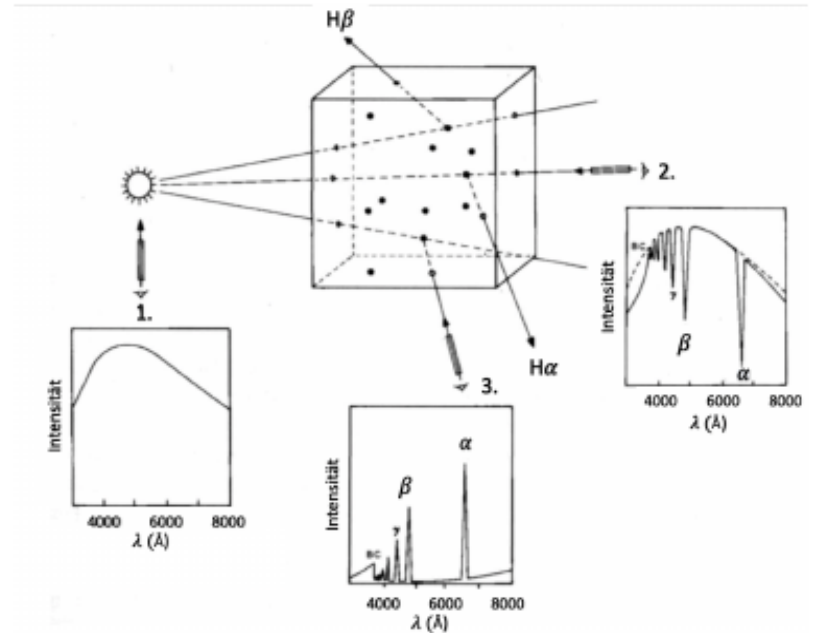# Spectroscopy

- decomposition of light in contributions of different wavelength

- the beginnings: I. Newton's optical experiments (1666–1672)
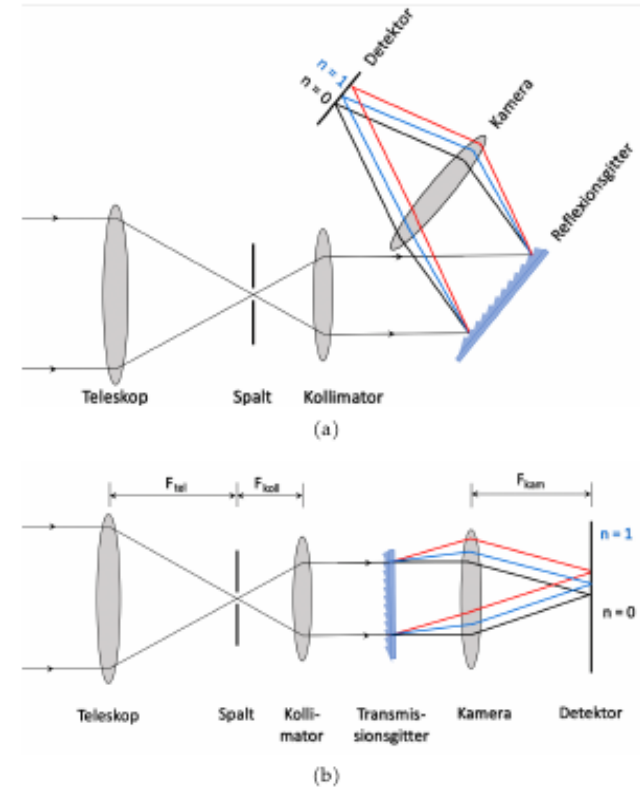
What can we see?

- continuous spectra (black-body)

- emission spectra

- absorption features

Main Components of a Spectrograph

- entrance pupil
  - slit in focal plane
  - fiber

- collimator → parallelizing light

- dispersive element
  - prism
  - grating
  - grism

- camera + detector
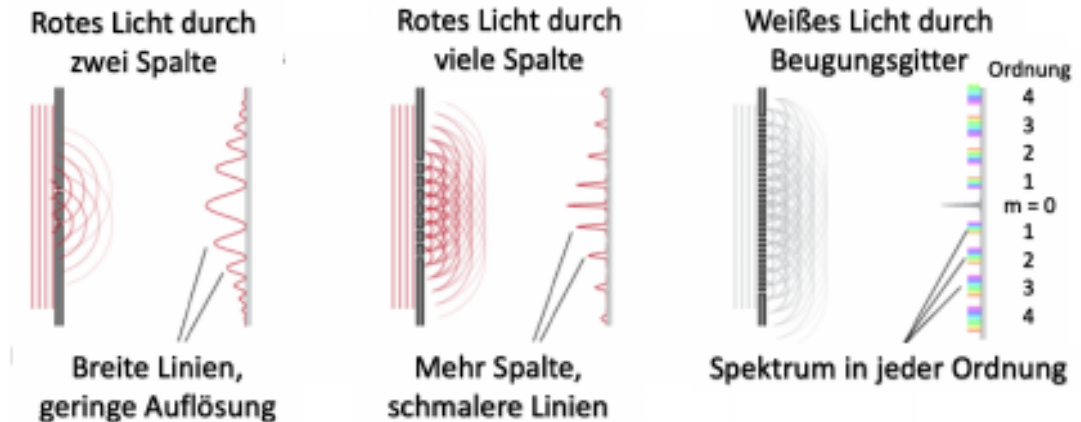 - focusing + imaging + intensity measurement

Interference pattern of a diffraction grating

- transmissive or reflective periodic structure (with spacing d)
  → light is being diffracted

$$d(\sin \theta_i - \sin \theta_m) = m\lambda.$$

- Resolution R (increasing with order number and smaller spacing):

  $R = \lambda/\Delta\lambda$

Rotes Licht durch
zwei Spalte

Rotes Licht durch
viele Spalte

Weißes Licht durch
Beugungsgitter   Ordnung

4
3
2
1
m = 0
1
2
3
4

Breite Linien,
geringe Auflösung

Mehr Spalte,
schmalere Linien

Spektrum in jeder Ordnung

From Raw Data to 1D spectra

- bias correction (varying offset over detector)

- flat-fielding (pixel-to-pixel variations in eff.)

- removal of cosmic rays

- tracing the spectrum on image

- extraction of the spectrum → 1D (flux vs. pixel)

- wavelength calibration → 1D (flux vs. wavelength)

- flux calibration (instr. response)
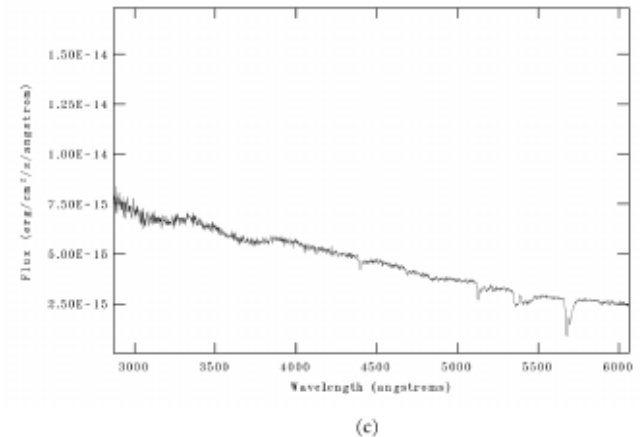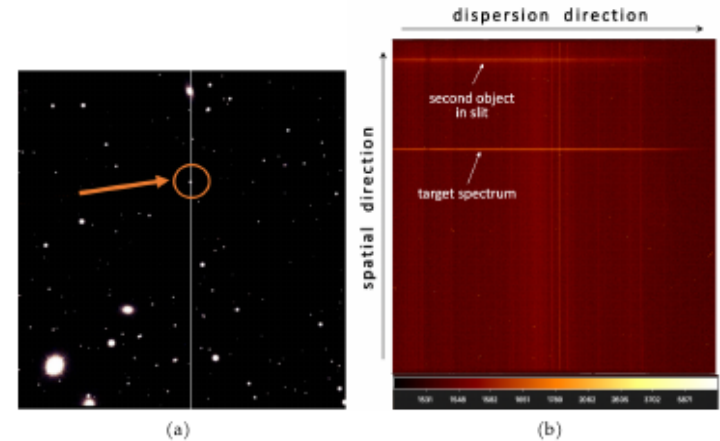
Data Sets – Osservatorio Astrofisico di Asagio

- Copernico telescope

- 1.82 m

- Asiago Object Spectrograph and Camera (AFOSC)

- Resolution: 311

- Grism #4
  → Central wavelength (580 nm)
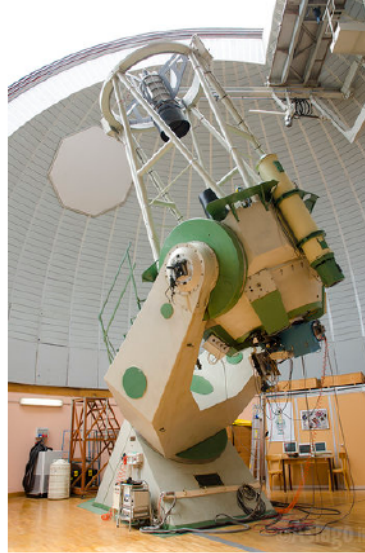
- Galileo telescope

- 1.22 m

- Boller & Chivens Spectrograph

- observations in Sep. 2018
- Wavelength range around 350-800 nm
- Low resolution
- Calibration frames + 15 different objects

What You are expected to do

- full data reduction of one or several objects with IRAF (Image Reduction and Analysis Facility)

- evaluation of the resulting spectra (and identification of object type)

Material:
- raw calibration and object frames
- reference sheet for IRAF
- excerpts from Magister-thesis of V. Pfeiffer (reference for procedures and IRAF)
- IRAF web ressources:
  - IRAF.net
  - http://joshwalawender.github.io/IRAFtutorial/IRAFintro_01.html
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