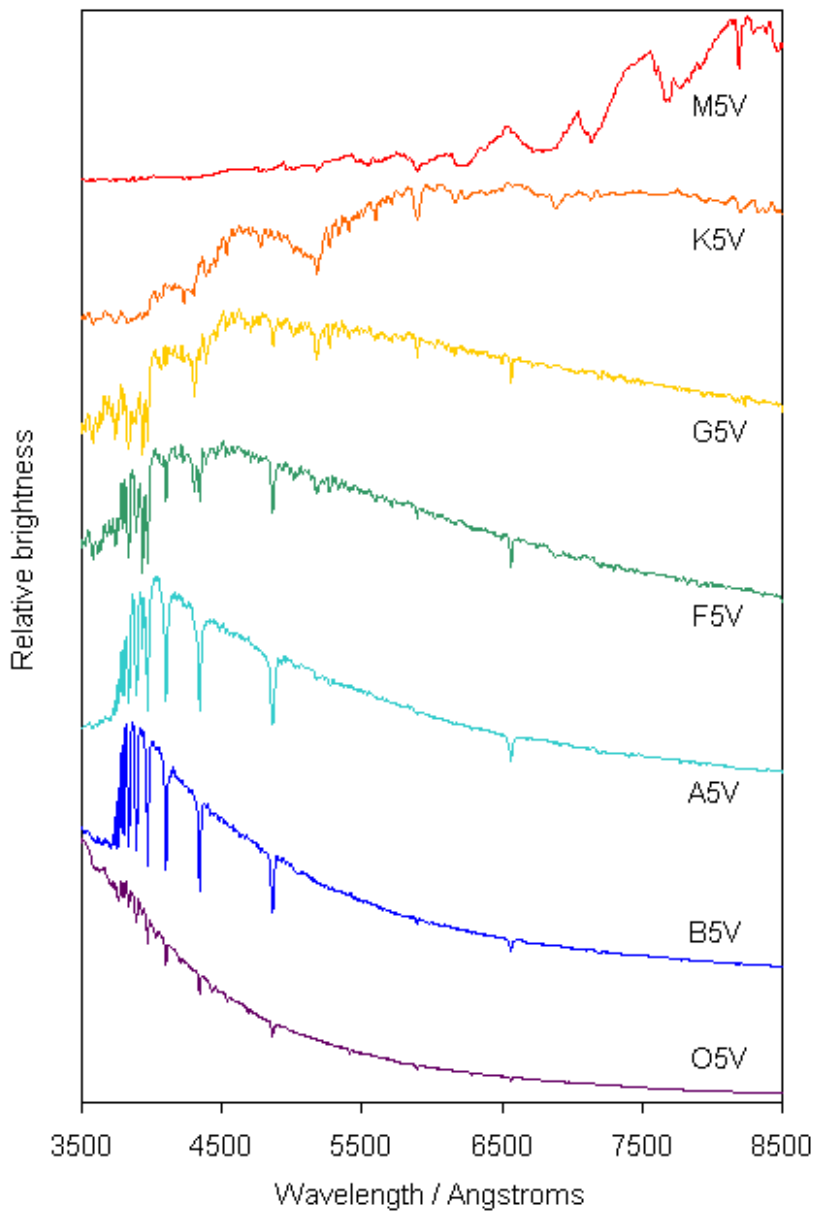
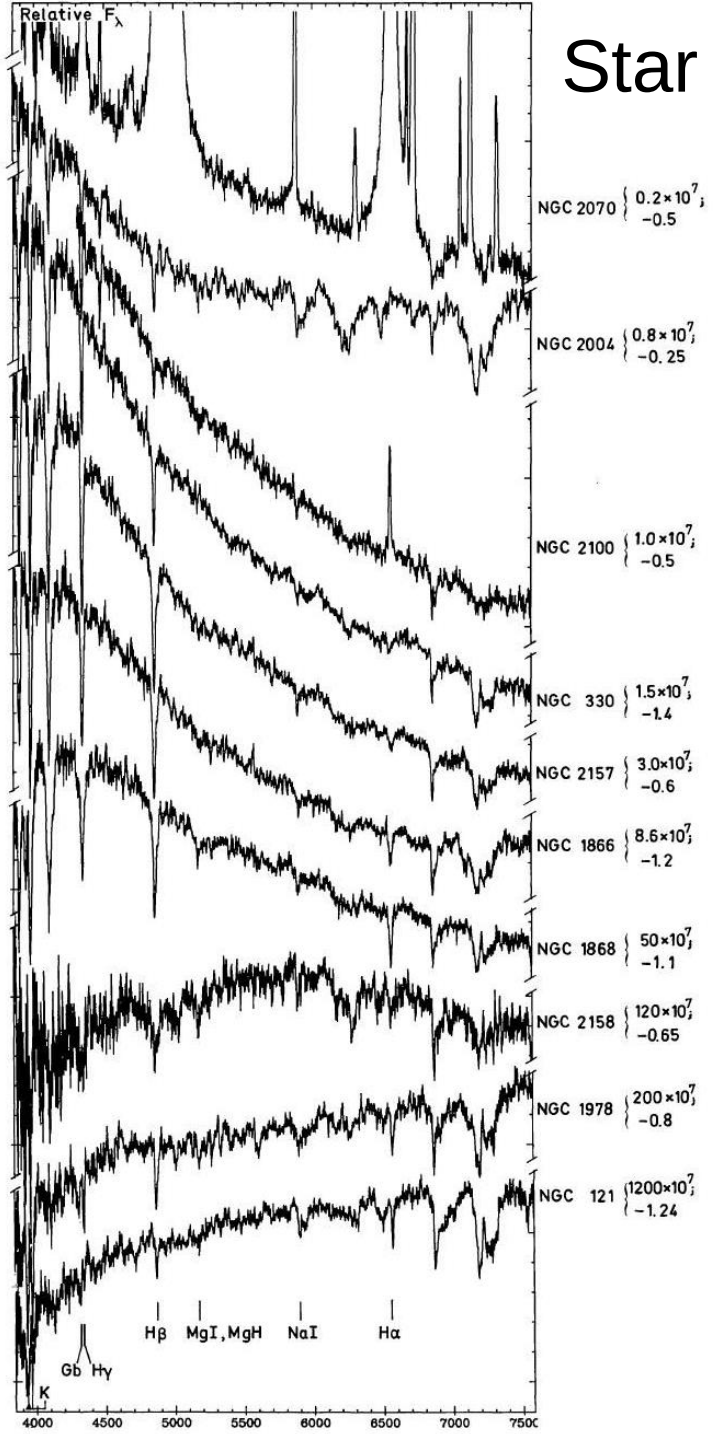




Star clusters

Age

Stellar Spectroscopy

- Resolution!
- Classification
- Determination of
  - [X/H]
  - Teff, log g
  - vsini
  - R_v
  - Binarity
  - Magnetic field
  - Emission, shell, ISM, … lines

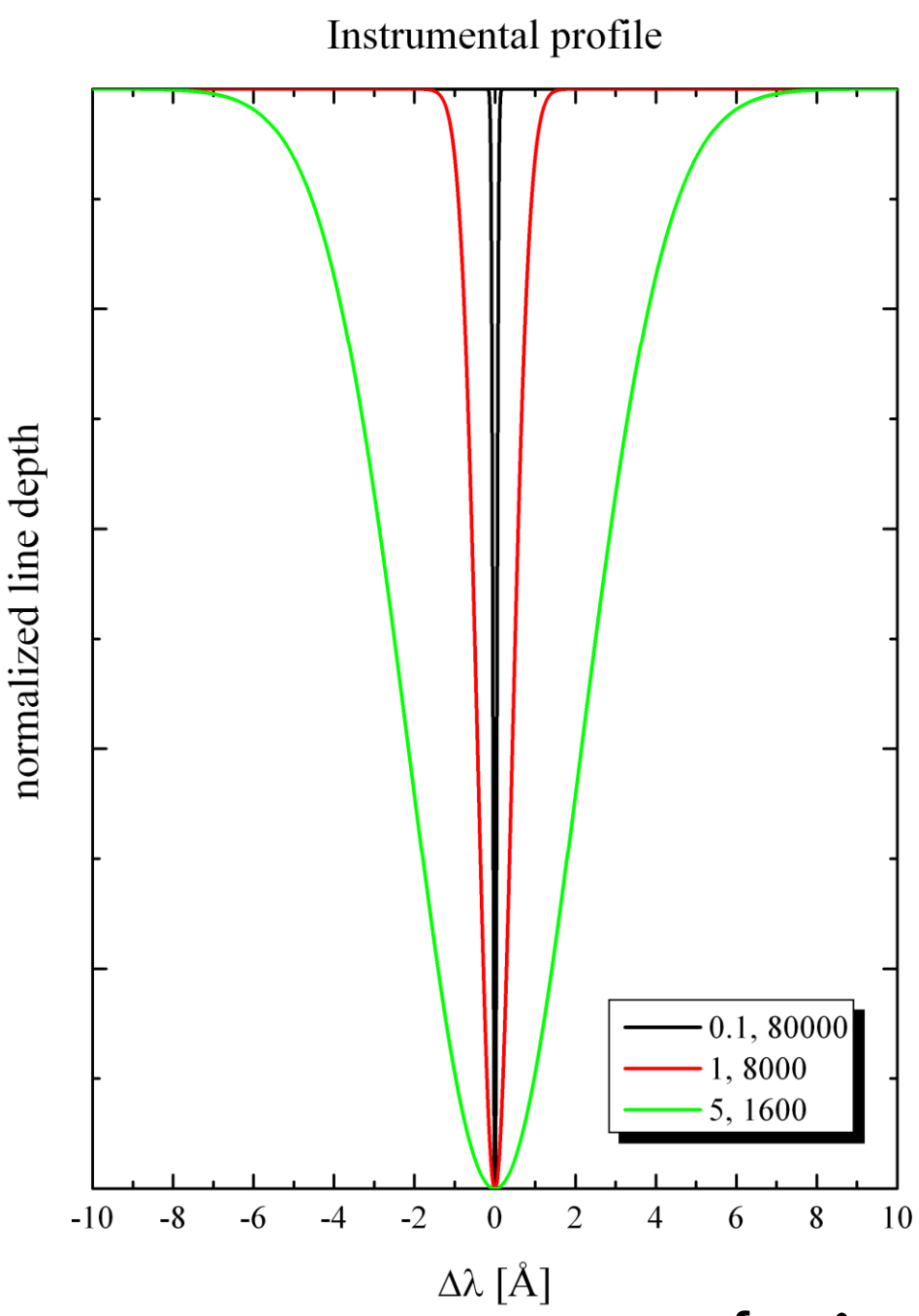
Instrumental profile defined by the resolution:

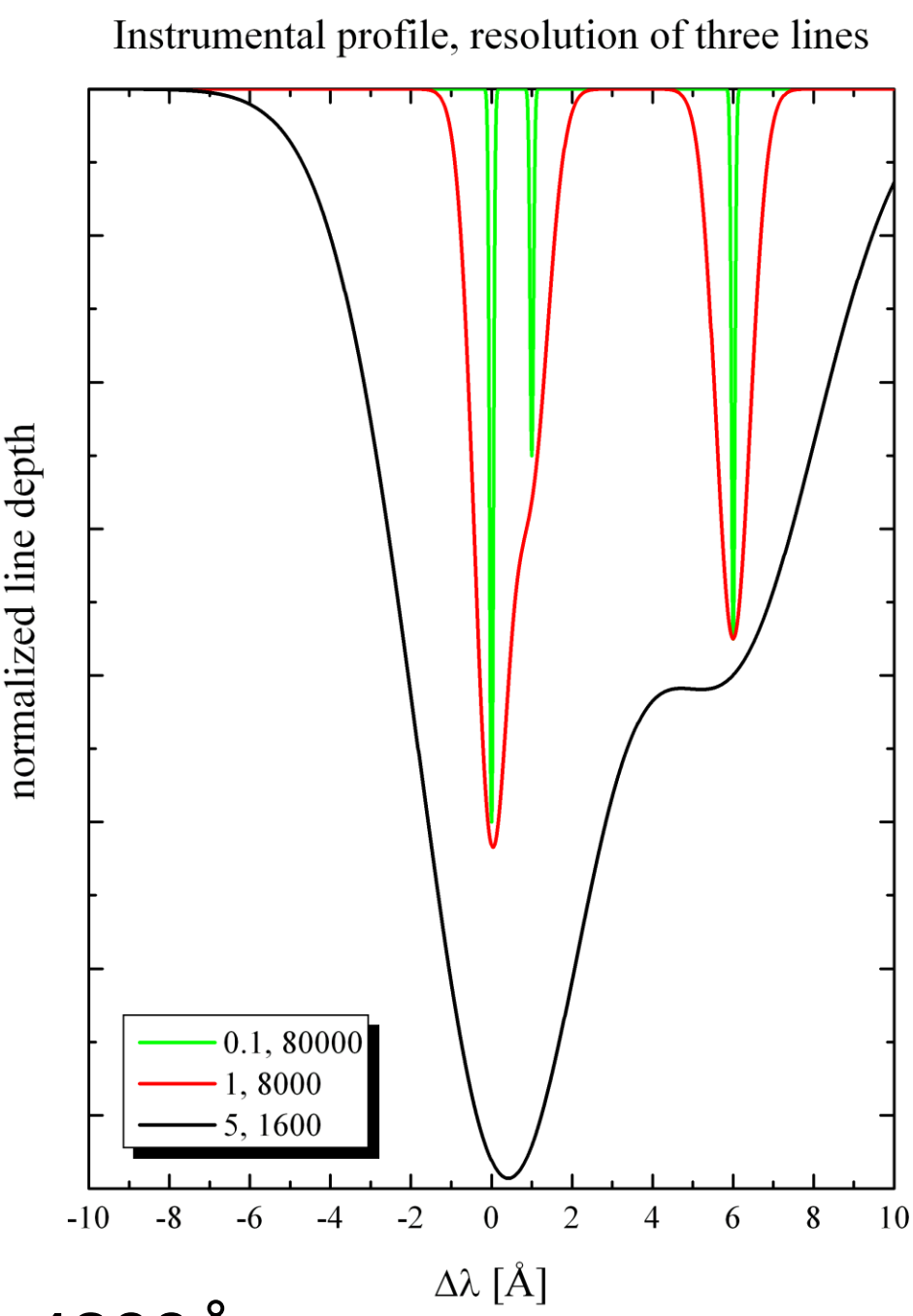
$$IP(\Delta\lambda) = \exp\left[-0.5\left(\frac{(\lambda-\Delta\lambda)}{\sigma}\right)^2\right] \text{ with } \sigma = \frac{FWHM}{2.355}$$

Rotational (profile) broadening:

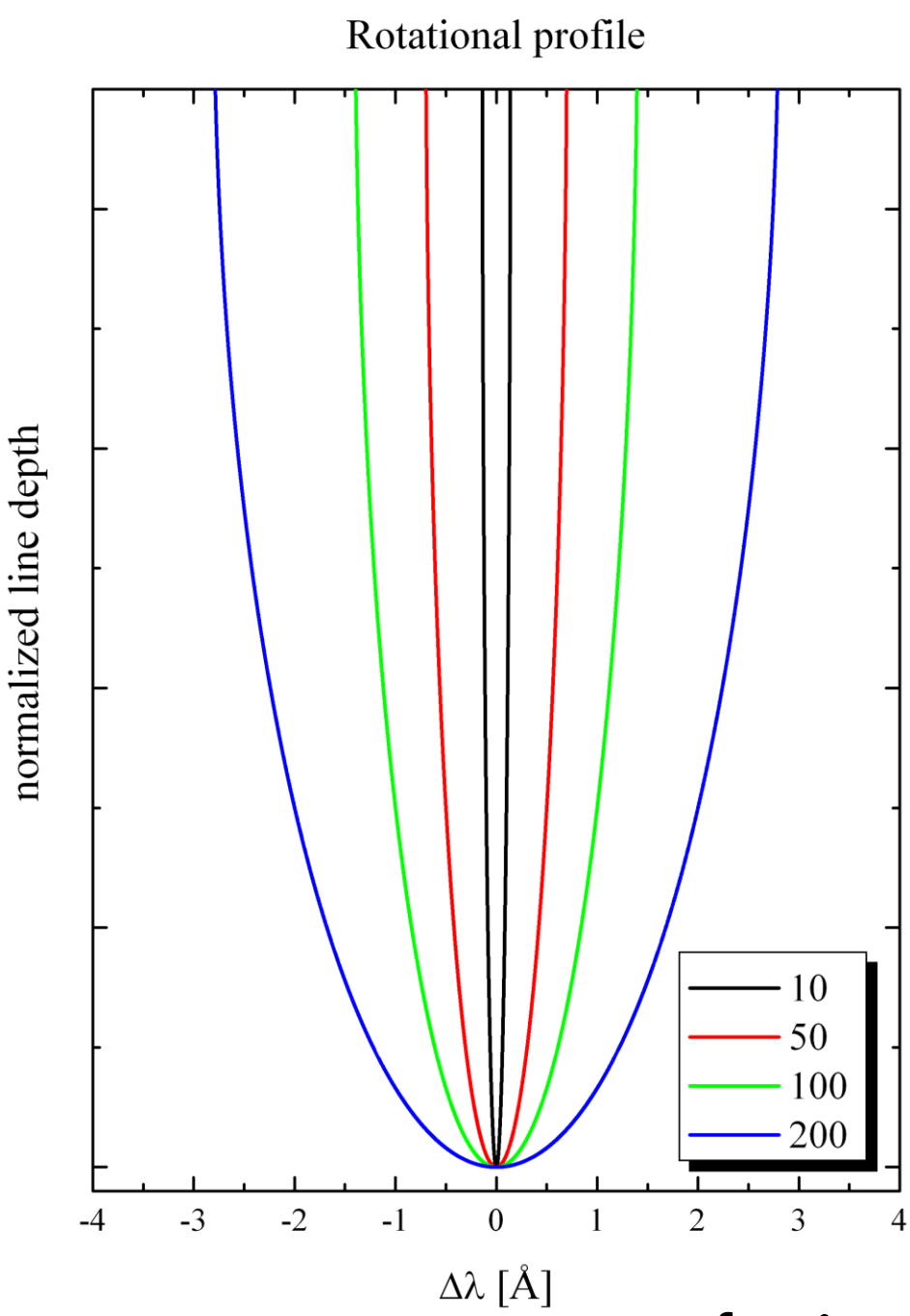
$$RP\ (\Delta\lambda) = c_1\sqrt{x} + c_2 x \quad \text{with} \quad x = 1 - \left(\frac{\Delta\lambda}{\Delta\lambda_L}\right)^2$$

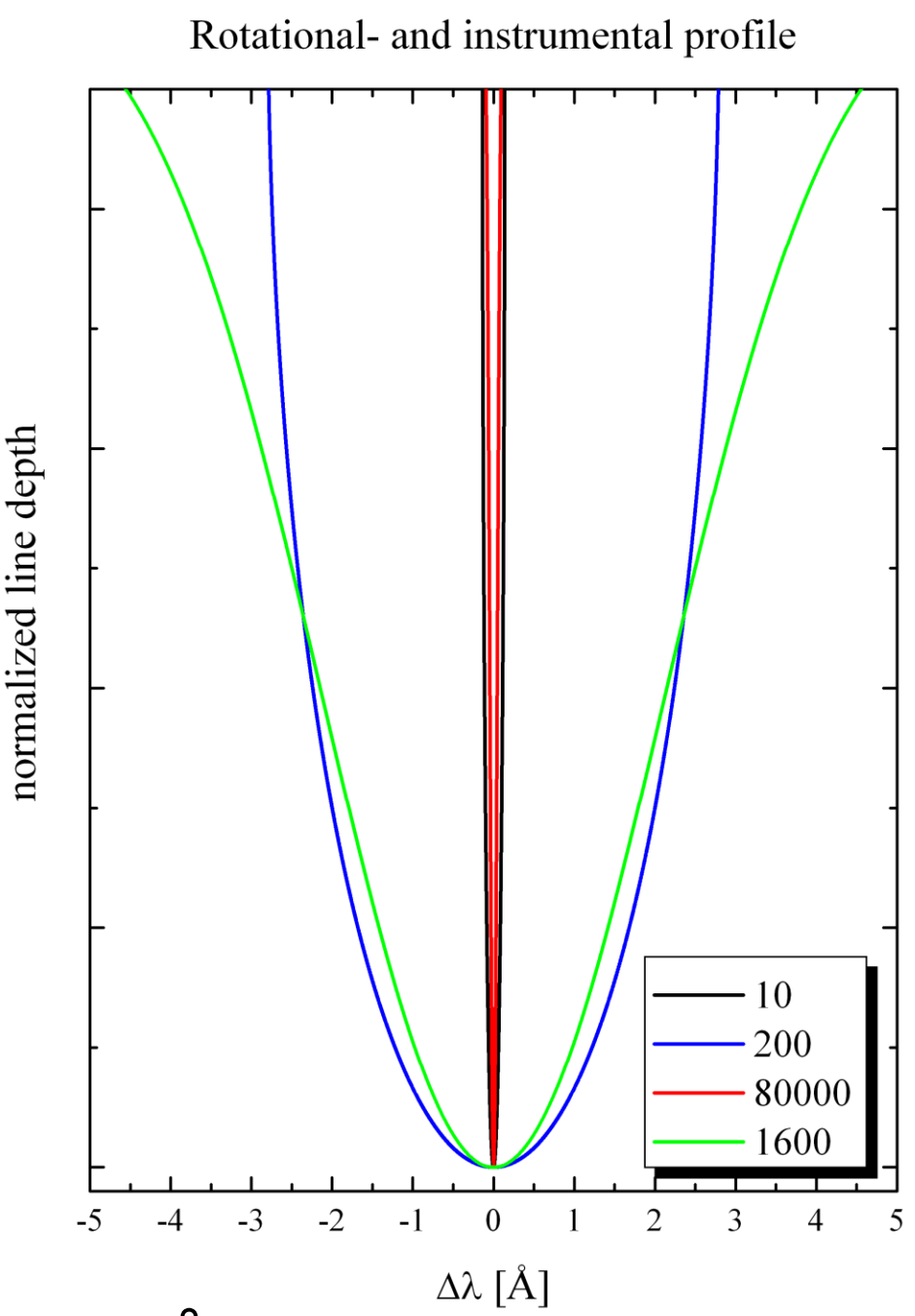
$$\Delta\lambda_L = \lambda\,\frac{v \sin\ i}{c}$$


Instrumental profile
normalized line depth
0.1, 80000
1, 8000
5, 1600
-10 -8 -6 -4 -2 0 2 4 6 8 10
Δλ [Å]

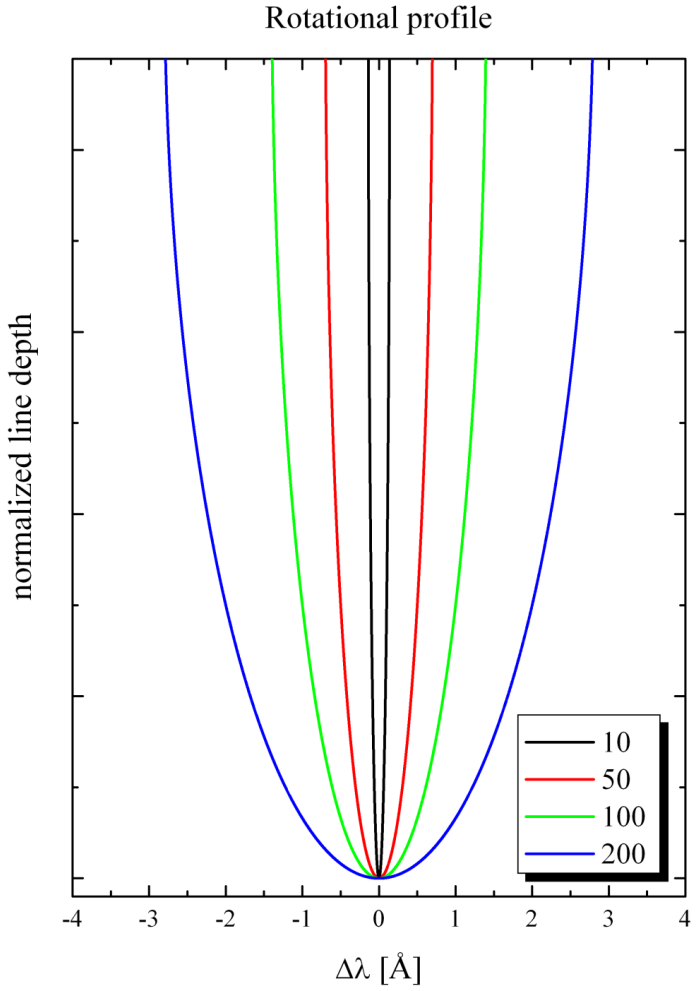

Instrumental profile, resolution of three lines
normalized line depth
0.1, 80000
1, 8000
5, 1600
-10 -8 -6 -4 -2 0 2 4 6 8 10
Δλ [Å]

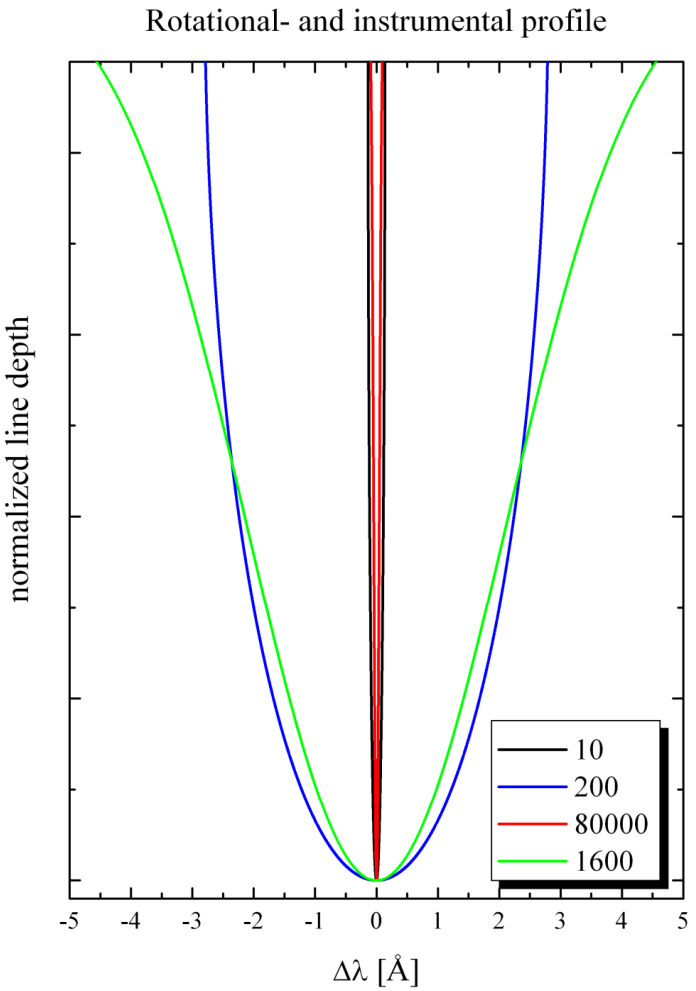
for λ = 4200Å


Rotational profile
normalized line depth
Δλ [Å]
10
50
100
200

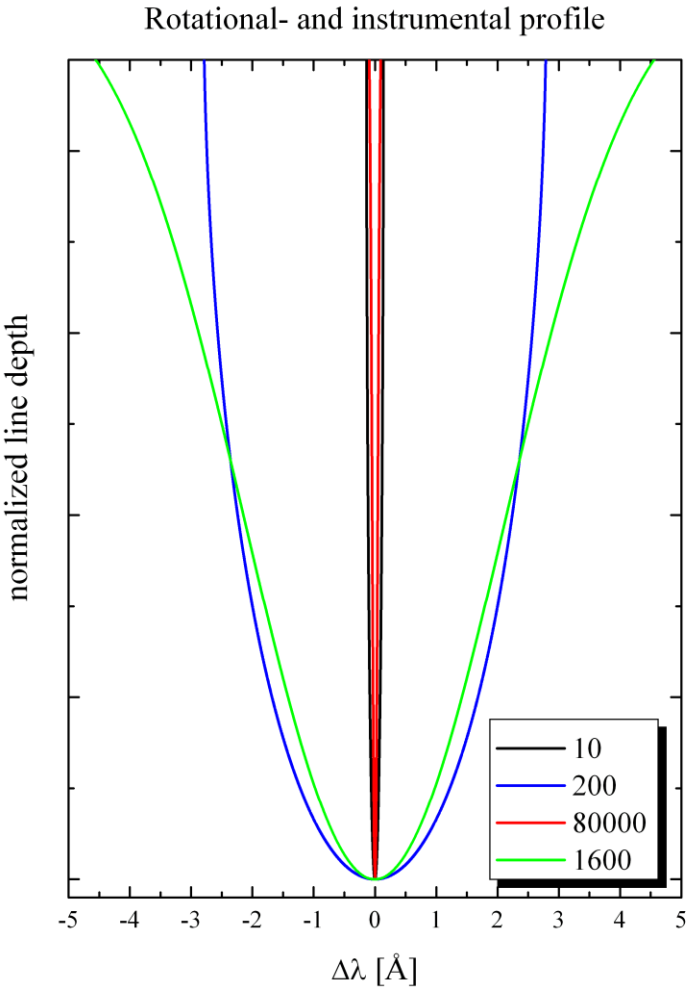

Rotational- and instrumental profile
normalized line depth
Δλ [Å]
10
200
80000
1600

for λ = 4200Å





To plan your observations: vsini = 200 km/s == resolution of about 1600; no „new“ information with higher resolution



Class IV		Class III		Class II	
Sp.	V*sini* km s^{-1}	Sp.	V*sini* km s^{-1}	Sp.	V*sini* km s^{-1}
F9	5.4	G1	6.4	G0	4.8
G0	5.4	G2	6.4	G1	3.5
G1	2.2	G3	6.4	G2	3.5
G2	2.2	G4	3.3	G3	3.5
G3	2.2	G5	3.3	G4	3.2
G4	2.2	G6	3.3	G5	3.2
G5	2.2	G7	2.1	G6	3.2
G6	2.2	G8	2.1	G7	2.9
G7	2.2	G9	2.1	G8	2.9
G8	2.2	K0	2.1	G9	2.9
G9	1.5	K1	2.0	K0	2.9
K0	1.5	K2	2.1	K1	2.9
K1	1.4	K3	1.6	K2	2.5
K2	1.4	K4	1.6	K3	2.7
K3	1.0	K5	2.0	K4	2.7
K4	1.3	K6	2.2	K5	2.9
		K7	2.2	K6	2.9
				K7	3.3

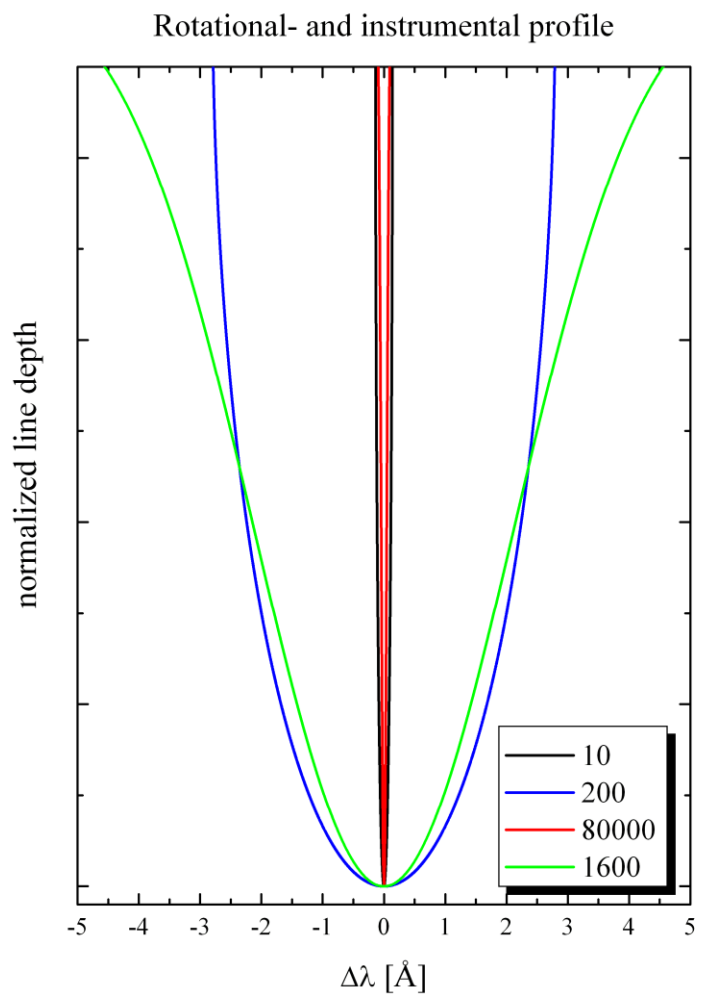
De Medeiros et al., 1996, A&A, 314 499

MEAN PROJECTED ROTATIONAL VELOCITIES (km s^{-1}) FOR NORMAL STARS

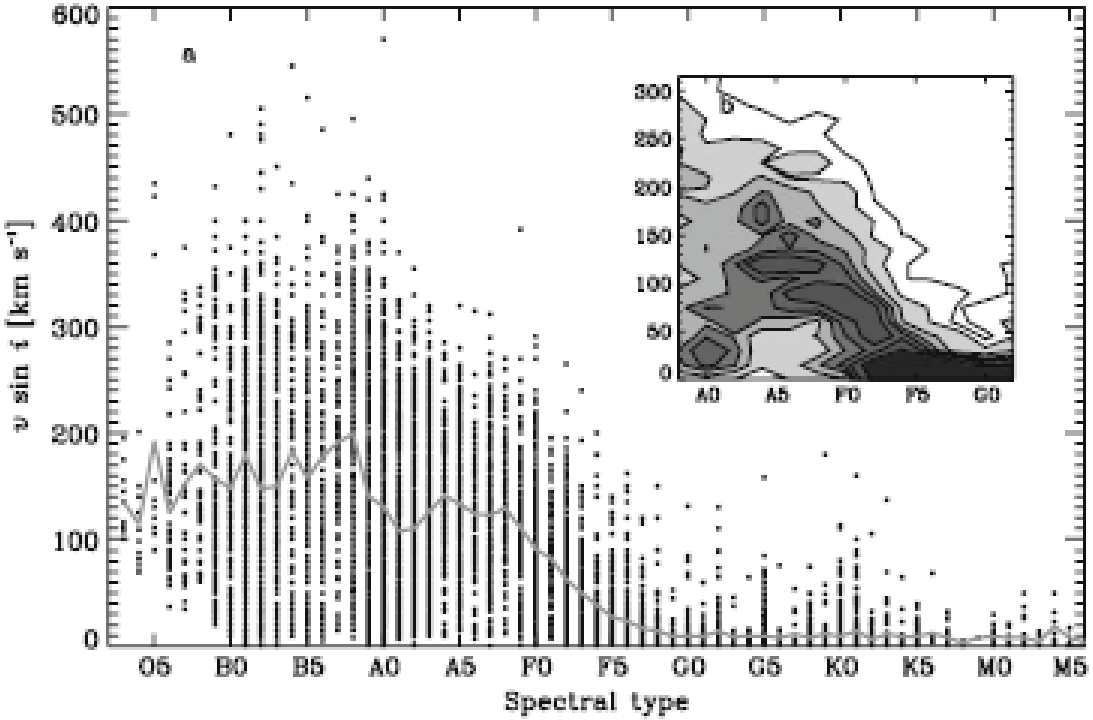
A. Class V

Type	A0	A1	A2	A3	A4	A5	A6	A7	A8	A9	F0
n	104	86	143	83	21	36	44	43	25	31	46
$\langle v \sin i \rangle$	150	131	132	124	147	148	138	112	114	132	106
s.e./mean	±7	7	5	7	13	8	7	8	11	8	7
s.e.	±68	61	61	64	56	46	45	54	52	44	50

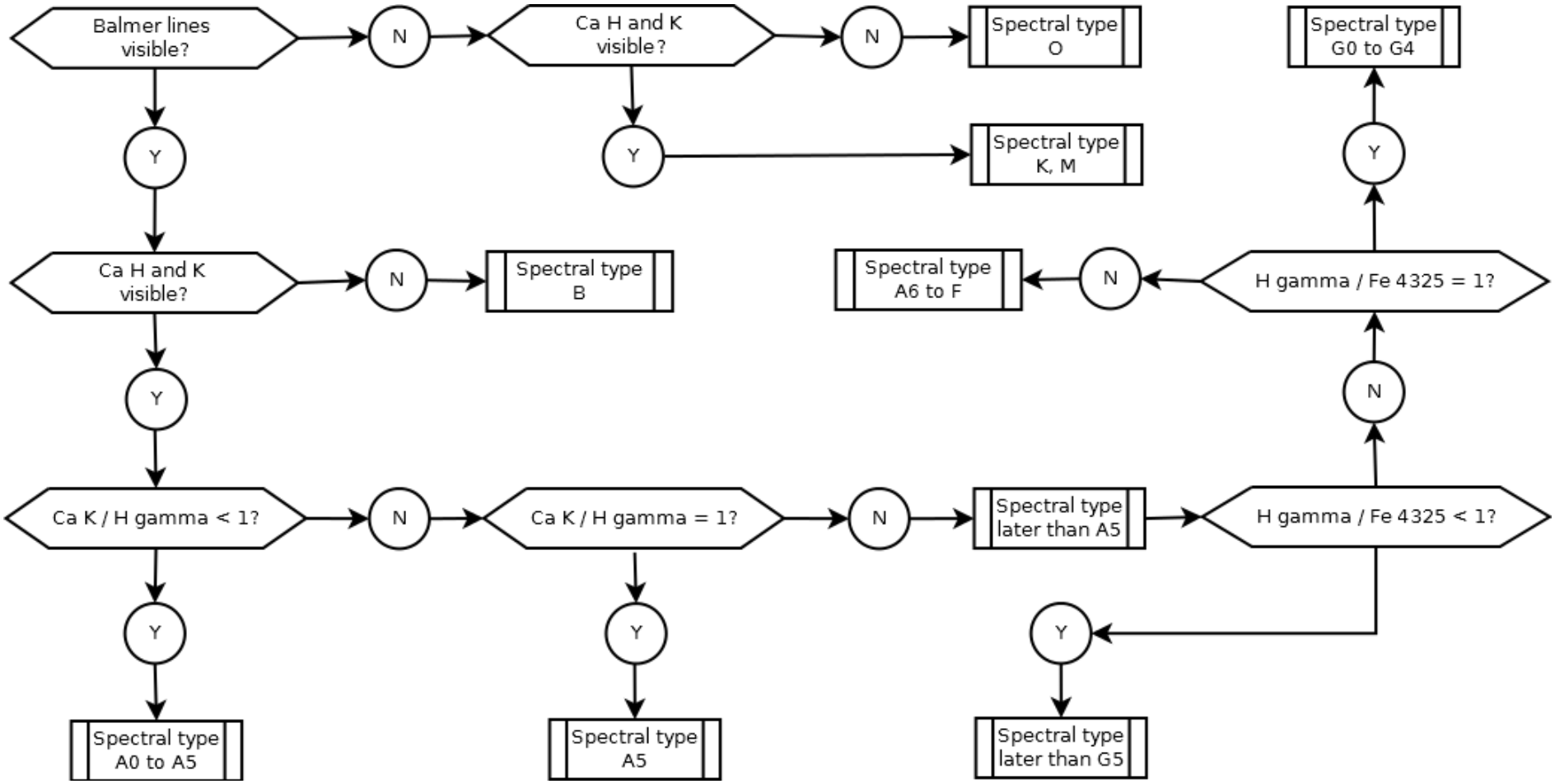
Abt & Morrell, 1995, ApJS, 99, 135



The rotation of the Sun and Stars

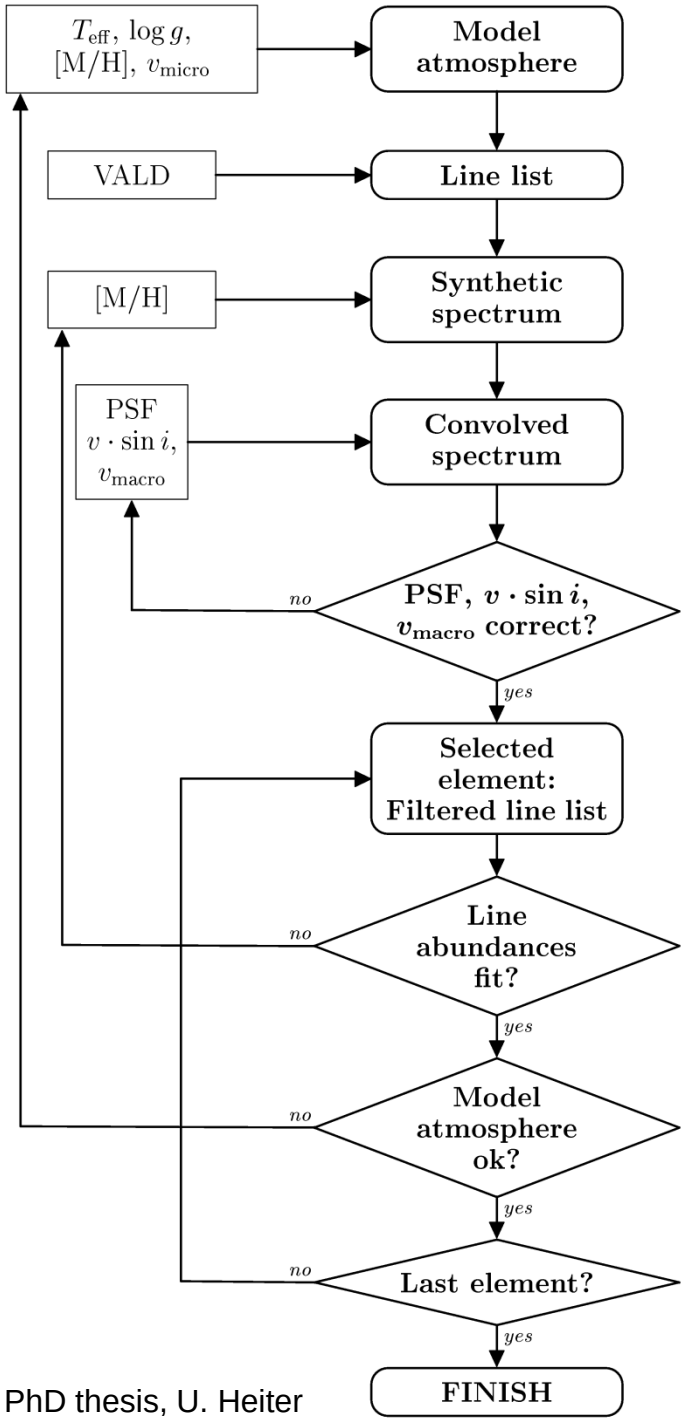


Spectral classification



Nice scheme for automatization

How to determine abundances and stellar parameters from a spectrum



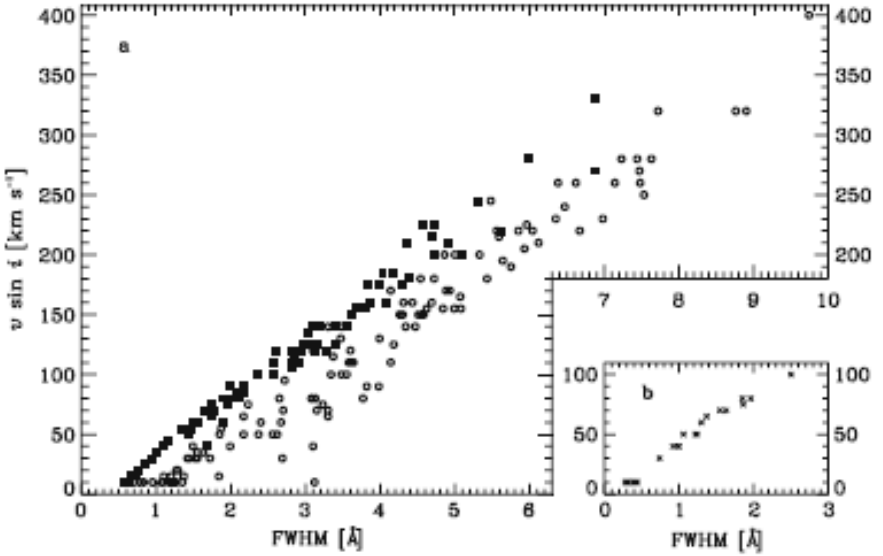
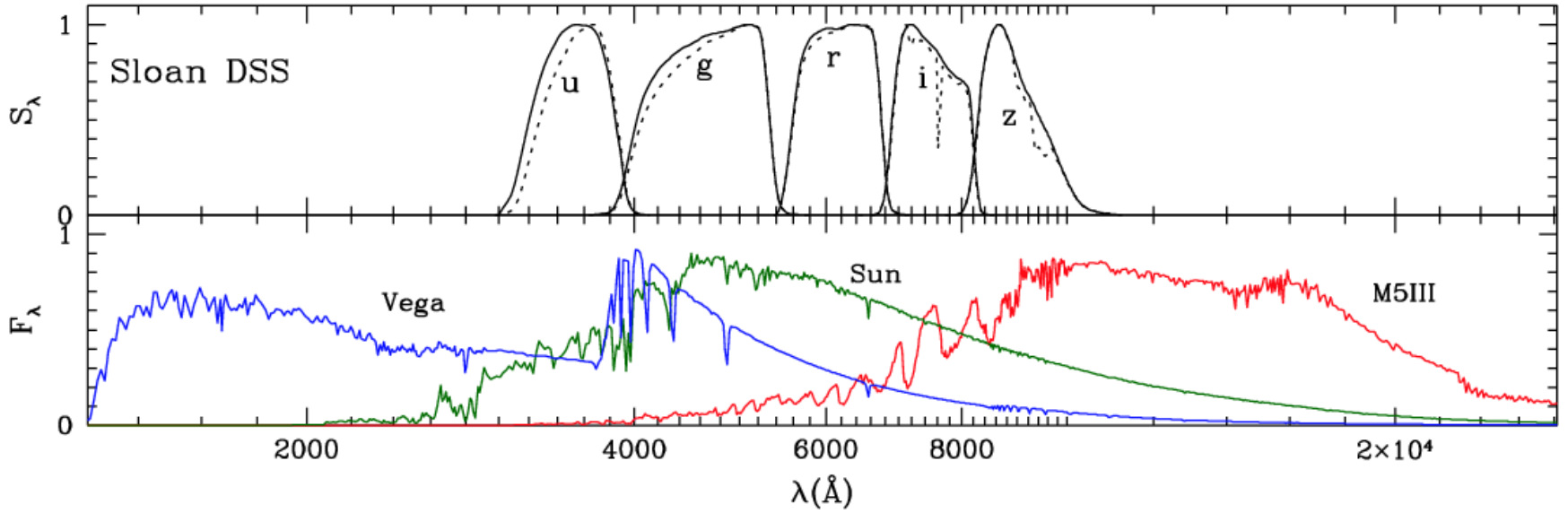


Fig. 4. Rotational velocity $v \sin i$ as a function of the full width at half maximum from the standard stars in [55]. (a) FWHM derived from the He I 4471 line (O9- to B8-type stars, *open circles*) and Mg II 4481 line (B8- to F0-type stars, *filled squares*). (b) FWHM derived from the Fe I 4476 line (F0- to F8-type stars, *crosses*)

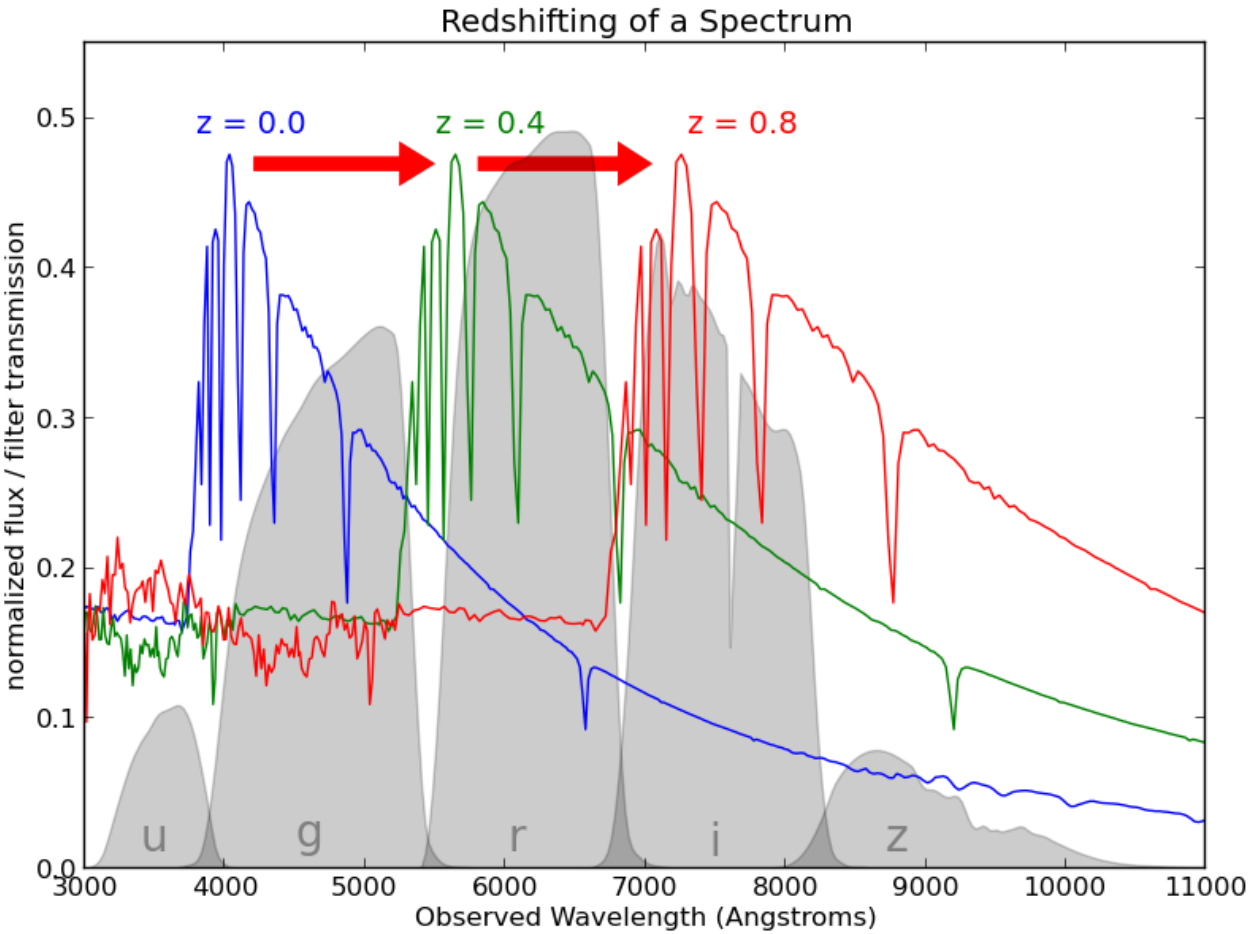
PhD thesis, U. Heiter

Photometry of stars and galaxies



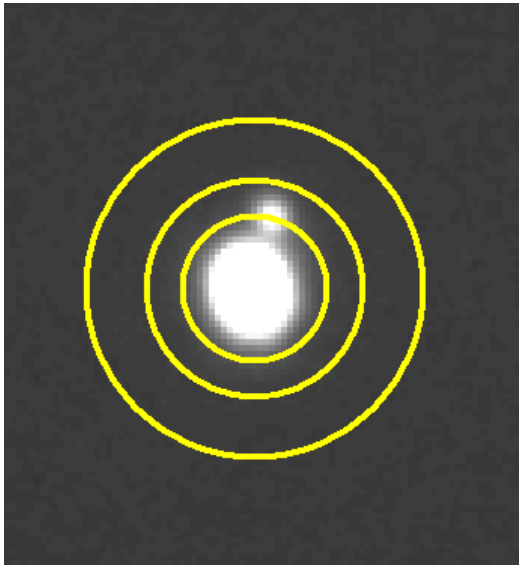
We measure different lines/characteristics of stars

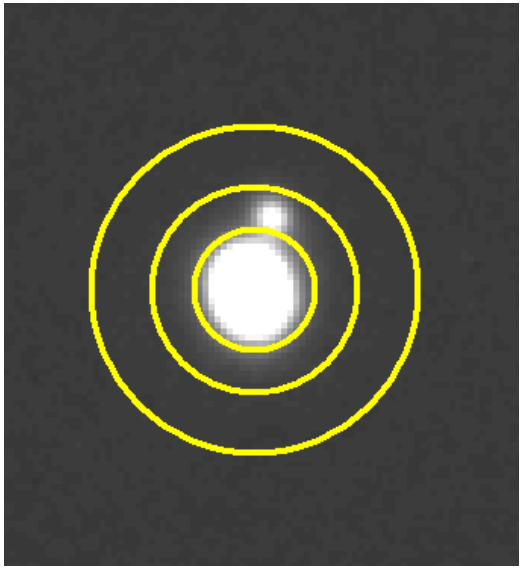
Photometry of stars and galaxies



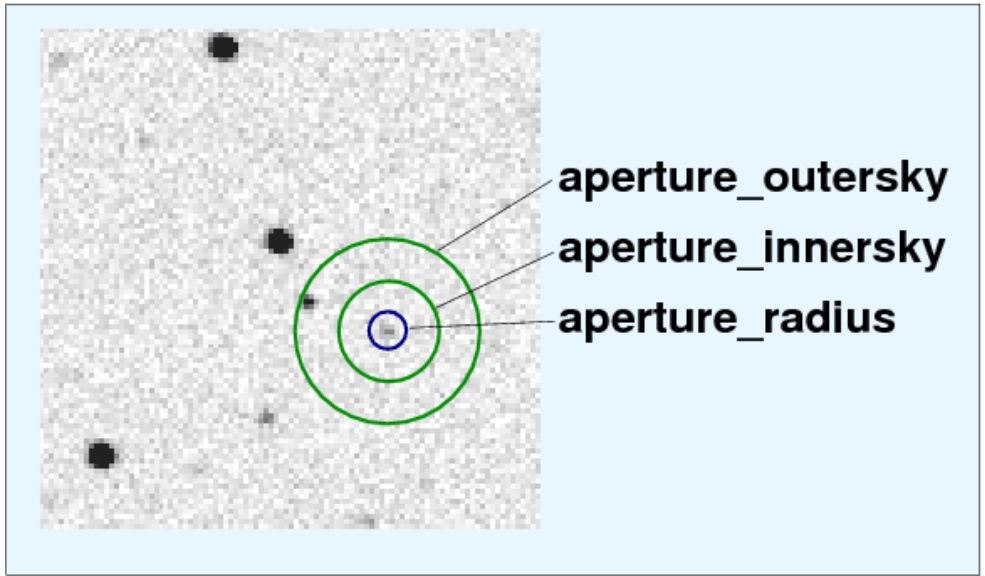
We measure different lines/characteristics of galaxies

- Photometry = low resolution spectroscopy





Not working in crowded fields



Aperture photometry, choice of aperture for target and sky

- Point Spread function fitting

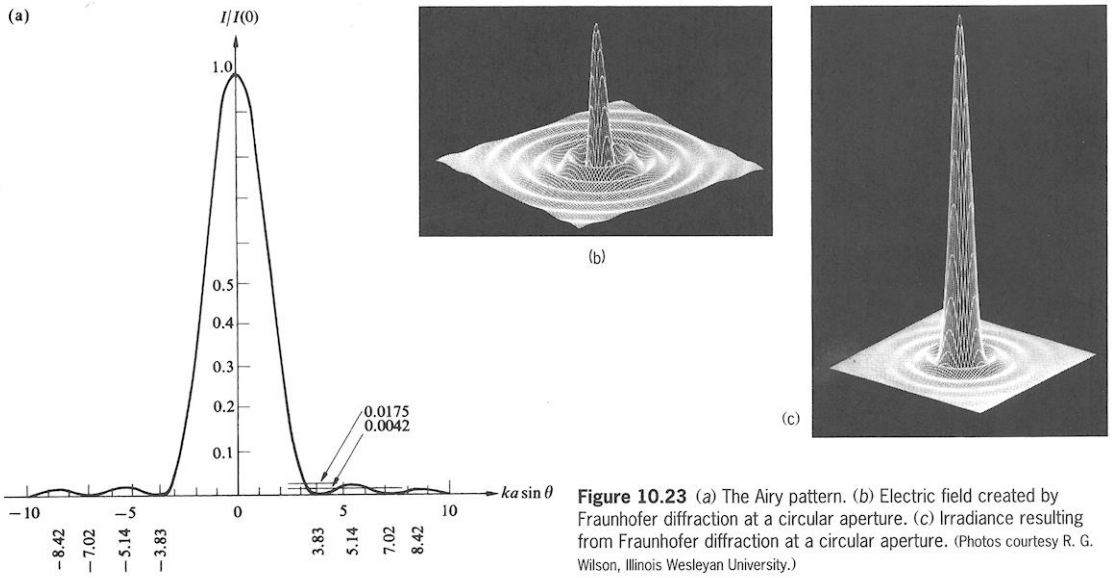
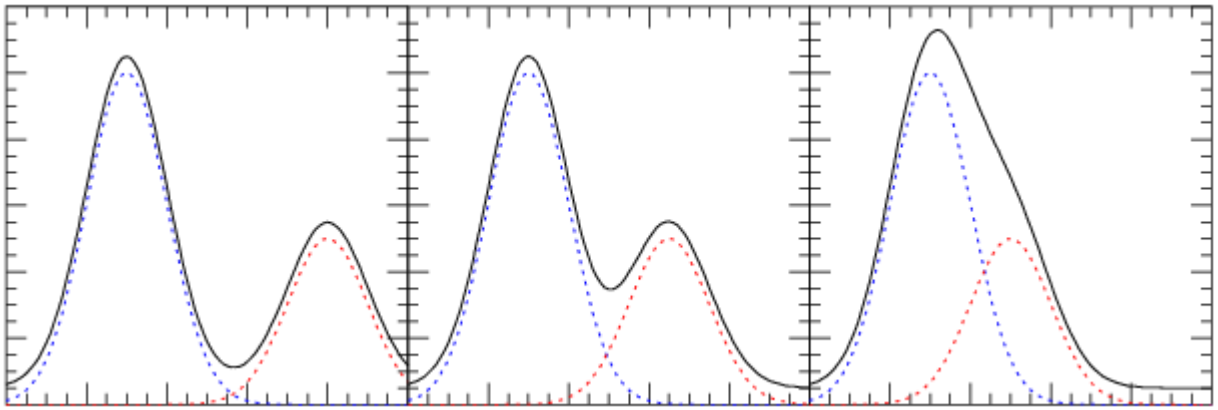


Figure 10.23 (*a*) The Airy pattern. (*b*) Electric field created by Fraunhofer diffraction at a circular aperture. (*c*) Irradiance resulting from Fraunhofer diffraction at a circular aperture. (Photos courtesy R. G. Wilson, Illinois Wesleyan University.)

Working in crowded fields



PSF 3D, could change within image