

# PRELIMINARY WORK FOR LECTURE 17.9.

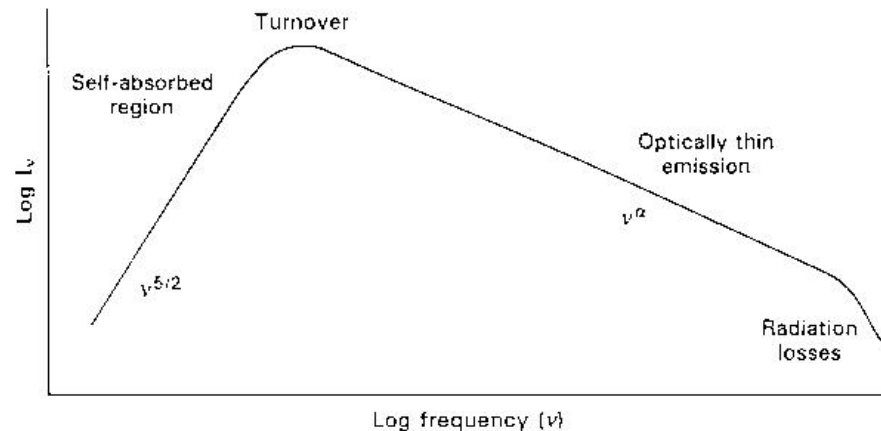
---

- ▶ Read these slides to learn about the following concepts needed on the next lecture about emission mechanisms and the radio Milky Way:
  - ▶ Spectral index (recap from ELEC-E4210 Introduction to Space)
  - ▶ Polarisation
  - ▶ Faraday rotation
  - ▶ Zeeman splitting



# RECAP on SPECTRAL INDEX $\alpha$

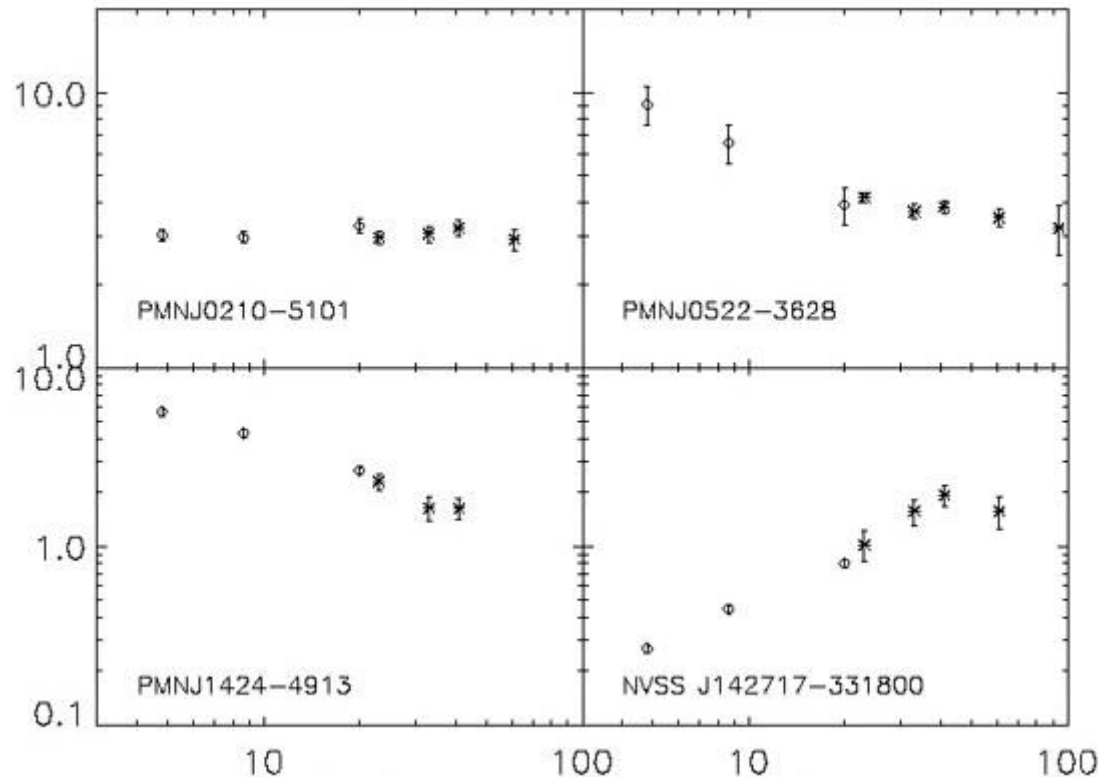
- ▶ Flux density  $S \propto \nu^\alpha$  (used to be  $S \propto \lambda^\alpha$ , always remember to define which one you are using!)
- ▶ Steepness of the slope in a flux density vs. frequency plot
  - ▶ for thermal sources typically  $\alpha=+2$
  - ▶ for the optically thick part of the synchrotron spectrum  $\alpha=+2.5$ , and  $\alpha \approx -0.5$  for the optically thin



# SPECTRAL INDEX $\alpha$

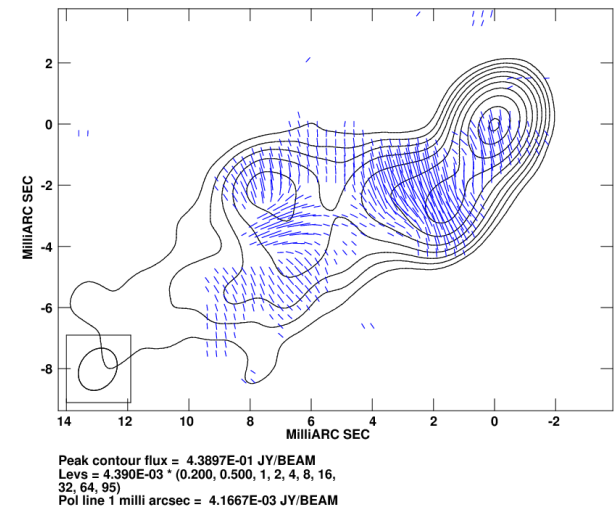
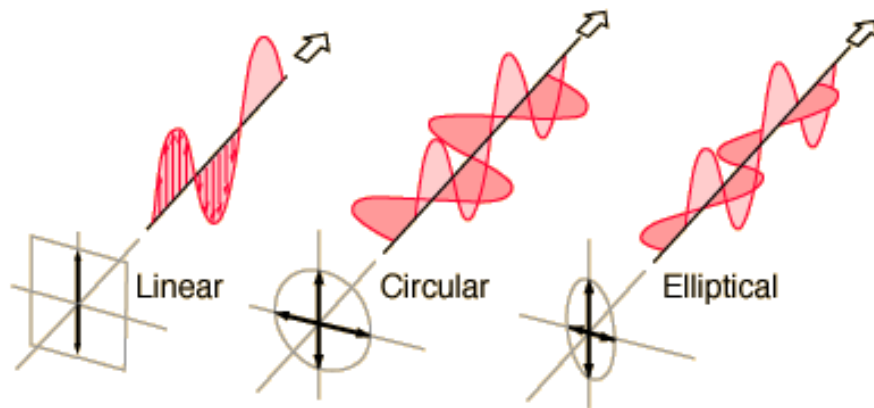
- Usually the spectral index  $\alpha$  is calculated between two frequencies (for example, quasars):

$$\alpha_{(f_1-f_2)} = \frac{\log(S_1/S_2)}{\log(f_1/f_2)}$$



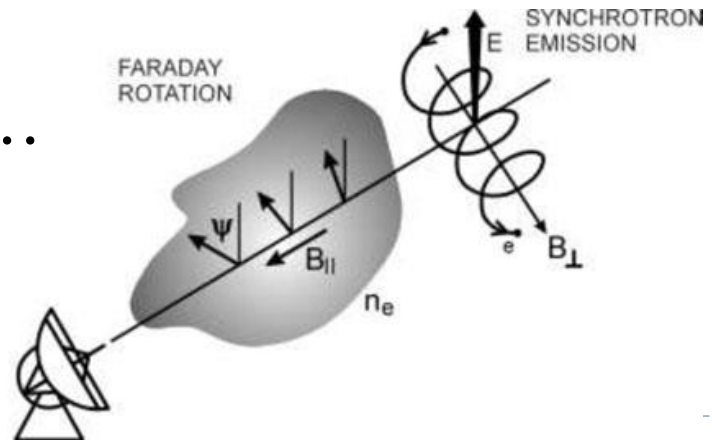
# POLARISATION

- ▶ An electromagnetic wave vibrates in one plane along propagation: linear polarisation.
- ▶ Two em waves of equal amplitude with  $90^\circ$  difference in phase rotate: right and left circular polarisation.
- ▶ Measurement of the magnetic field: galaxies, active galactic nuclei, starlight, masers...



# FARADAY ROTATION

- ▶ Rotation of the plane of polarization; proportional to the component of the magnetic field in the direction of propagation.
- ▶ Caused by left and right-circularly polarised waves propagating at slightly different speeds.
- ▶ Depends on the intervening medium.
- ▶ Measurement of the magnetic field: rotation measure  $\psi = RM \lambda^2$
- ▶ Active galactic nuclei, pulsars...



# ZEEMAN SPLITTING

- ▶ Splitting of atomic energy levels and therefore the spectral lines due to a magnetic field.
- ▶ The pattern and the number of split levels depend on the strength of the magnetic field.
- ▶ Measurement of the magnetic field: the Sun, masers, Milky Way...

