Optical spectroscopy: data reduction and processing

Lecture 10

Course of:

Signal and imaging acquisition and modelling in environment

10/04/2024

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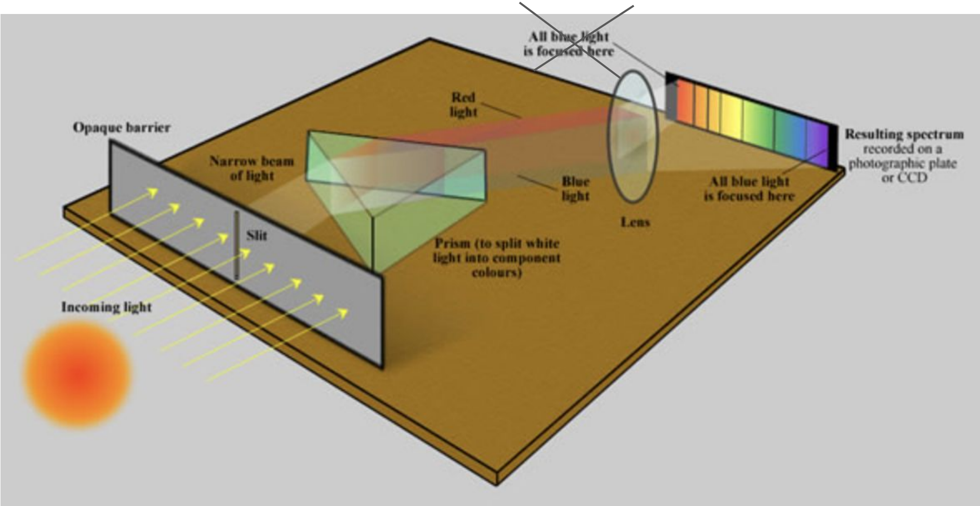
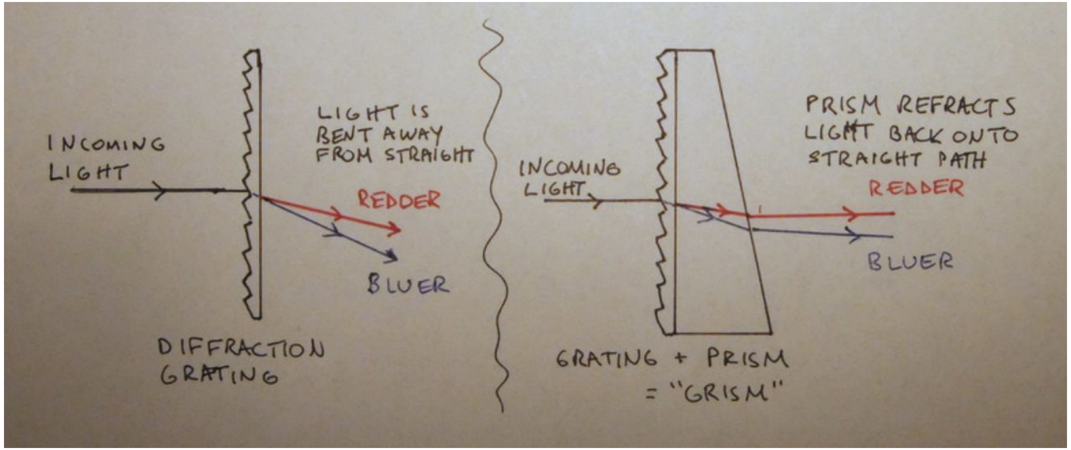
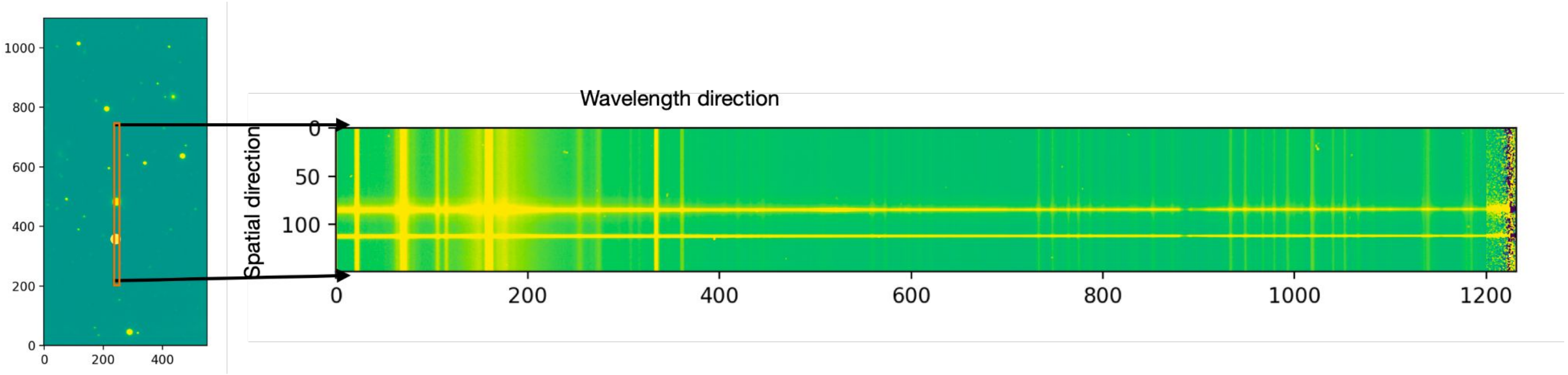
The concept of long slit spectroscopy

The concept of long slit spectroscopy



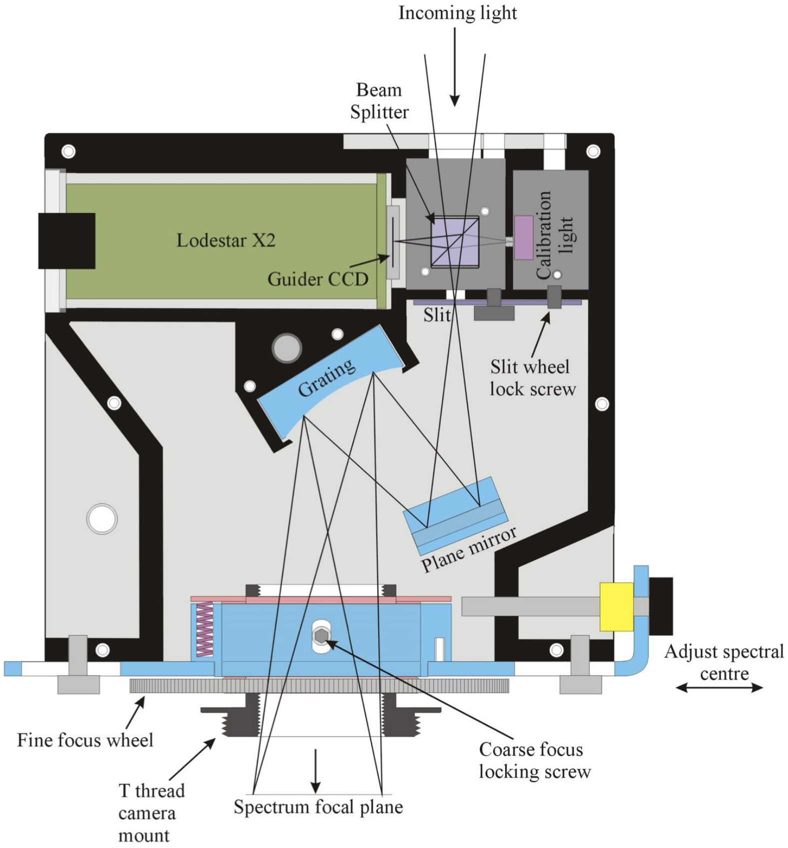


The concept of long slit spectroscopy

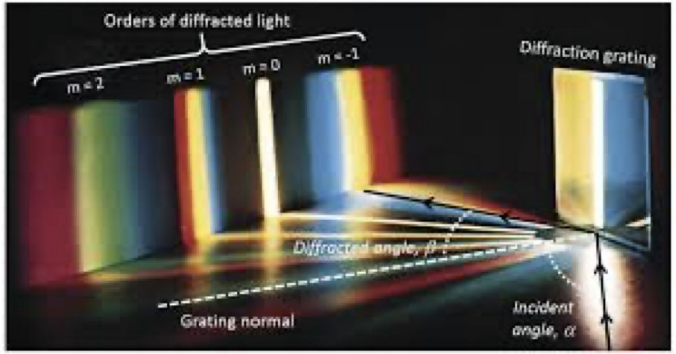


Spectra are characterized by:
a Point spread function (PSF) which is the extension of a source in the slit plane,
a Line spread function (LSF) which is sometimes called spectral resolution (DeltaL/L) and depends on the grism/prism in use.

The spectrograph on the Bicocca Telescope

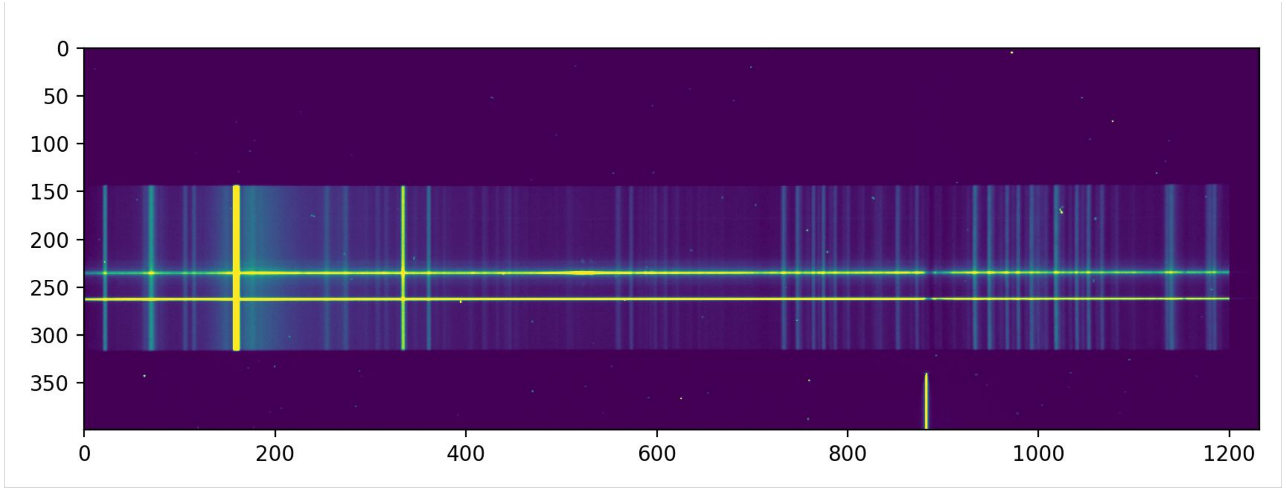


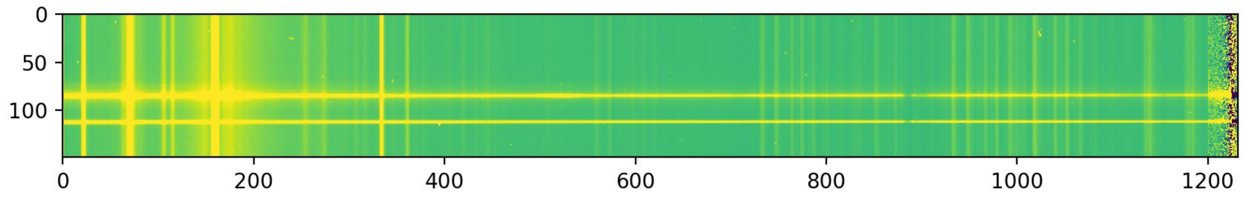
Two types of calibration lights: Flat lamp emits uniformly over the entire optical spectrum, Arc lamp (Ne-Ar) generates atomic lines by exciting Neon and Argon atoms.



Basic Calibration

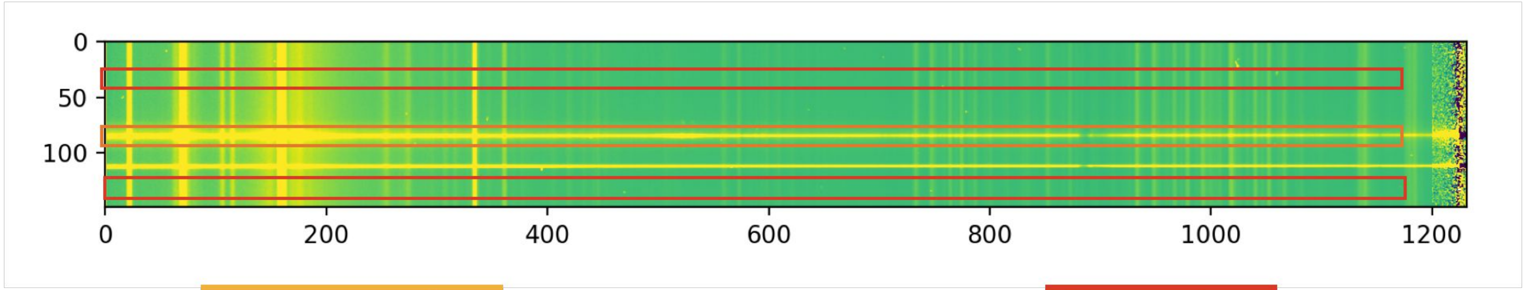
The recorded values are counts on a detector: images! The Basic calibration is made of bias/dark subtraction and division by a flat field image. Science = (Raw-Bias)/Flat



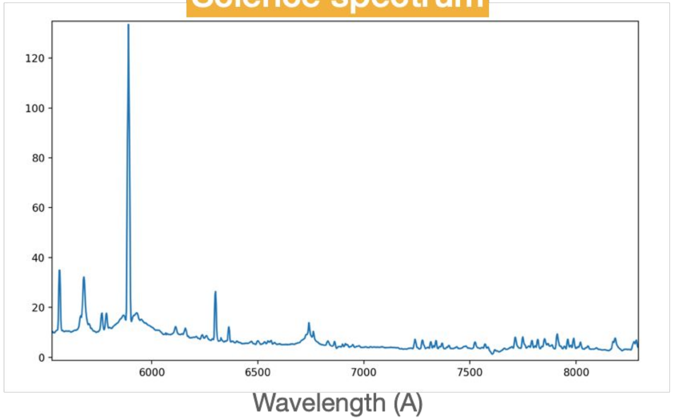


Spectral Extraction

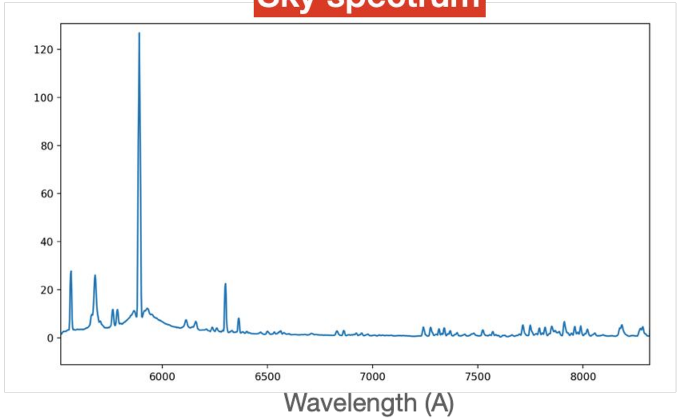
Sources (one in your assignment) must be traced in the wavelength direction and the spatial pixels should be summed in the orthogonal direction, such that the total flux is preserved). Empty regions in the slit plane can be used to sample a sky/background spectrum that can (optionally) be subtracted from the science one.



Science spectrum

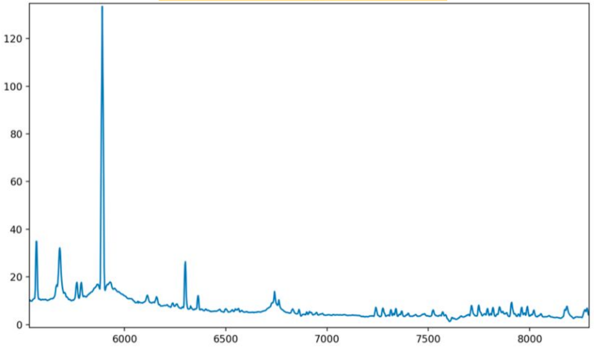


Sky spectrum



Spectral Extraction

Science spectrum



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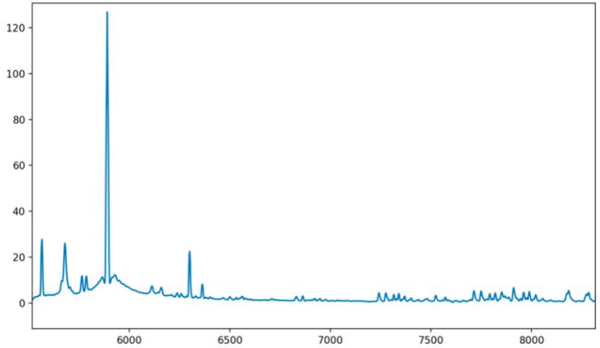
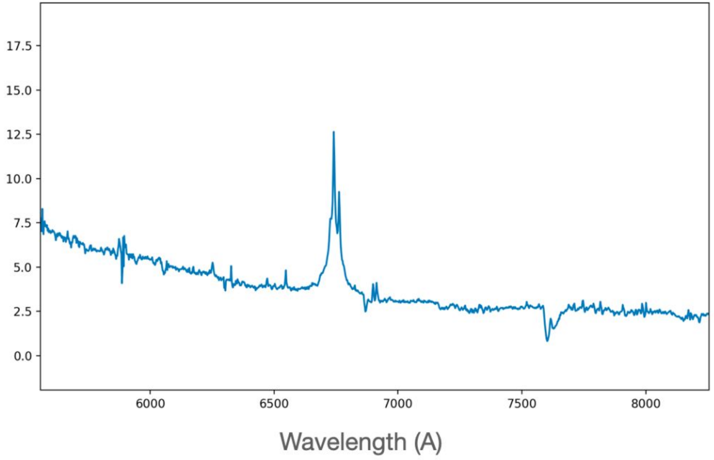
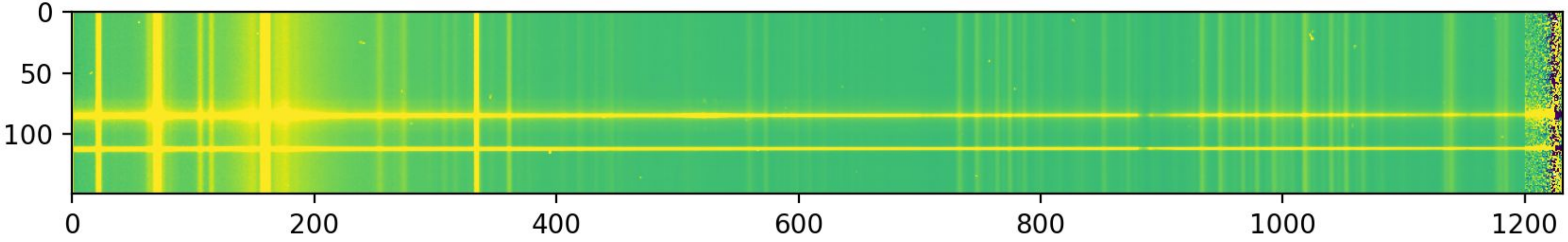
Sky spectrum





Wavelength calibration

How do we associate the x-axis position of the spectrum in pixels to the corresponding wavelength of the EM radiation?



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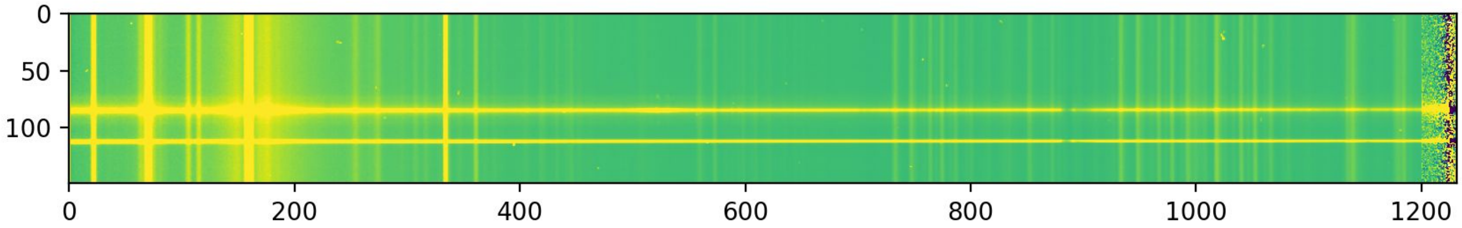
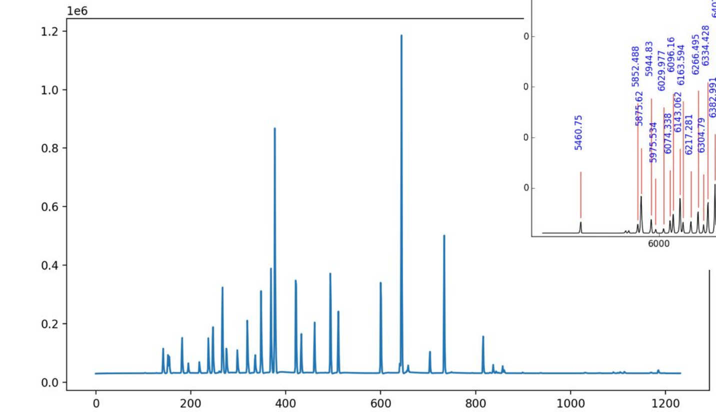
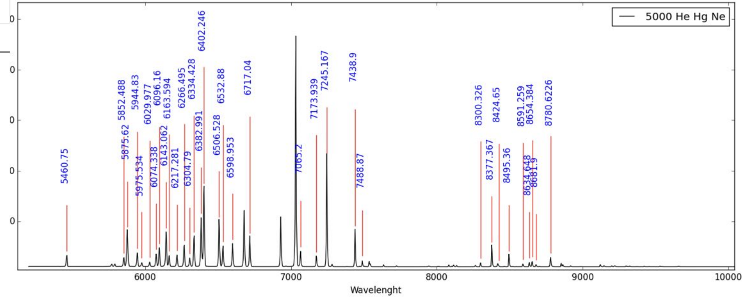


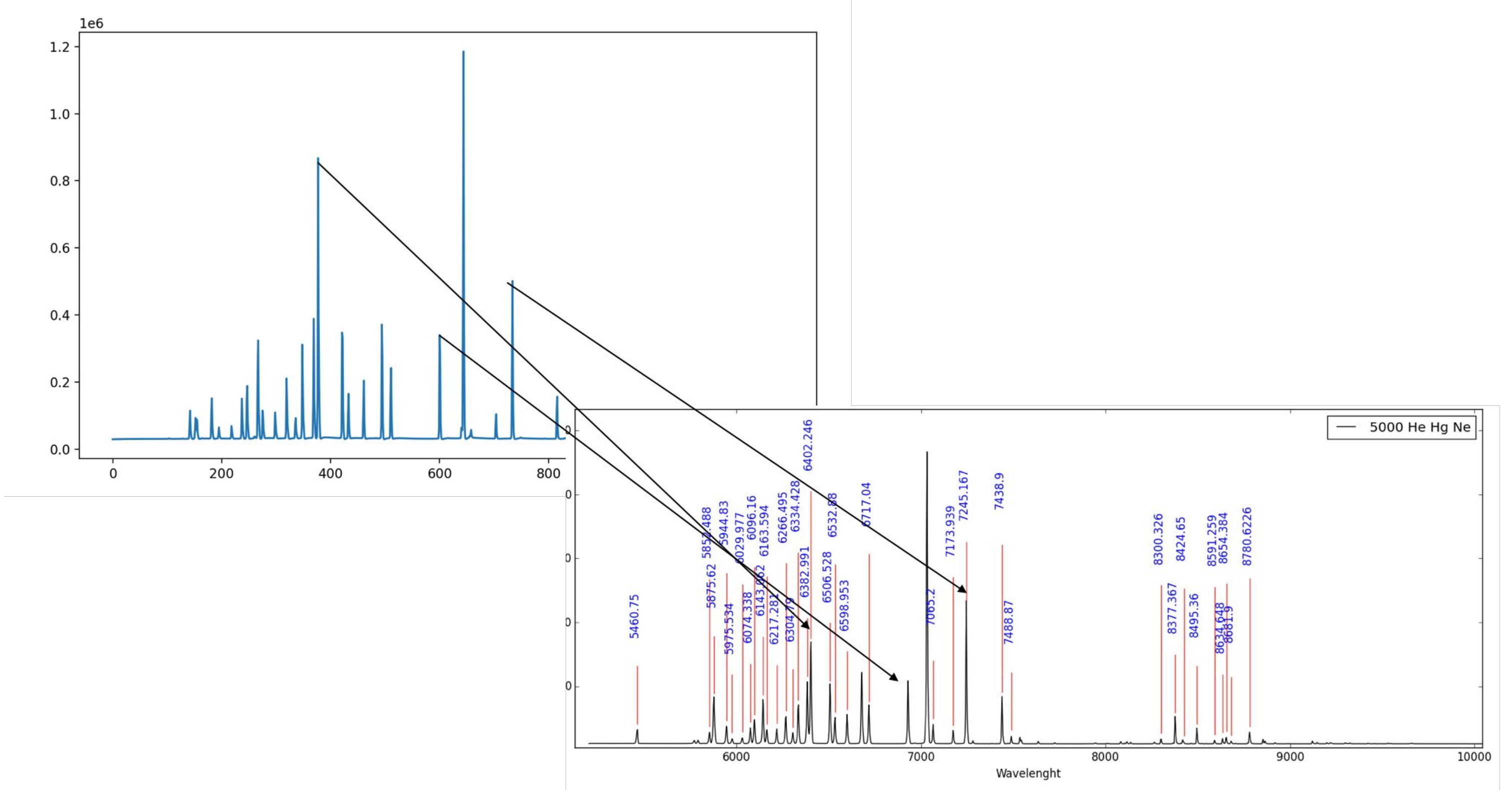
We observe arc frames: spectra of the light from a lamp filled with known gases producing atomic lines of which we know the wavelength.





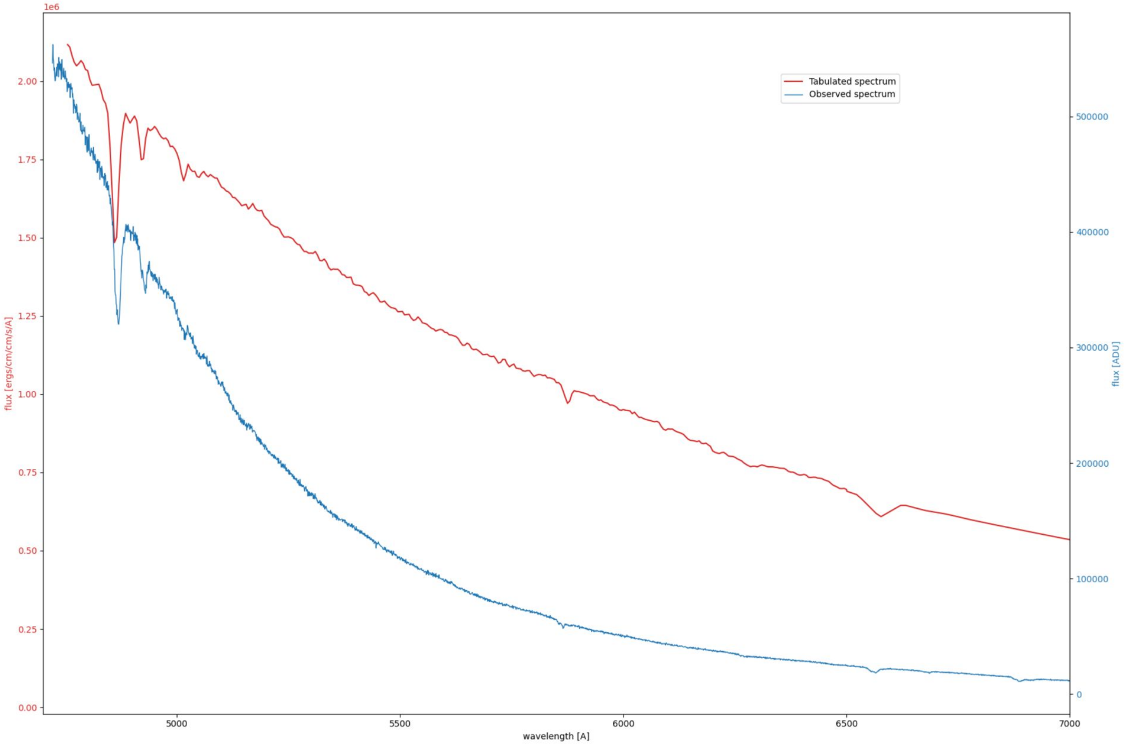
Wavelength calibration

By recognising a common pattern you can associate a wavelength to specific x-axis values on the detector and by fitting a linear (or quadratic) equation you can extend the calibration to the entire x-axis.



Throughput calibration

Sources with a known spectrum can be observed to correct for the response of specific detectors+spectrographs. When this is applied to all the science observations you obtain calibrated spectra that can be used for measurements.



Your Turn

Today's lab activity

- Get familiar with the steps of spectroscopic data reduction
    - Basic Bias and Flat Calibration
    - 1D spectral extraction
    - Wavelength calibration
    - Throughput calibration

- Apply these concepts in the guided notebook available at this link: https://colab.research.google.com/drive/1jq-3fKT104qroYinnuBXwUIl8UpmjY5V?usp=share_link