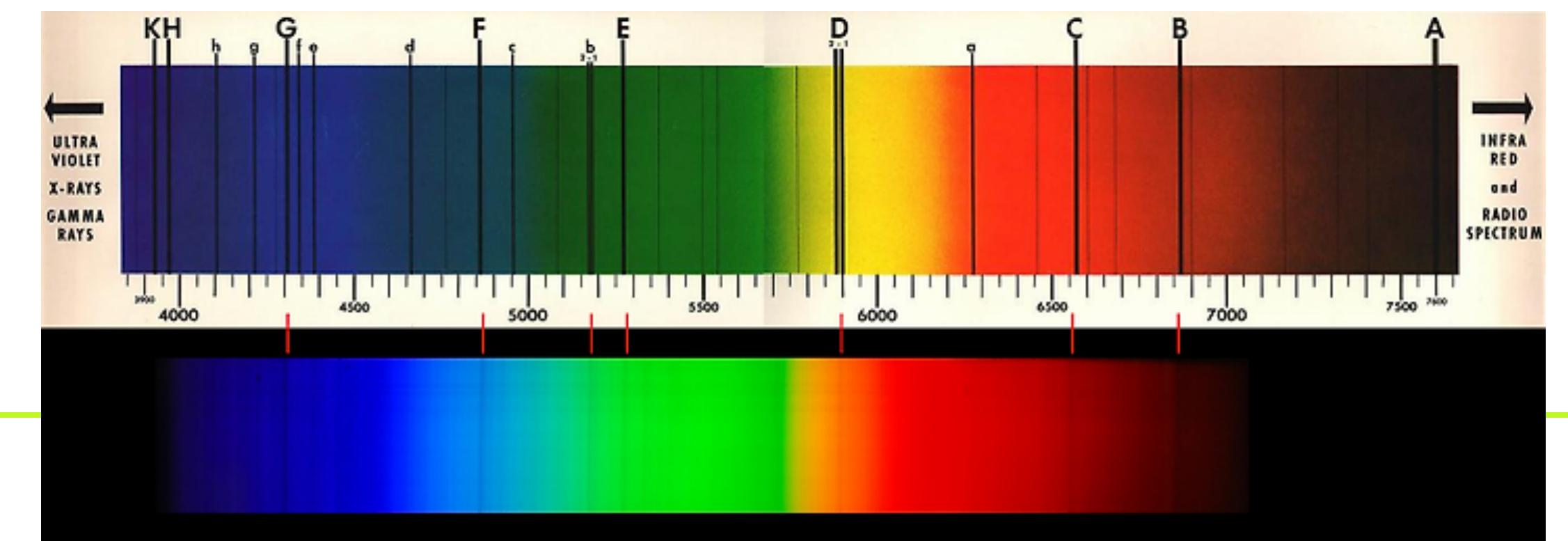
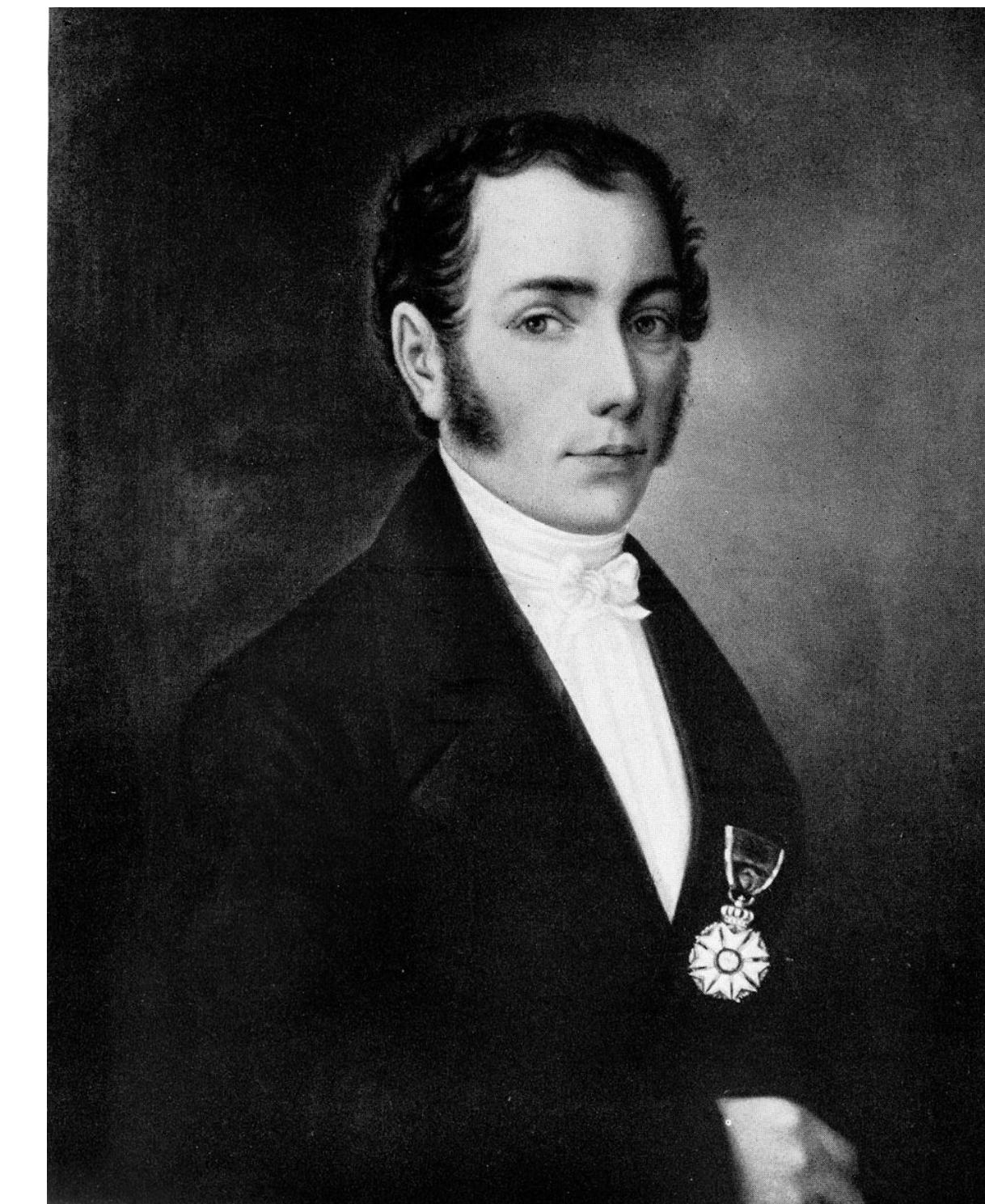

Spectroscopy

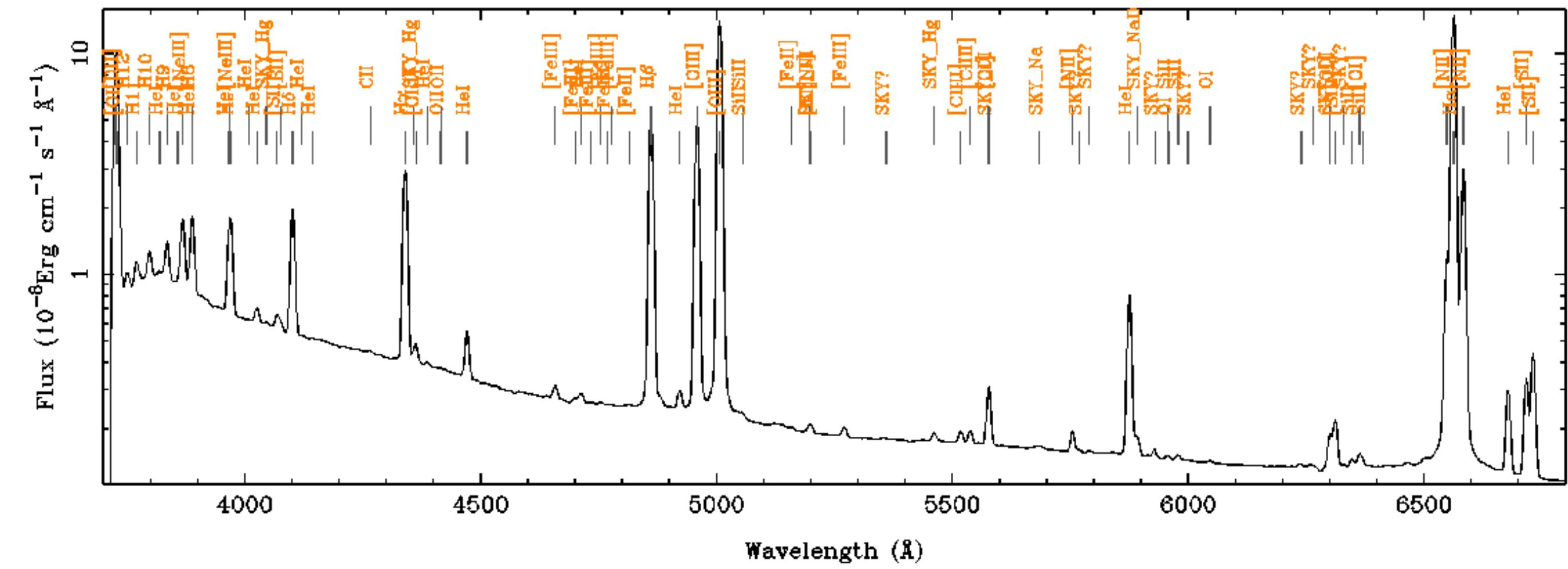
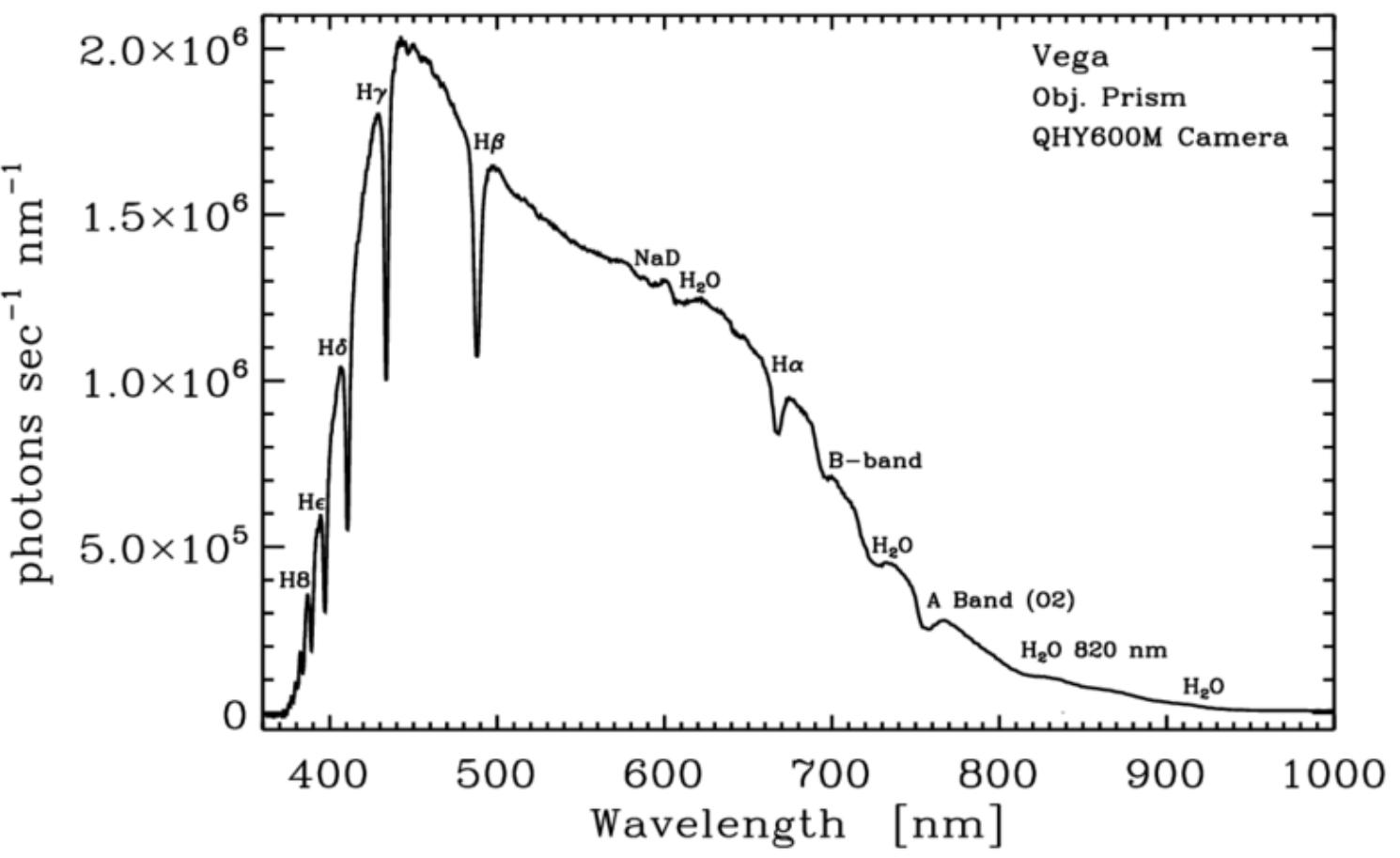
25.05.20

Spectroscopy

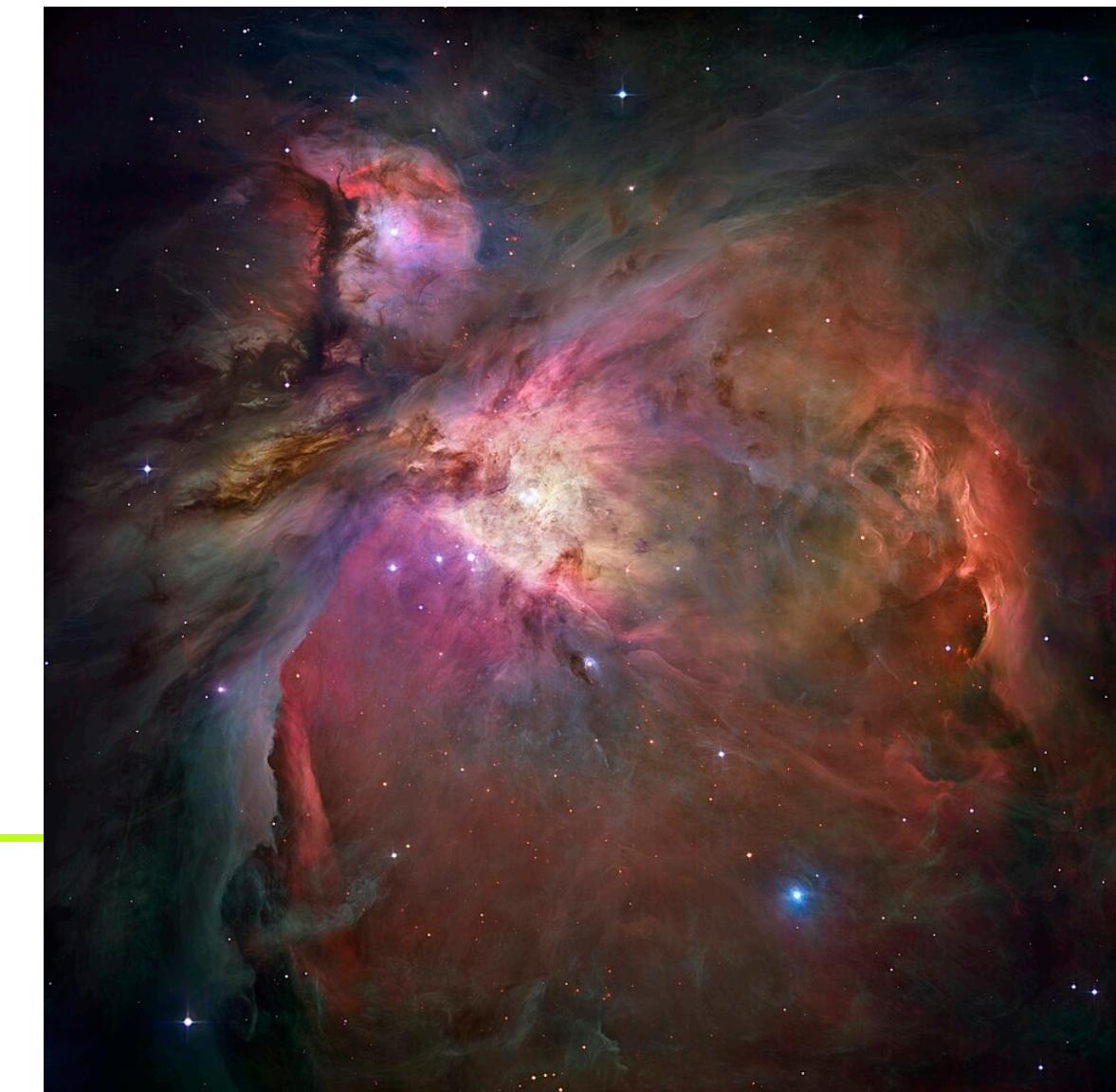
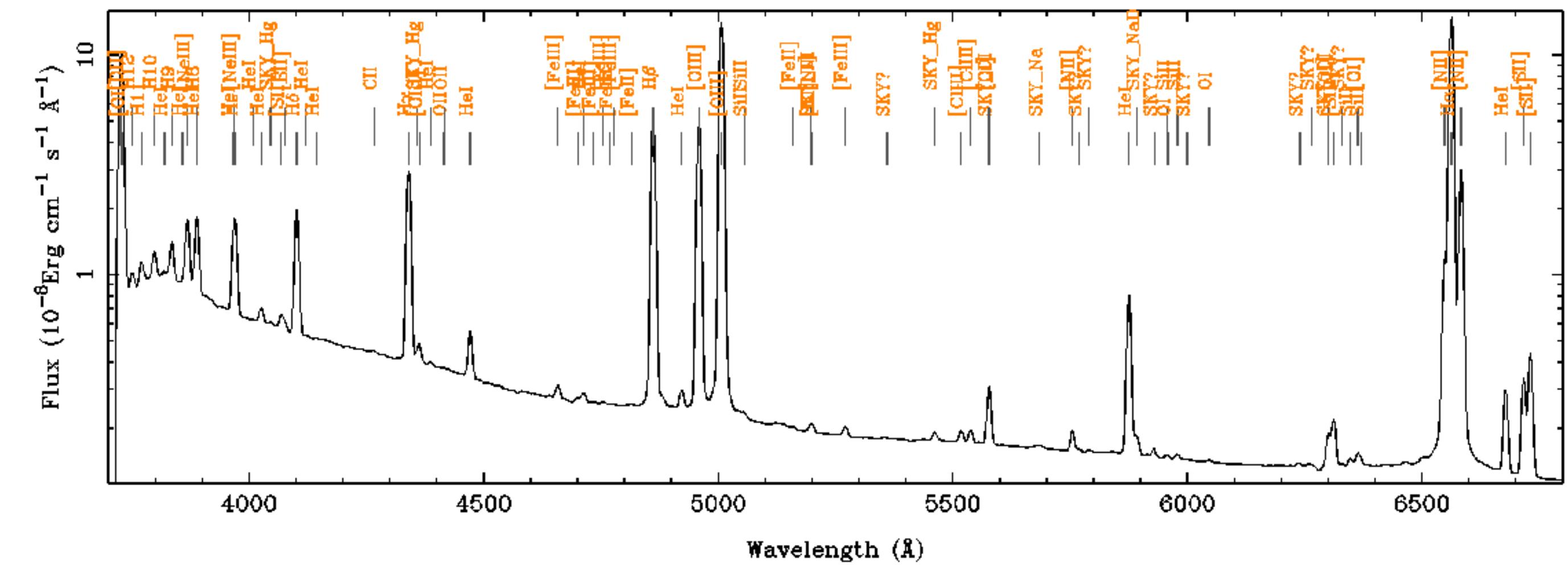
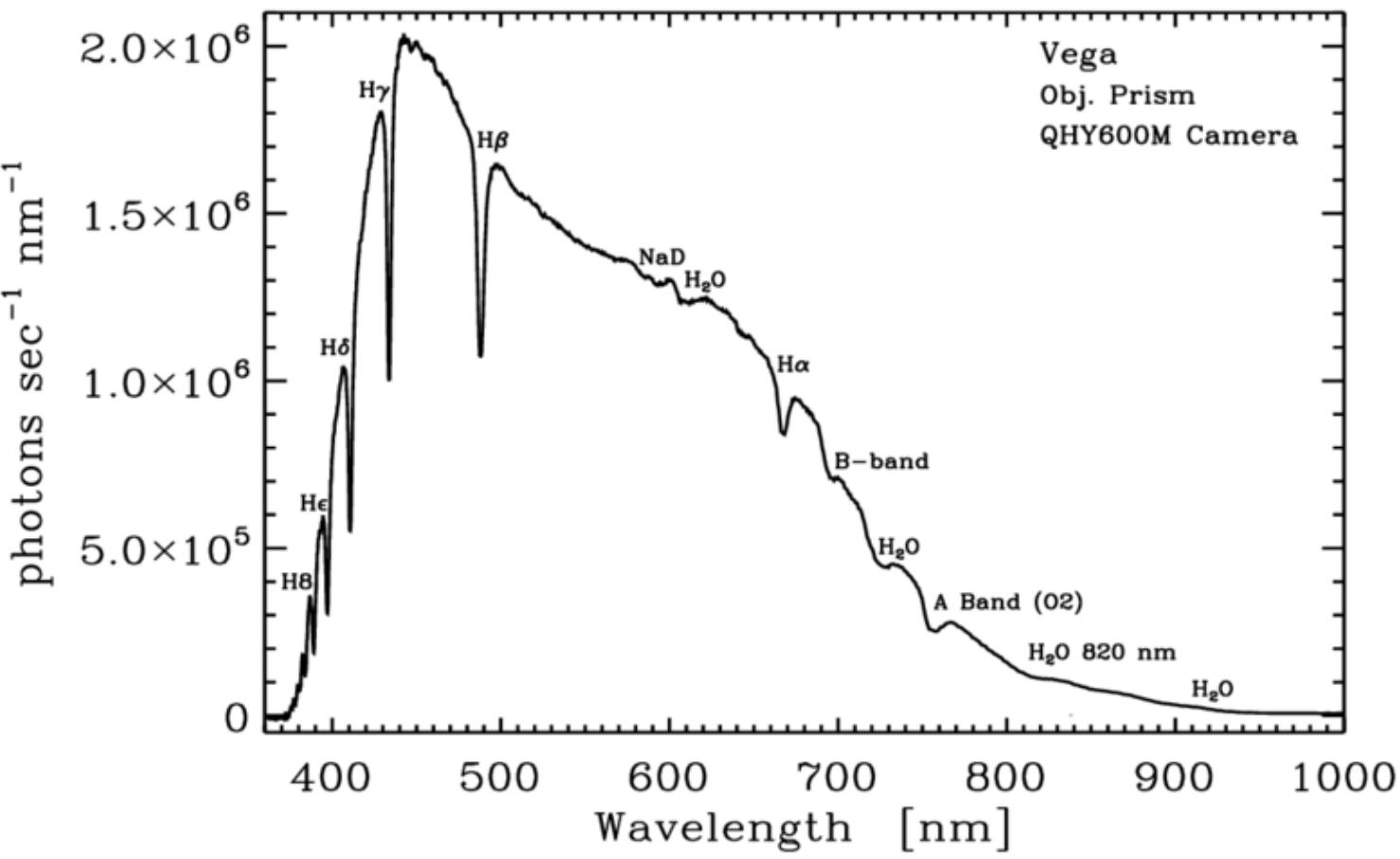
- Fraunhofer found the ‘black line’ in the spectrum of sun
- This is the first time astronomers use spectroscopy
- Astronomy becomes ‘Astrophysics’ with the spectroscopy



Spectrum



Spectrum



Spectrum of galaxies?

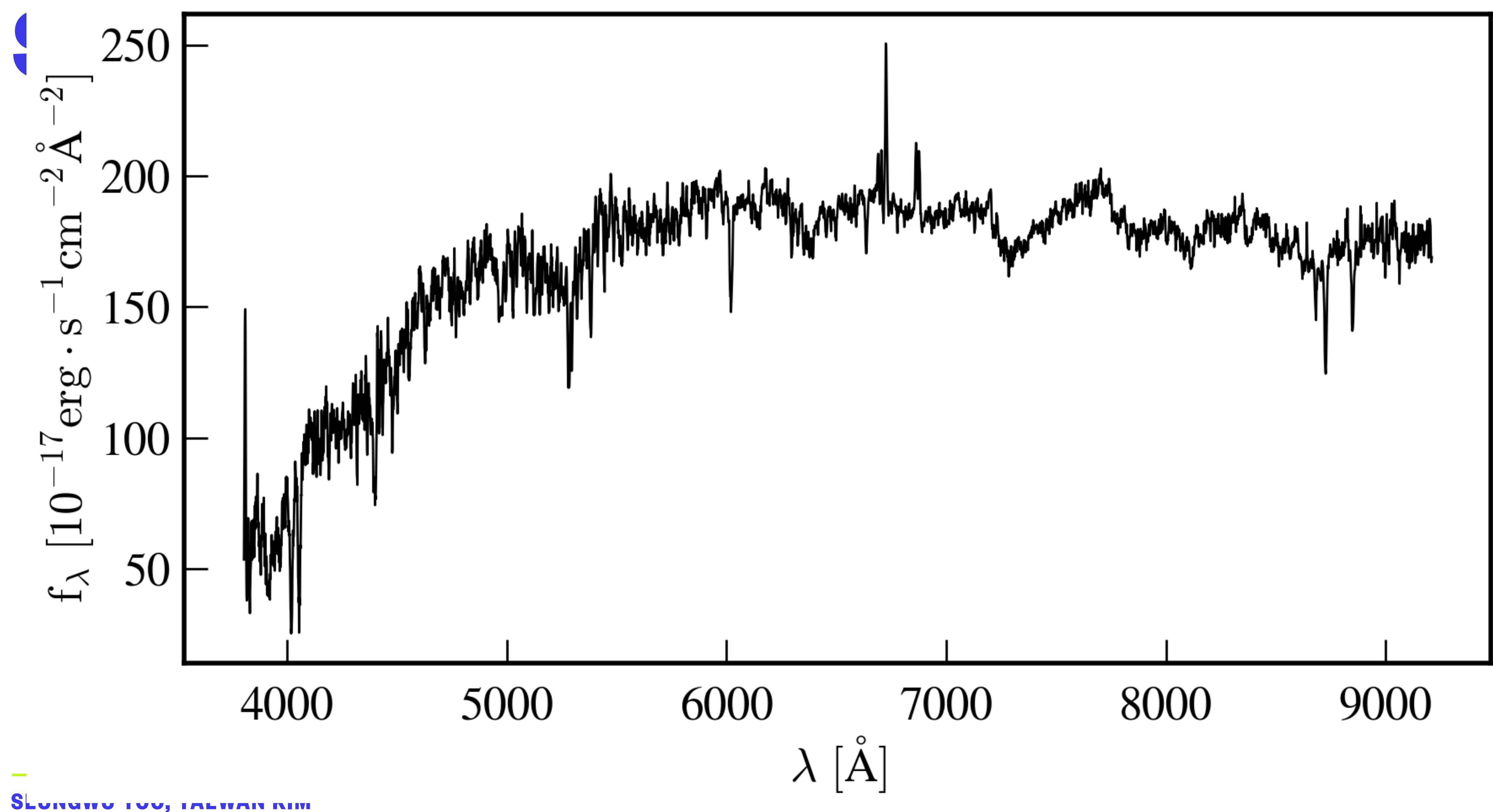
- Galaxies contain lots of stars, gas and dust
- What can we know from the spectrum of galaxies?

Spectrum of galaxies?

- Galaxies contain lots of stars, gas and dust
- What can we know from the spectrum of galaxies?
 - Kinematics
 - Composition

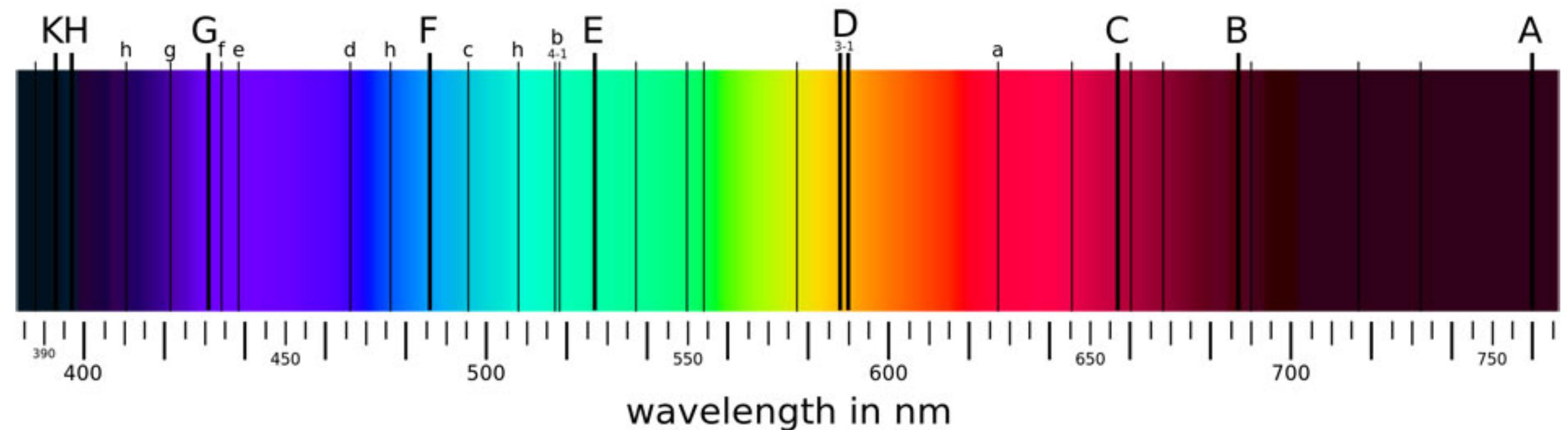
Spectrum of galaxies?

- Galaxies contain lots of stars, gas and dust
- What can we know from the spectrum of galaxies?
 - Kinematics
 - Composition
 - **Redshift** ($((\lambda_{obs} - \lambda_{emit})/\lambda_{emit} = z)$)



Fraunhofer line

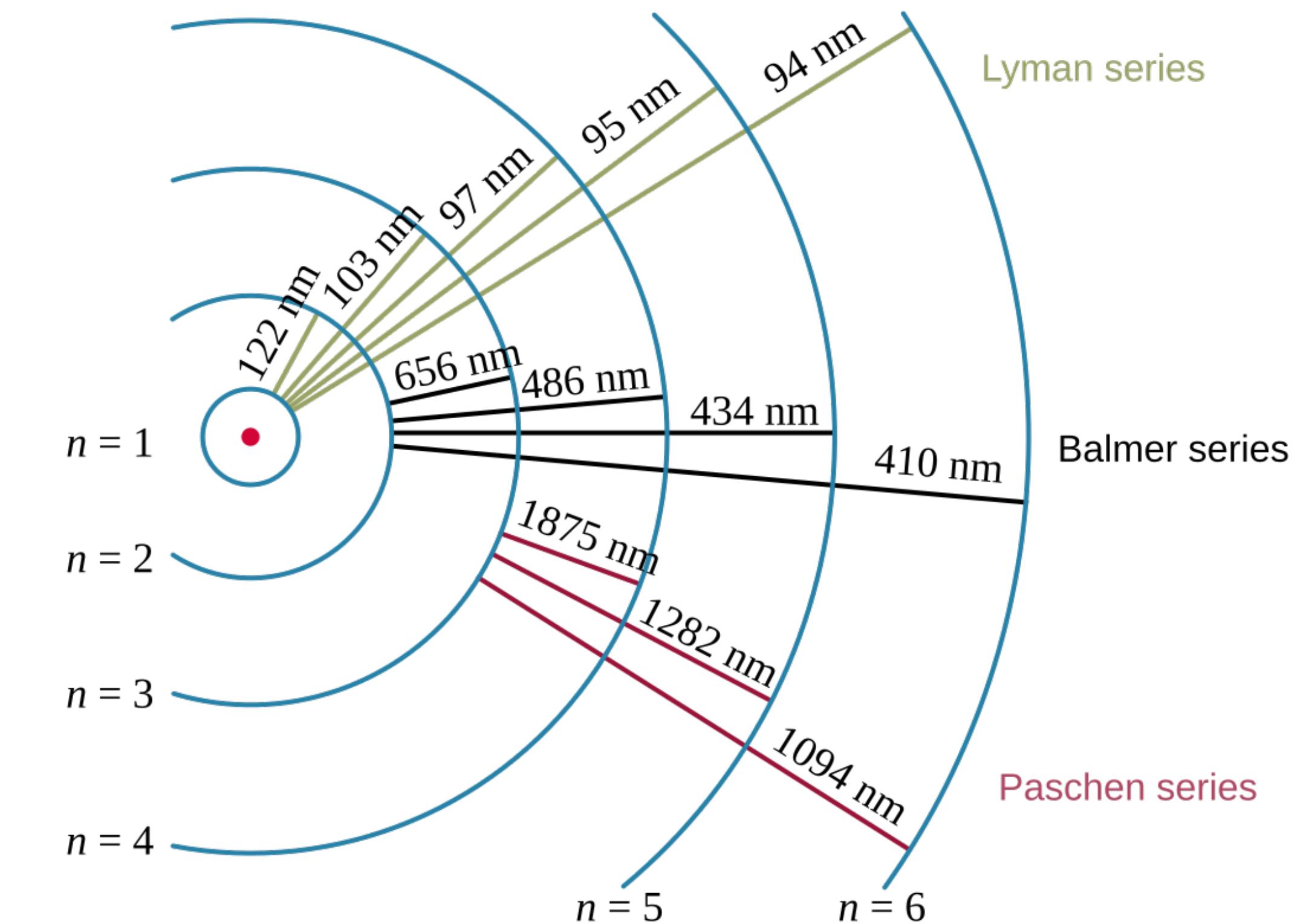
- Na D line, Ca II H&K lines etc..



- Especially, Ca II H & K lines are efficient (because, they are located at 'cliff' of 4000 Angstrom)

Balmer series

- H alpha, beta..etc
- Lyman series -> UV
- Paschen series -> IR
- In optical, Balmer series is the best



SDSS navigator

Select Image Source : SDSS 2MASS

DR16

Home | Help | Tutorial | Chart | List | Explore |

Parameters

name	Resolve
ra	195.838768 deg
dec	14.37701313 deg
opt	SQ

Search

+ -

Drawing options

- Grid
- Label
- Photometric objects
- Objects with spectra
- Invert Image
- Advanced options
- APOGEE Spectra
- SDSS Outlines
- SDSS Bounding Boxes
- SDSS Fields
- SDSS Masks
- SDSS Plates

Powered by
SciServer

Click, hold and drag to navigate!!

N
E [195.83806,14.37726] W
S

Selected object

ra	195.83844
dec	14.37751
type	GALaxy
u	15.72
g	14.04
r	13.21
i	12.80
z	12.51

Quick Look

Explore

Recenter

Add to notes

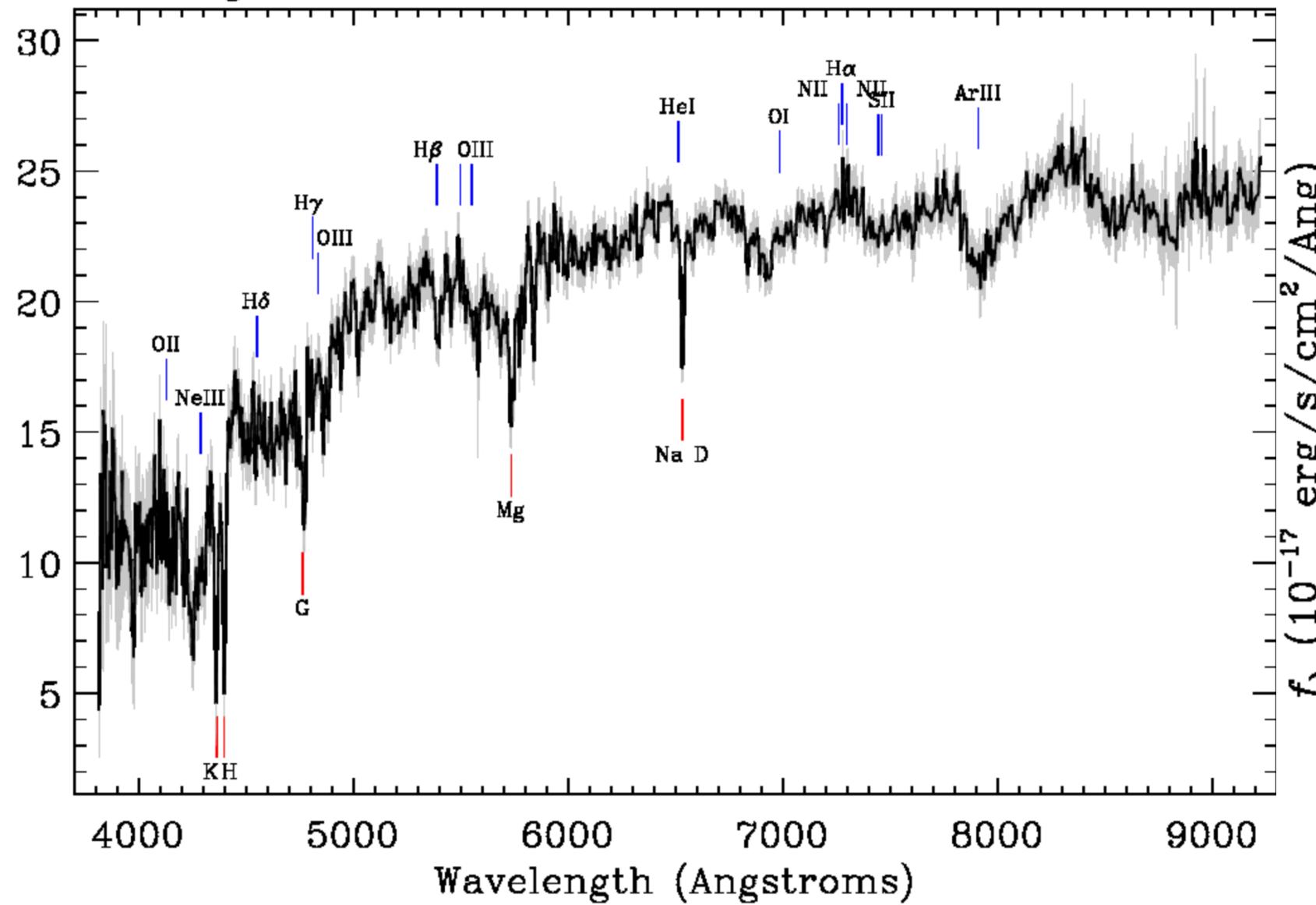
Show notes

Click!

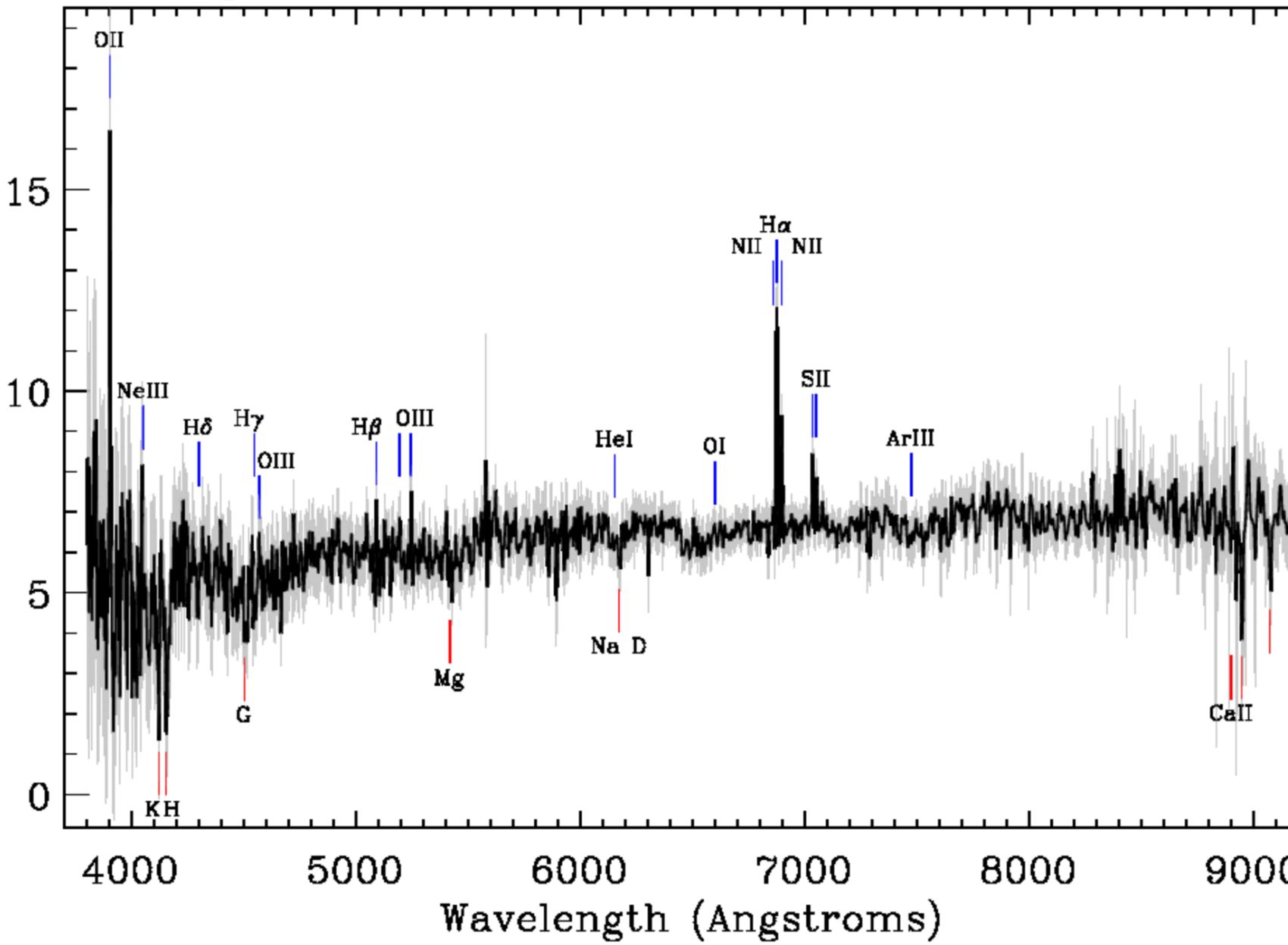
SDSS navigator

- Spectroscopy helps to distinguish the type of galaxies

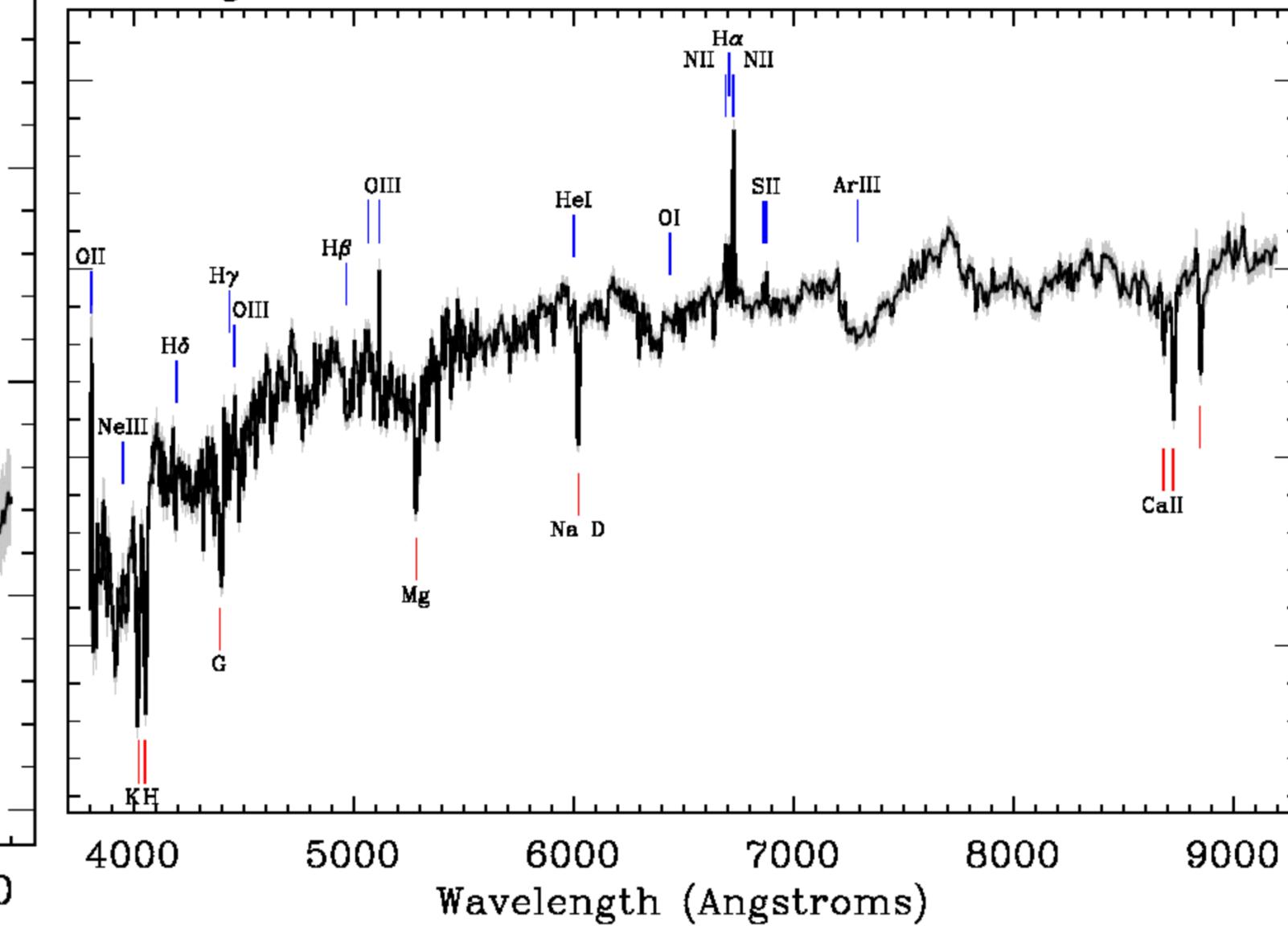
Survey: *sdss* Program: *legacy* Target: *GALAXY*
RA=179.92817, Dec=-0.04778, Plate=285, Fiber=495, MJD=51930
 $z=0.10811\pm0.00002$ Class=GALAXY
No warnings.



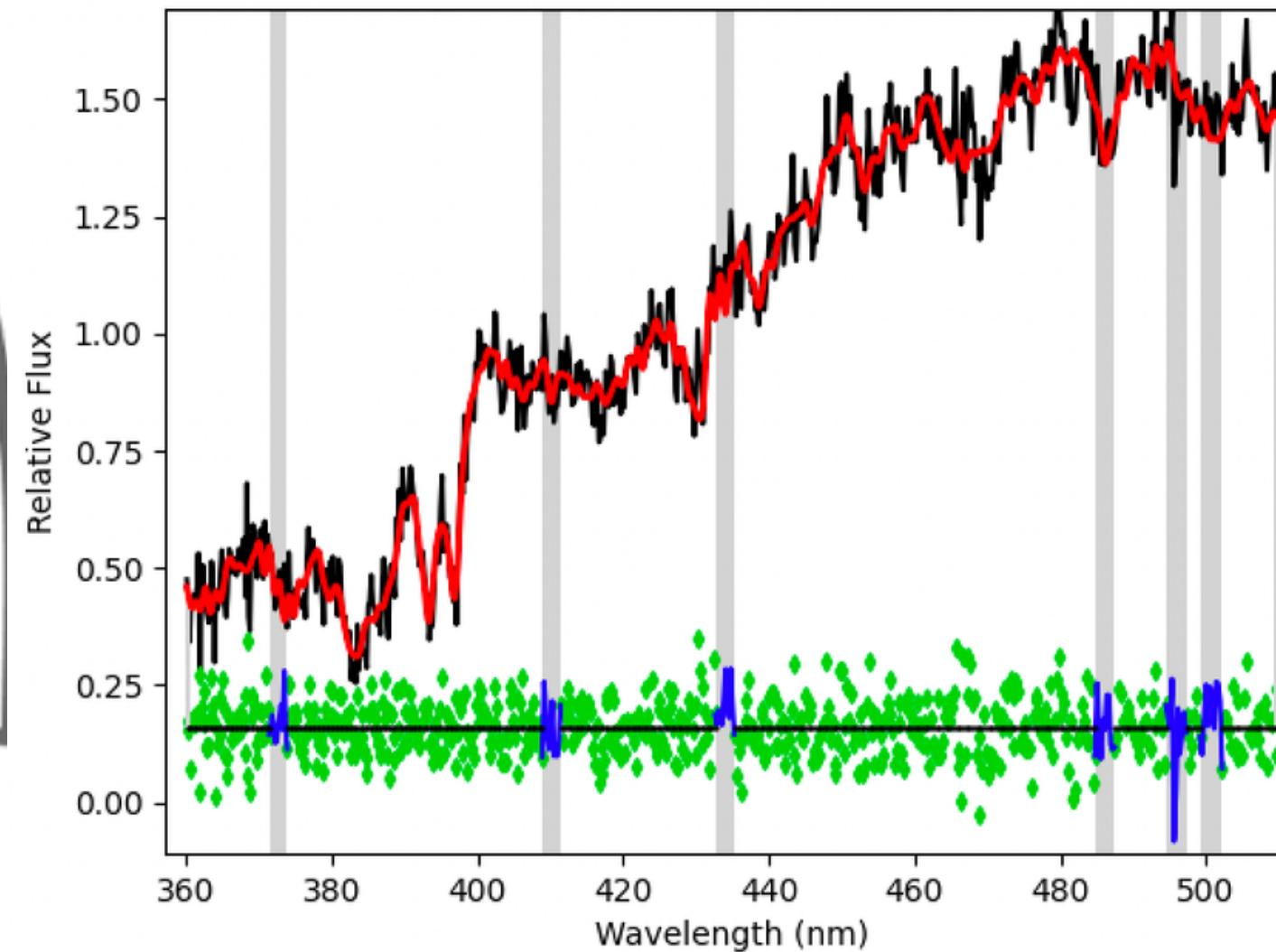
Survey: *sdss* Program: *legacy* Target: *GALAXY*
RA=179.85167, Dec=-0.41092, Plate=285, Fiber=191, MJD=51930
 $z=0.04724\pm0.00002$ Class=GALAXY STARFORMING
No warnings.



Survey: *sdss* Program: *legacy* Target: *GALAXY_RED GALAXY*
RA=179.80368, Dec=-0.52381, Plate=285, Fiber=181, MJD=51930
 $z=0.02134\pm0.00001$ Class=GALAXY AGN
No warnings.



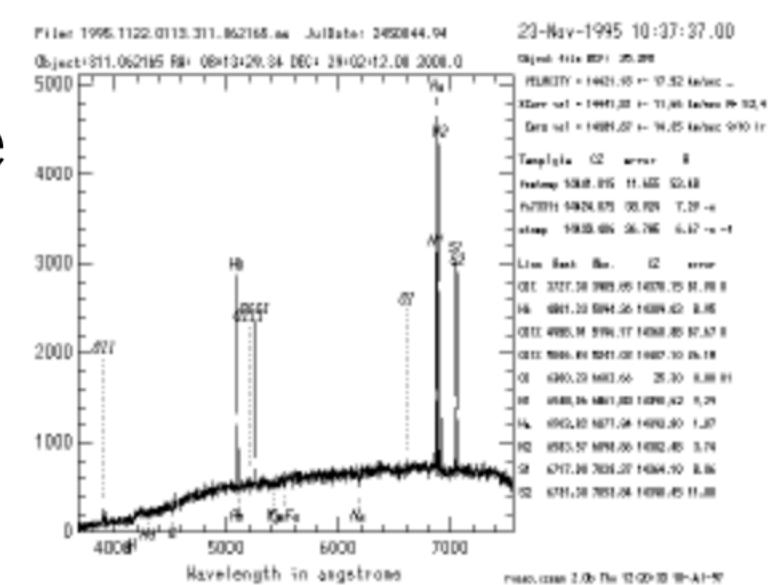
Several tools



RVSAO 2.8.5 An IRAF Radial Velocity Package

By Jessica Mink, SAO Telescope Data Center, March 15, 2022
RVSAO is an IRAF add-on package developed at the Smithsonian Astrophysical Observatory Telescope Data Center to obtain radial velocities from spectra using cross-correlation and emission line fitting techniques.

[Download the latest version, 2.8.5 \(March 15, 2022\).](#)
[See the references for this package.](#)



RVSNUPy: A Python Package for Spectroscopic Redshift Measurement Based on Cross-Correlation

Taewan Kim, Jubee Sohn, Ho Seong Hwang

We introduce RVSNUPy, a new Python package designed to measure spectroscopic redshifts. Based on inverse-variance weighted cross-correlation, RVSNUPy determines the redshifts by comparing observed spectra with various rest-frame template spectra. We test the performance of RVSNUPy based on ~ 6000 objects in the HectoMAP redshift survey observed with both SDSS and MMT/Hectospec. We demonstrate that a slight redshift offset (~ 40 km/s) between SDSS and MMT/Hectospec measurements reported from previous studies results from the small offsets in the redshift template spectra used for SDSS and Hectospec reductions. We construct the universal set of template spectra, including empirical SDSS template spectra, carefully calibrated to the rest frame. Our test for the HectoMAP objects with duplicated observations shows that RVSNUPy with the universal template spectra yields the homogeneous redshift from the spectra obtained with different spectrographs. We highlight that RVSNUPy is a powerful redshift measurement tool for current and future large-scale spectroscopy surveys, including A-SPEC, DESI, 4MOST, and Subaru/PFS.



(Tentative) HW

- Figure out the redshift of 20 given galaxies (or more)

