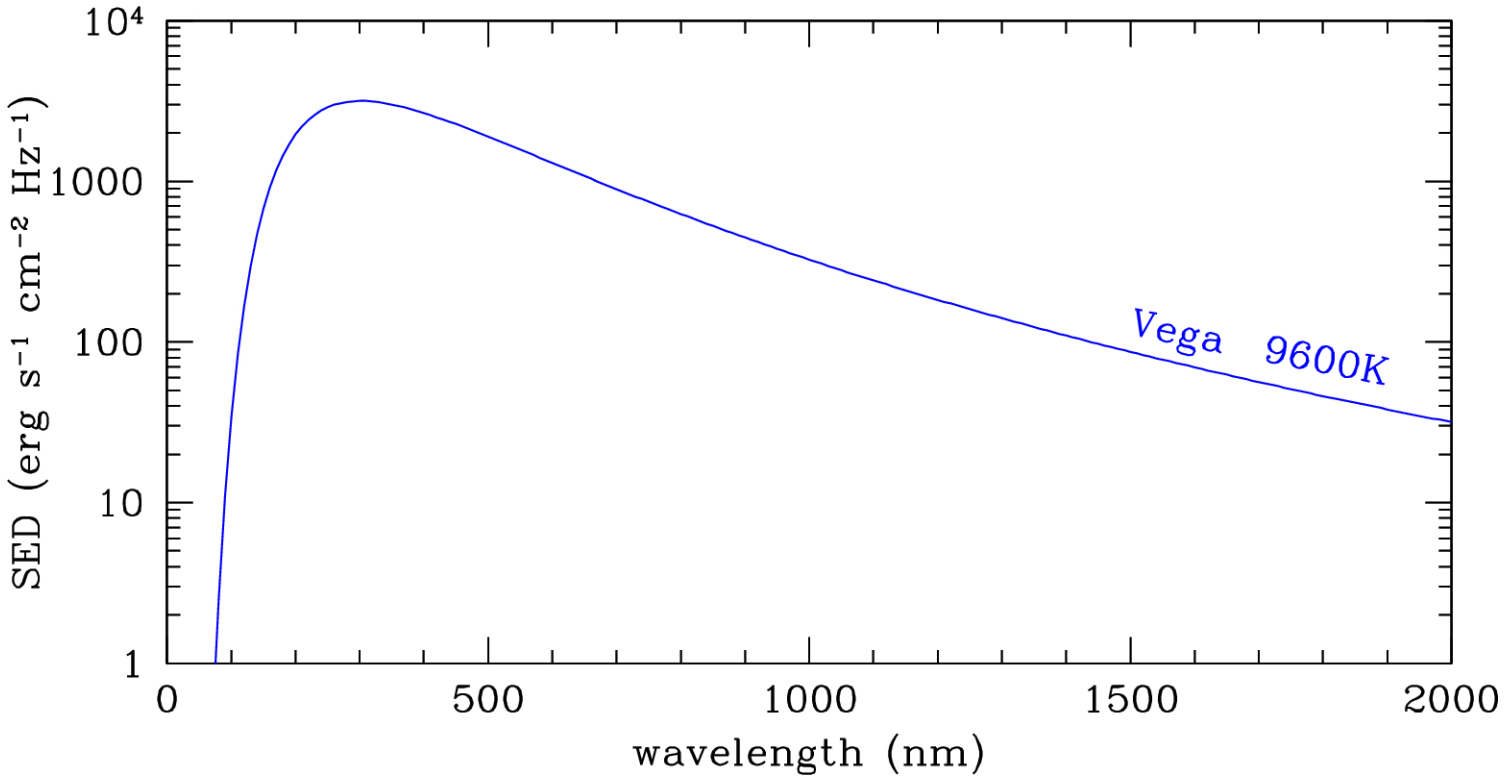
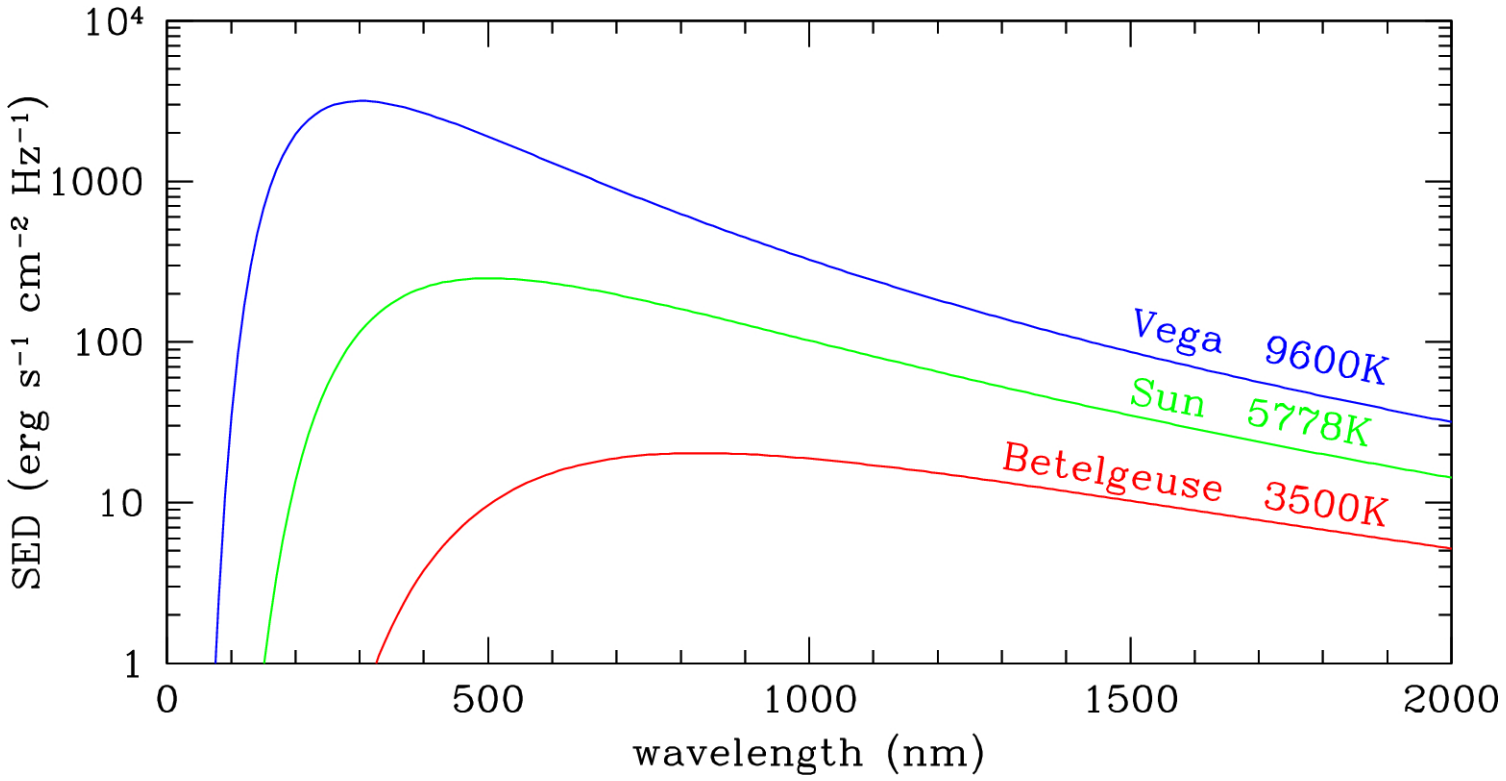
Analiza Widmowa Obiektów

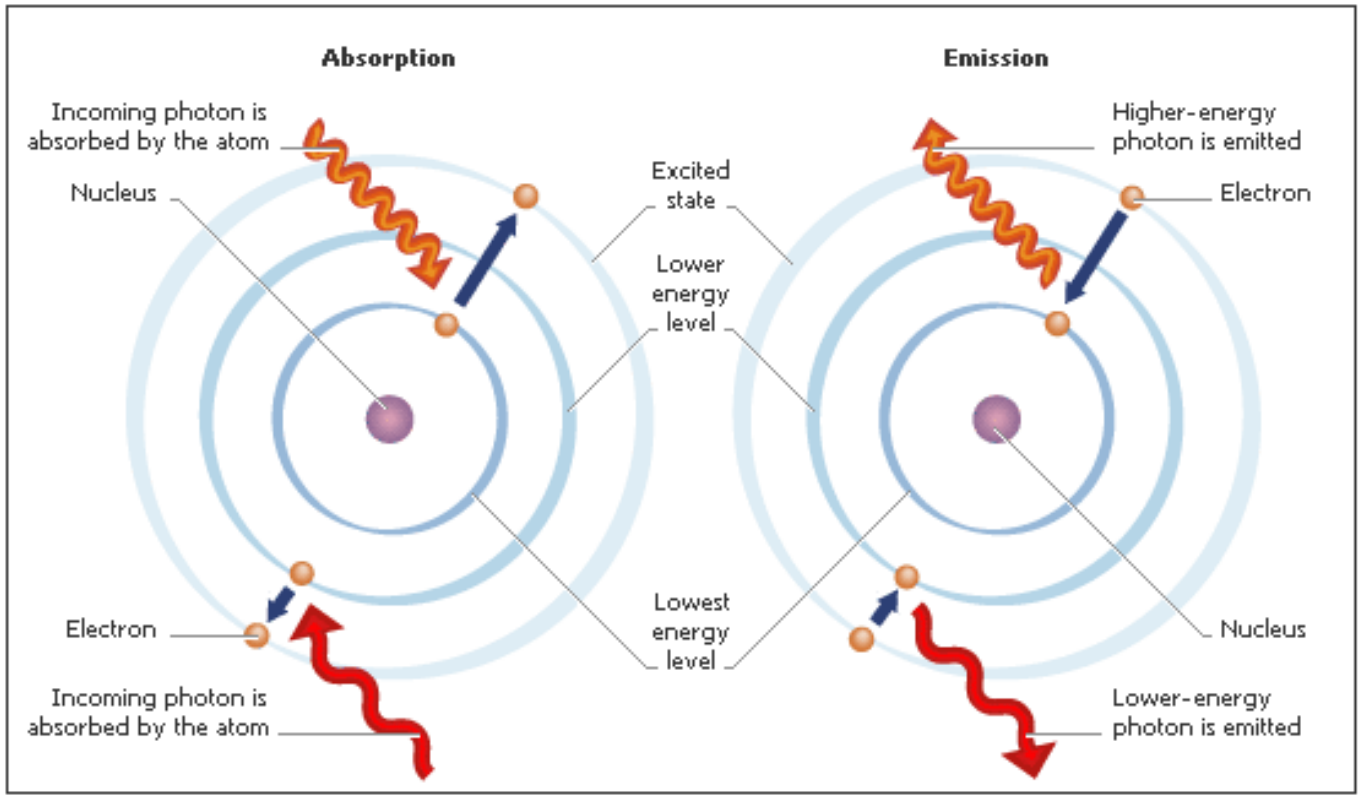
Szymon Kozłowski

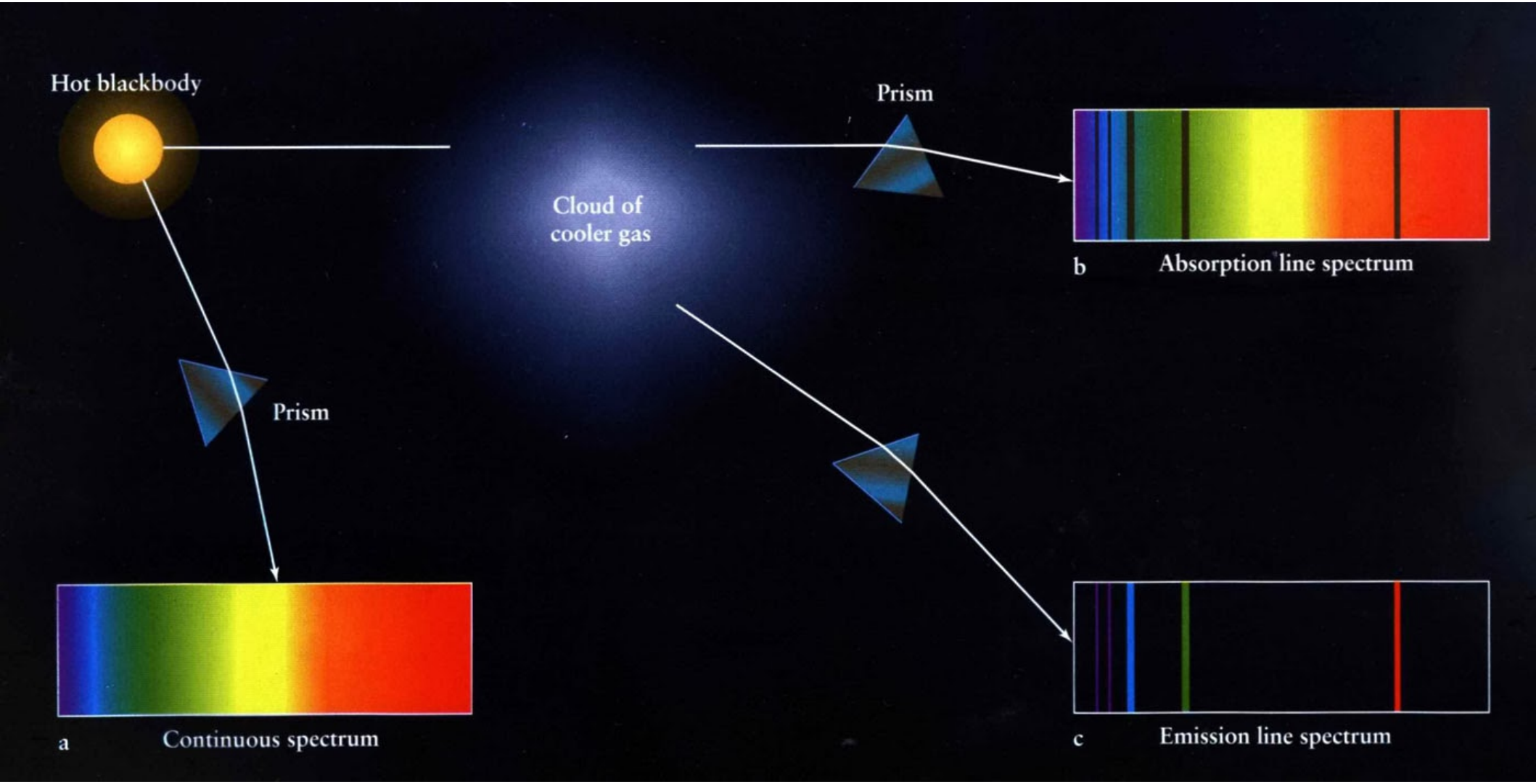
Widmo ciągłe - kontinuum



Widmo ciągłe - kontinuum




Absorption
Emission
Incoming photon is absorbed by the atom
Nucleus
Excited state
Lower energy level
Lowest energy level
Electron
Incoming photon is absorbed by the atom
Higher-energy photon is emitted
Electron
Nucleus
Lower-energy photon is emitted


Hot blackbody
Prism
Cloud of
cooler gas
Prism
b
Absorption line spectrum
Prism
a
Continuous spectrum
c
Emission line spectrum

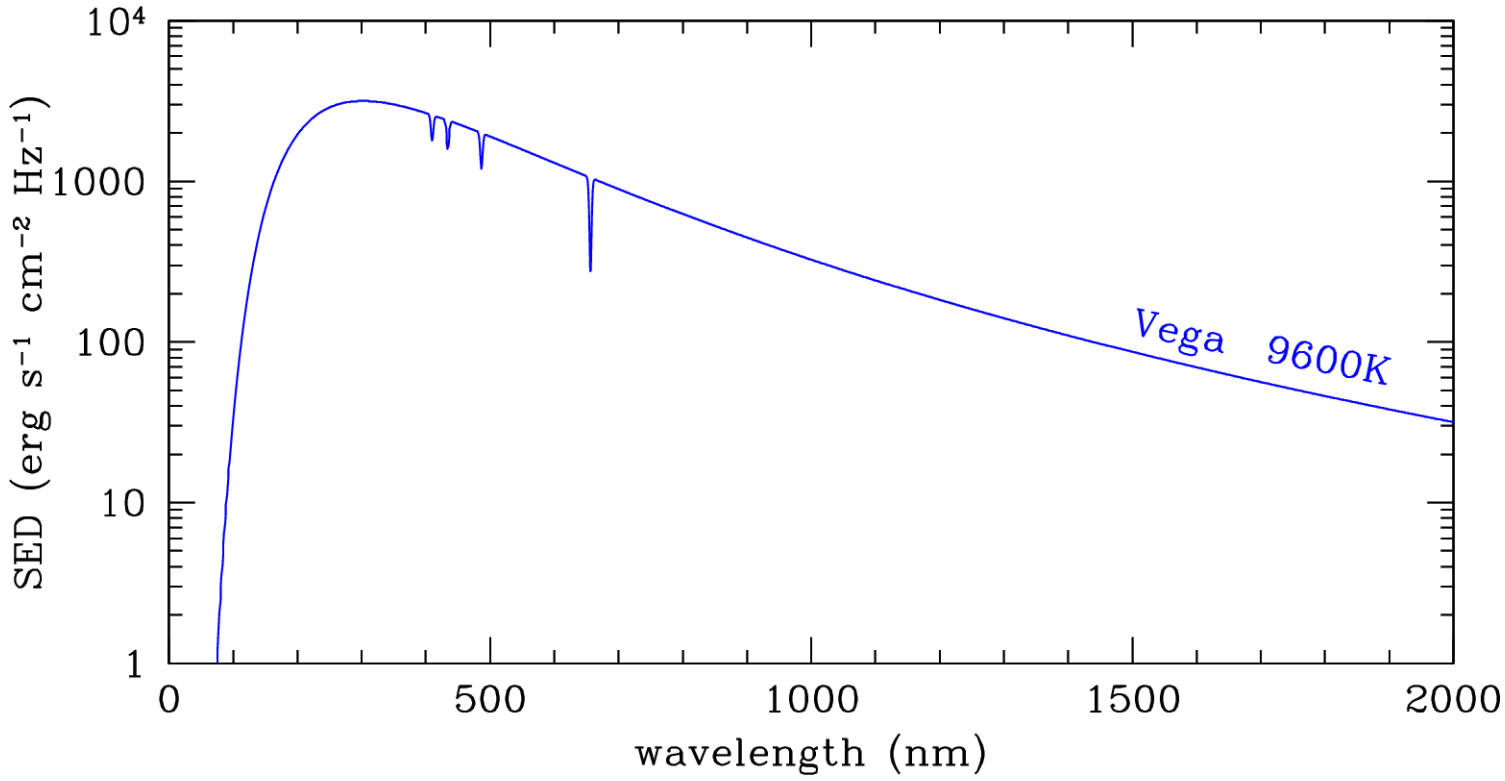
Widmo obiektów

widmo ciągłe – kontinuum (continuum)

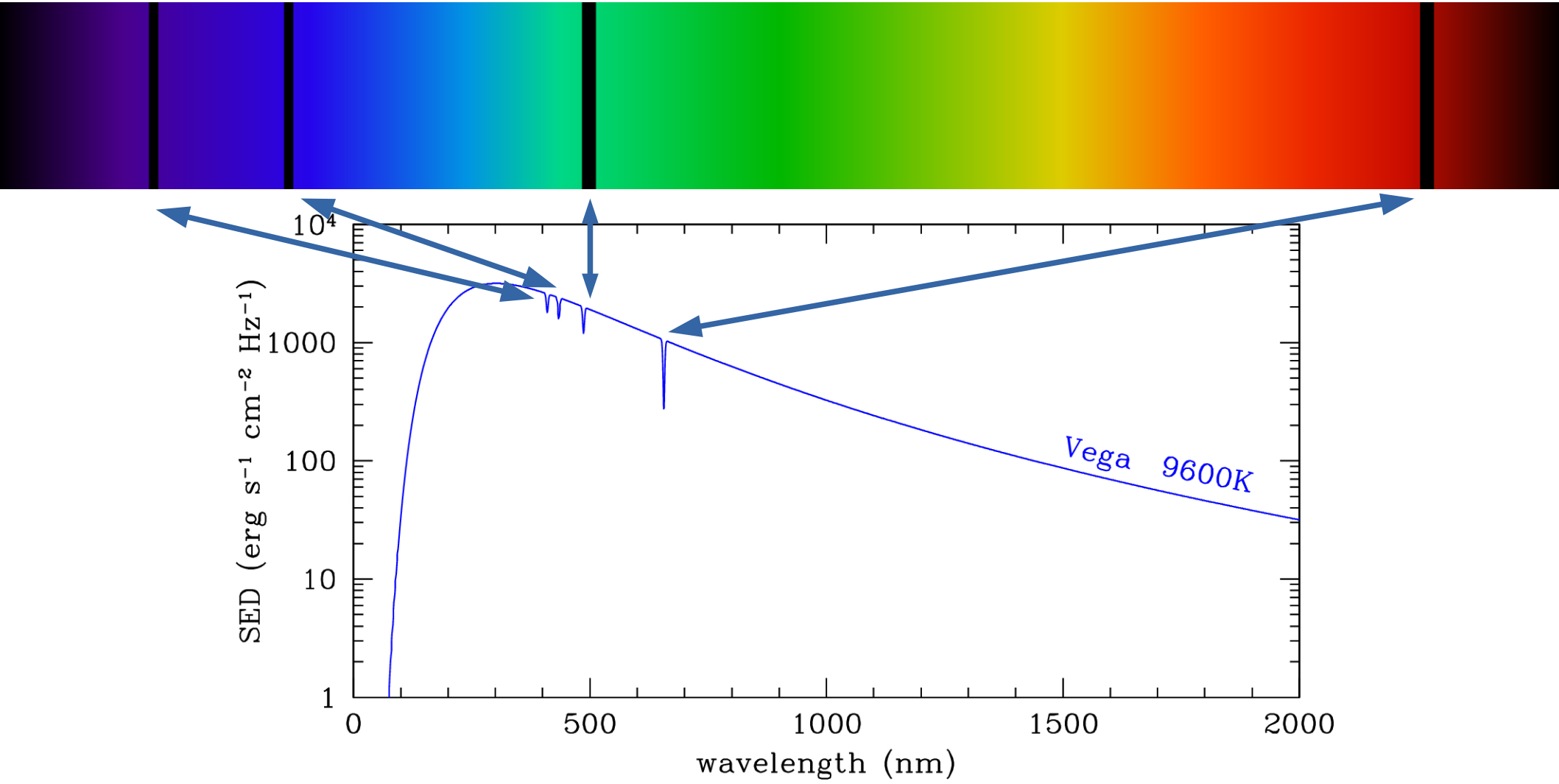
linie emisyjne (emission lines)

linie absorpcyjne (absorption lines)

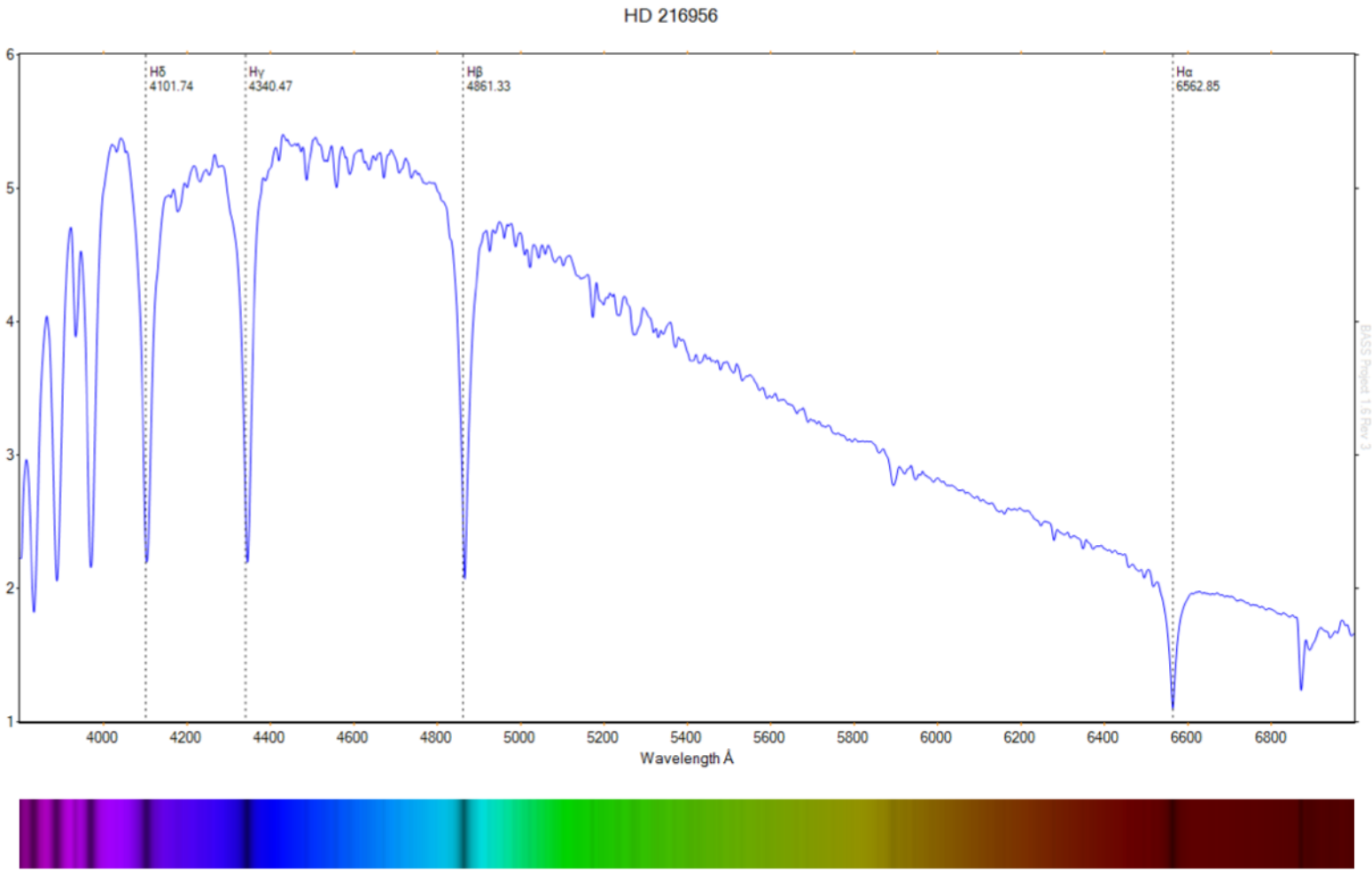
Linie absorpcyjne



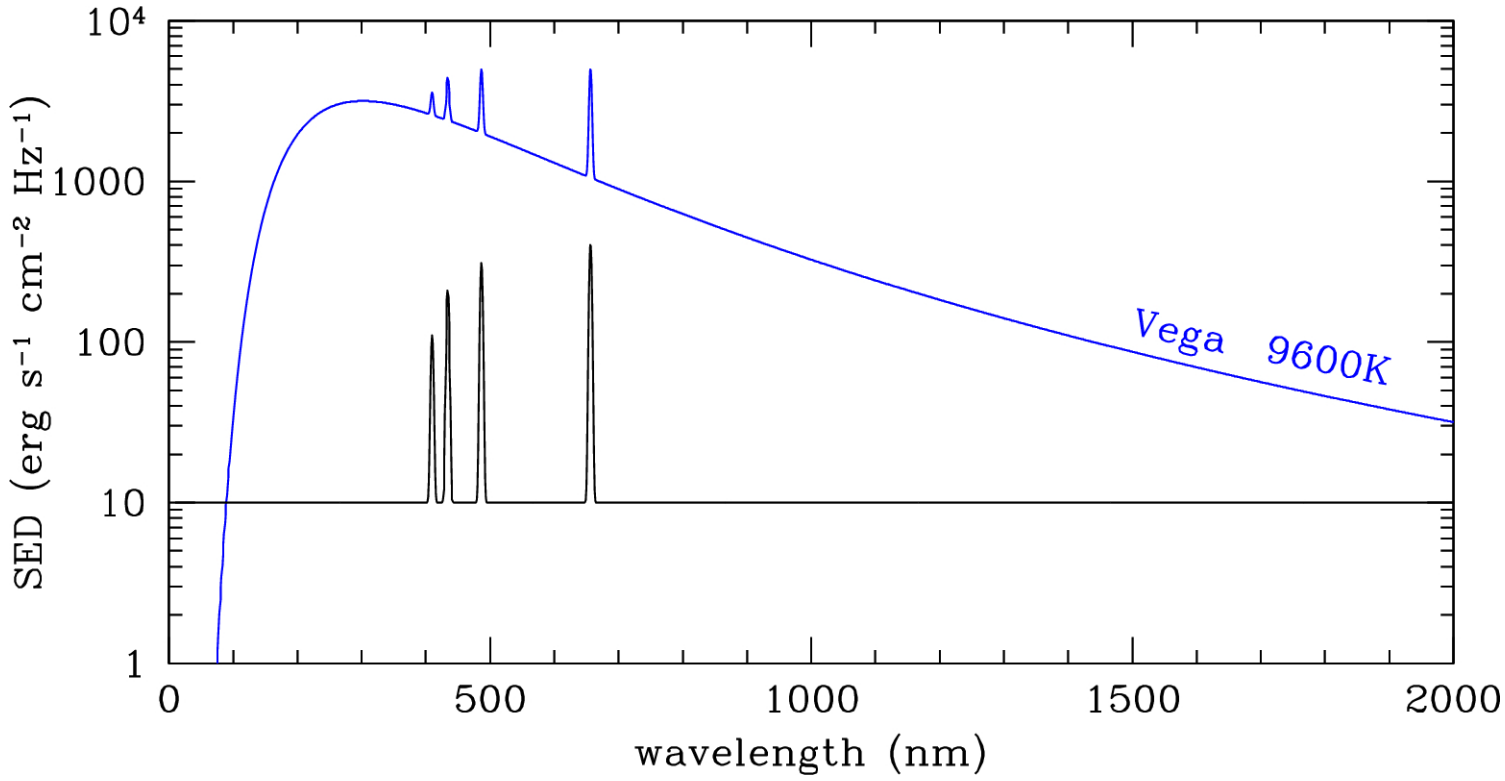
Linie absorpcyjne



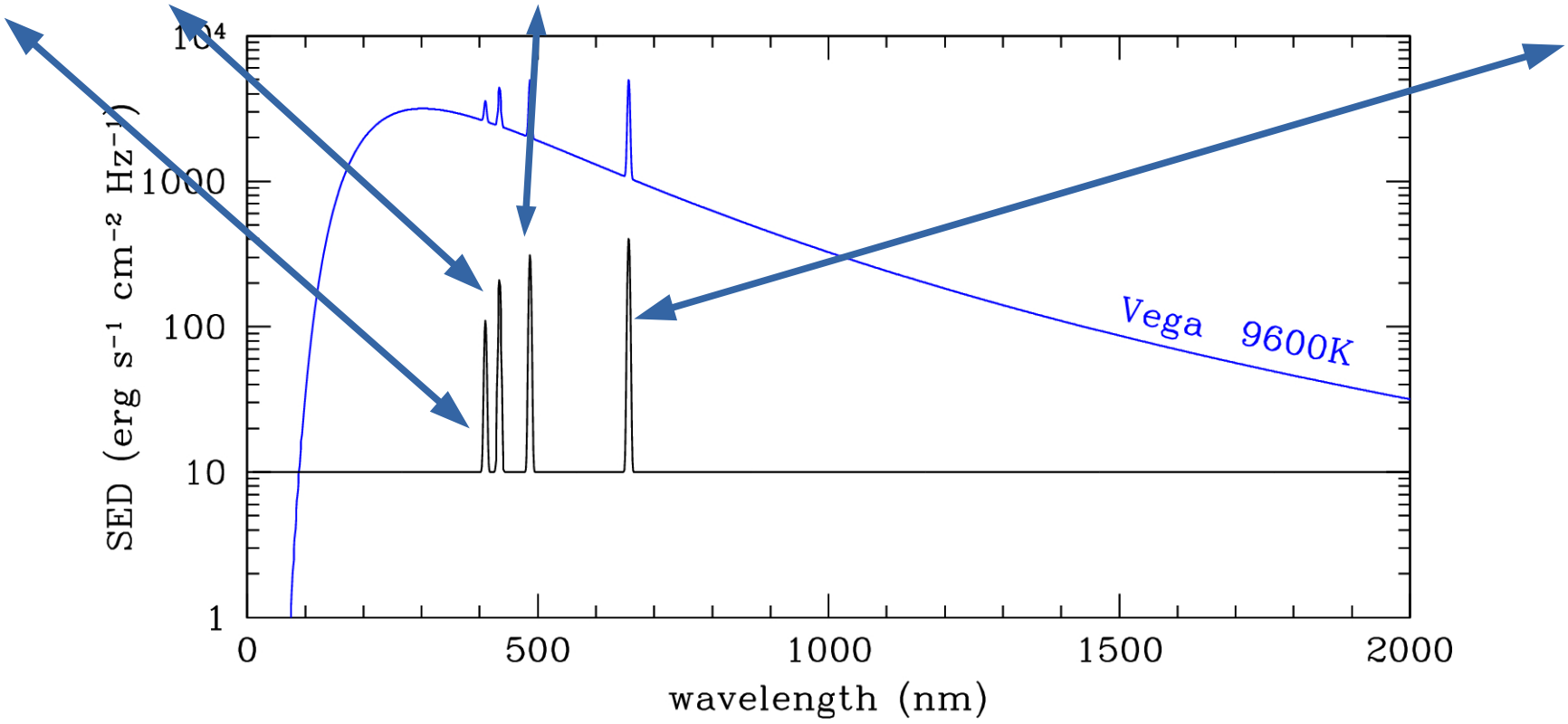
Widmo gwiazdy

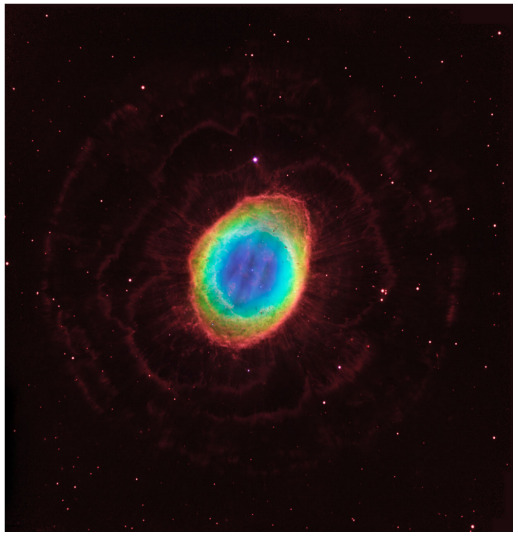


Linie emisyjne

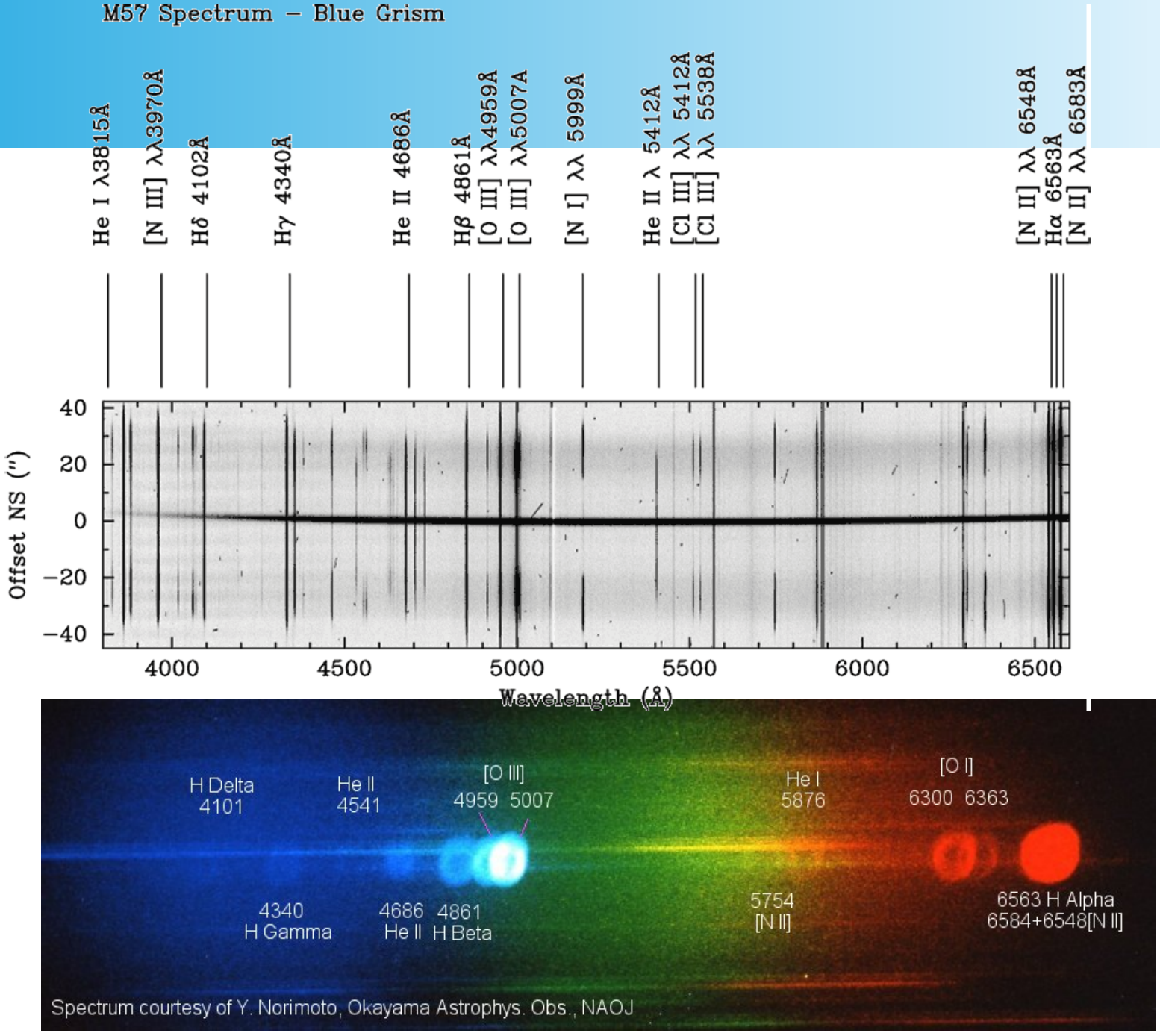


Linie emisyjne





M57

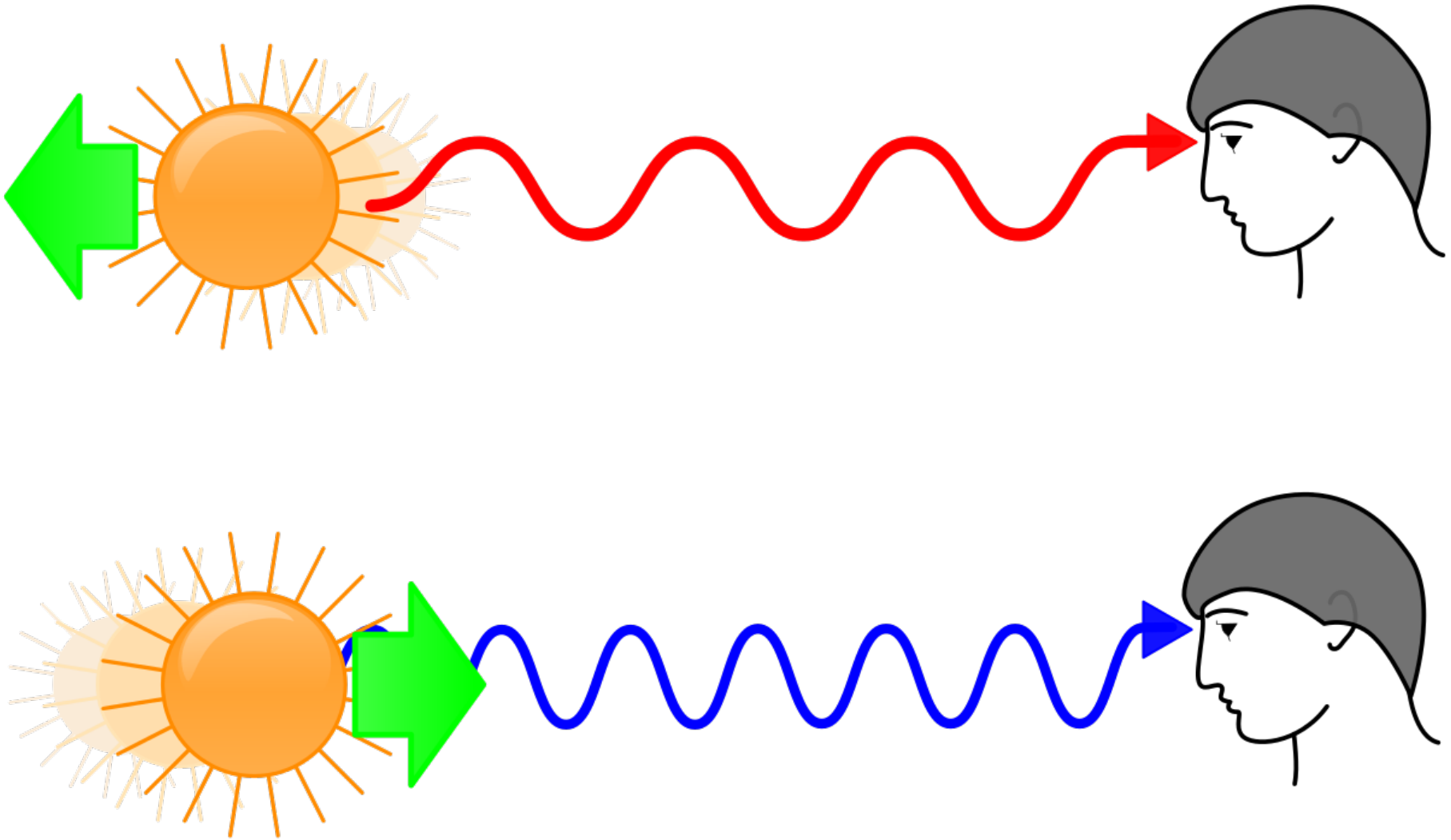

M57 Spectrum – Blue Grism
He I λ3815Å
[N III] λλ3970Å
Hδ 4102Å
Hγ 4340Å
He II 4686Å
Hβ 4861Å
[O III] λλ4959Å
[O III] λλ5007Å
[N I] λλ 5999Å
He II λ 5412Å
[Cl III] λλ 5412Å
[Cl III] λλ 5538Å
[N II] λλ 6548Å
Hα 6563Å
[N II] λλ 6583Å
Offset NS (")
40
20
0
−20
−40
4000
4500
5000
5500
6000
6500
Wavelength (Å)

H Delta
4101
He II
4541
[O III]
4959 5007
He I
5876
[O I]
6300 6363
4340
H Gamma
4686 4861
He II H Beta
5754
[N II]
6563 H Alpha
6584+6548[N II]
Spectrum courtesy of Y. Norimoto, Okayama Astrophys. Obs., NAOJ

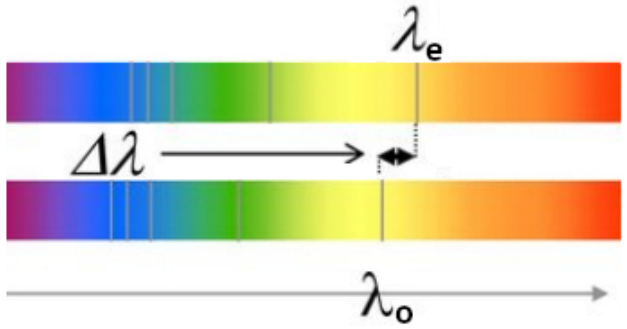
Linie wzbronione

- Oznaczamy je kwadratowymi nawiasami np. [OIII]
- Powstają w bardzo rzadkich gazach
- Czas pomiędzy zderzeniami atomów dużo dłuzszy niż czas spontanicznej emisji fotonu

Efekt Dopplera



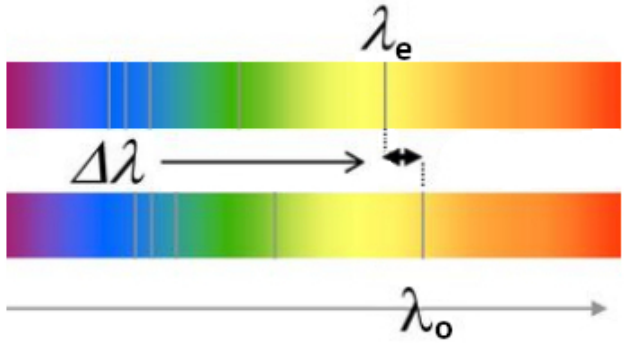
Blueshift / Redshift



$$\Delta\lambda = \lambda_o - \lambda_e$$

$\Delta\lambda$ is positive for redshift

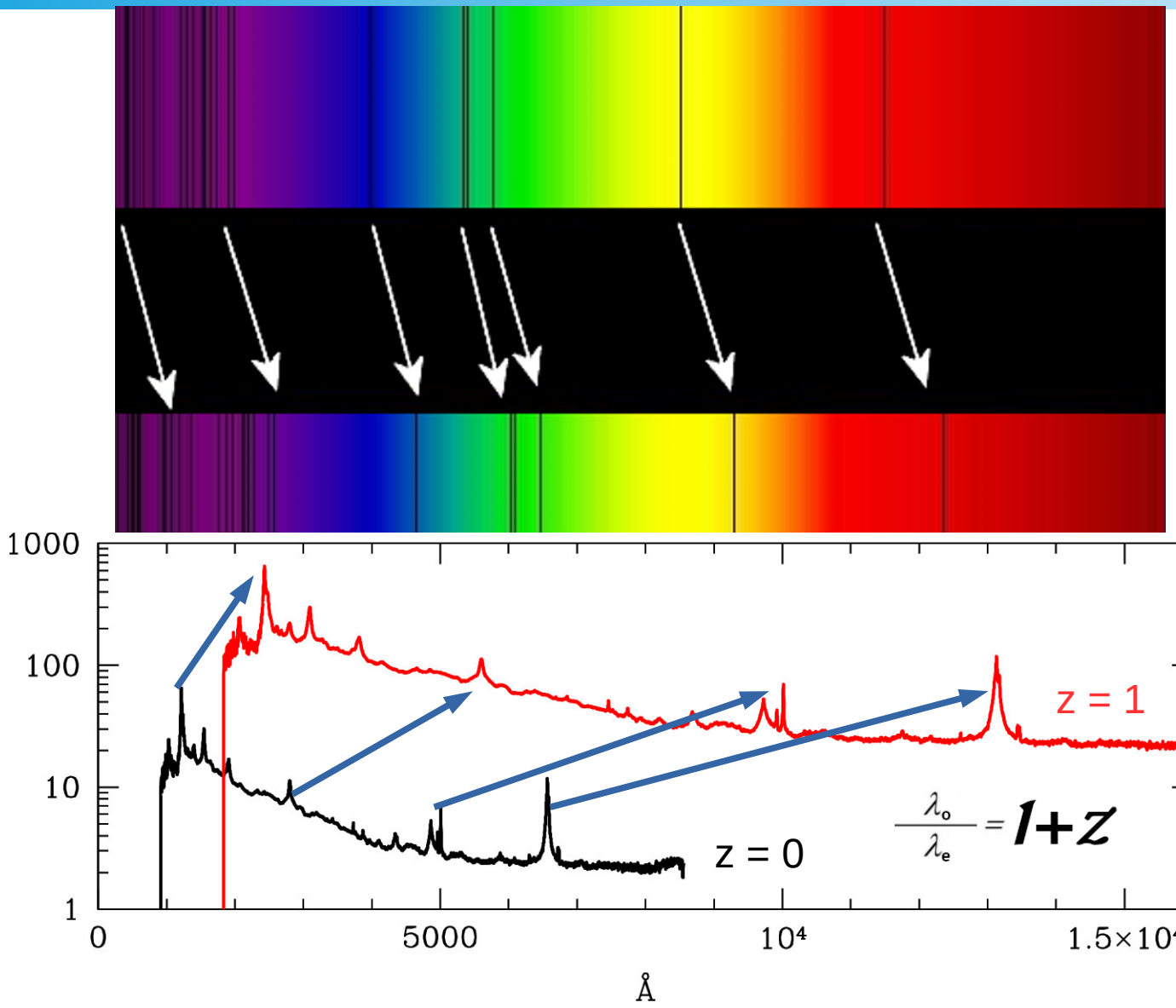
$\Delta\lambda$ is negative for blueshift



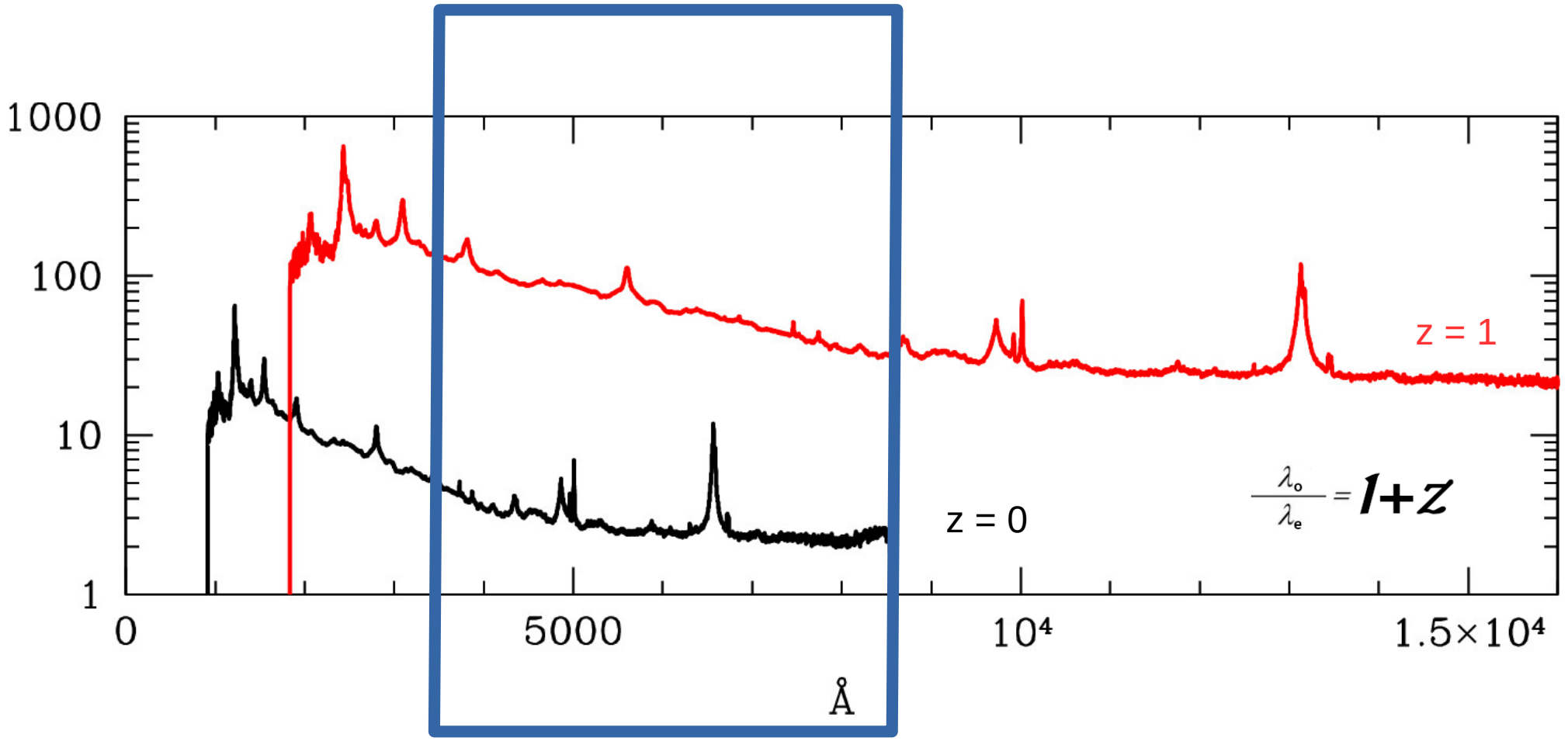
$$\frac{\lambda_o - \lambda_e}{\lambda_e} = z$$

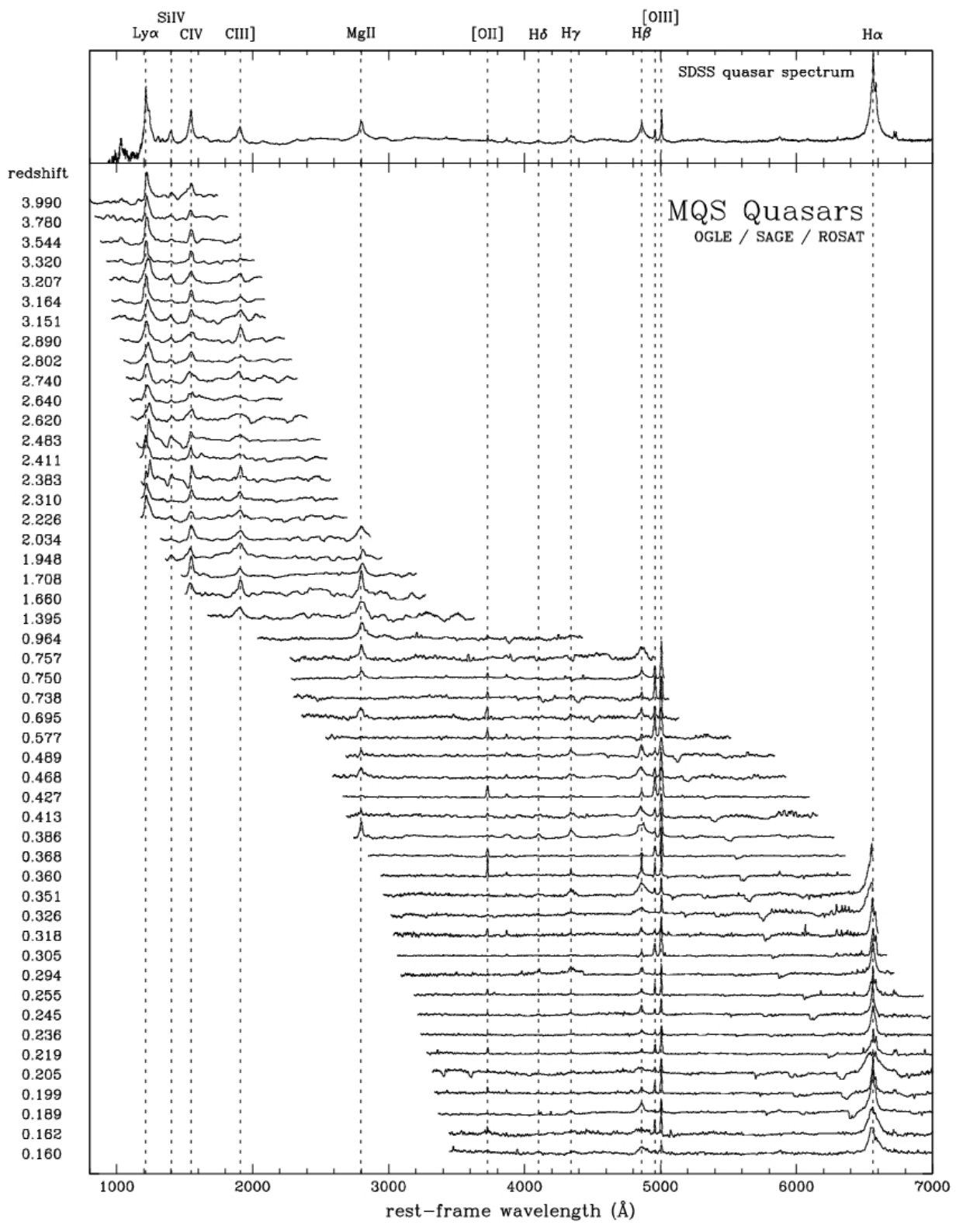
$$\frac{\lambda_o}{\lambda_e} = 1 + z$$

Redshift

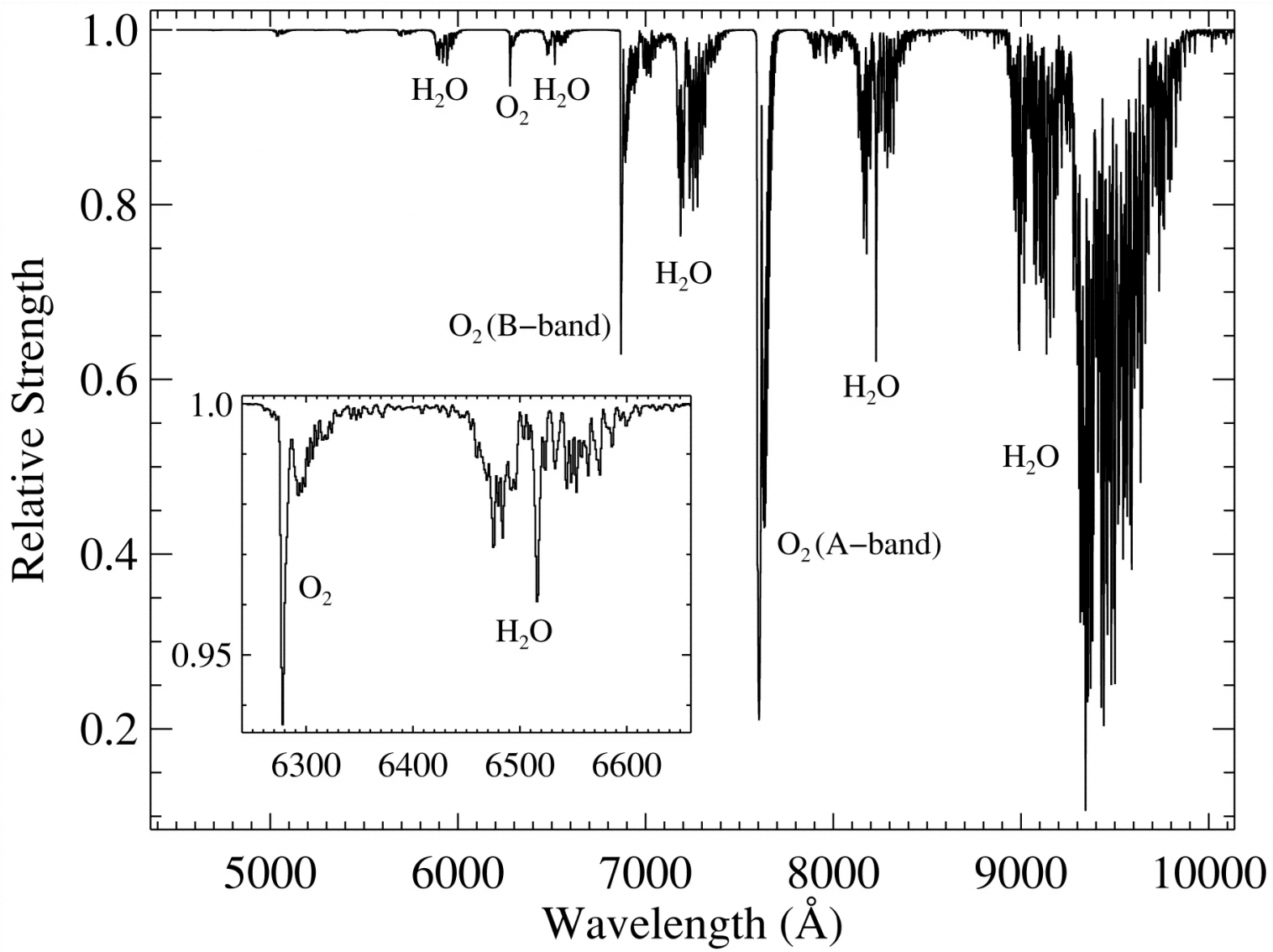


Zakres widmowy

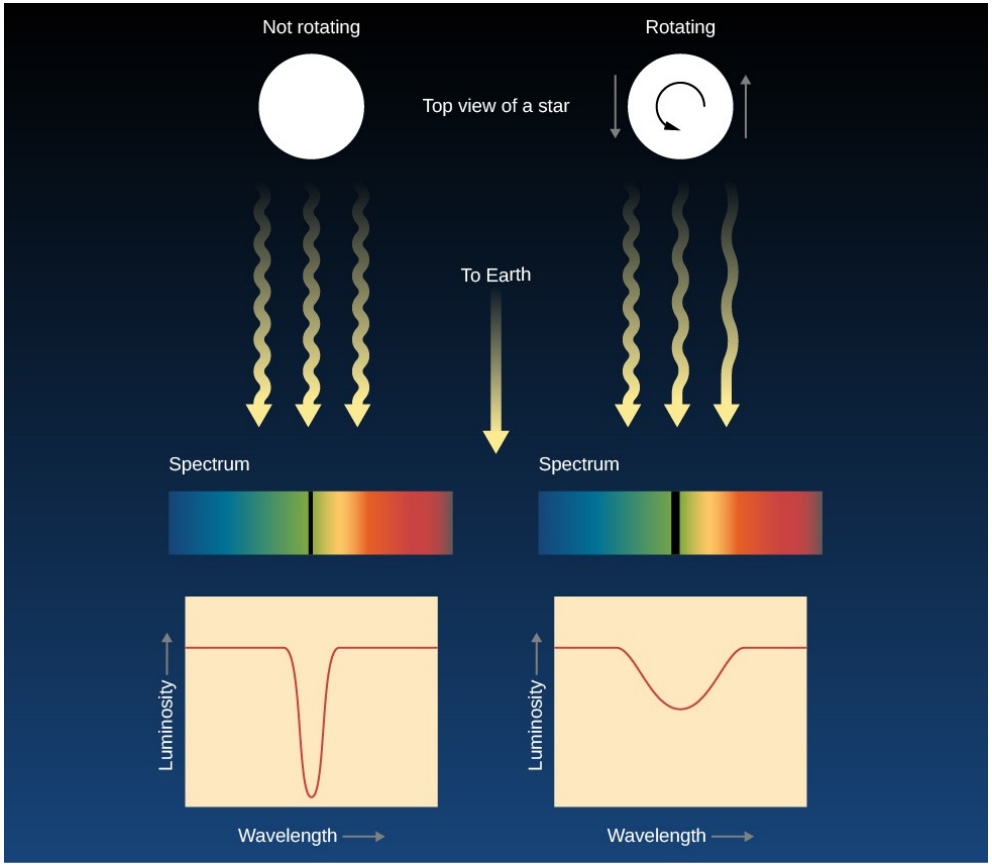


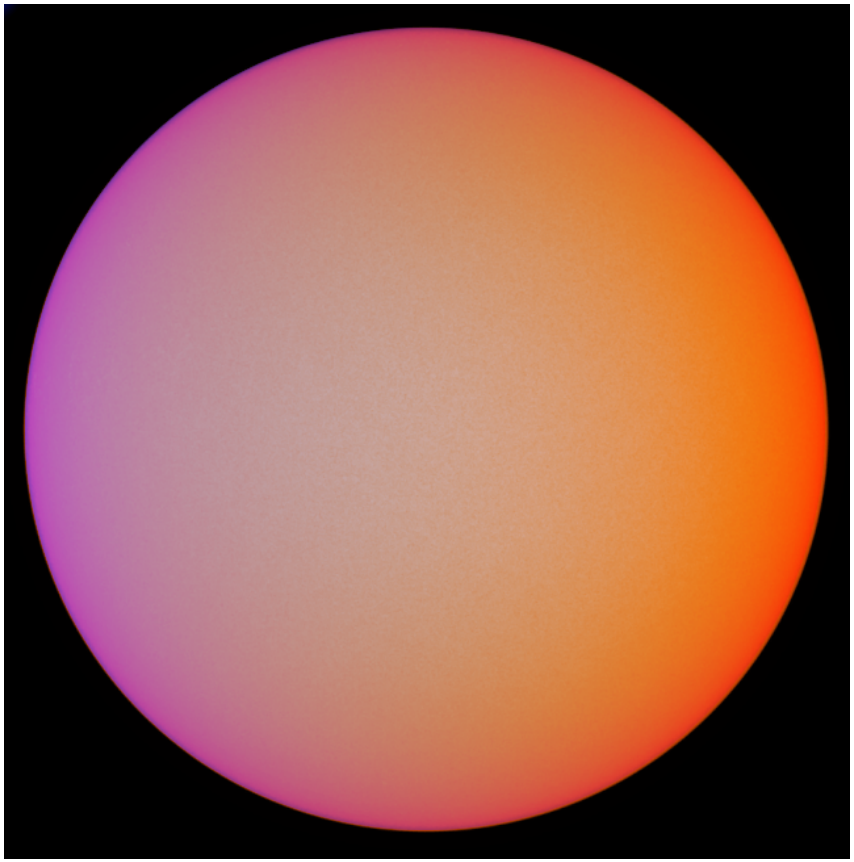

SiIV
Lyα
CIV
CIII]
MgII
[OII]
Hδ
Hγ
[OIII]
Hβ
Hα
SDSS quasar spectrum
redshift
3.990
3.780
3.544
3.320
3.207
3.164
3.151
2.890
2.802
2.740
2.640
2.620
2.483
2.411
2.383
2.310
2.226
2.034
1.948
1.708
1.660
1.395
0.964
0.757
0.750
0.738
0.695
0.577
0.489
0.468
0.427
0.413
0.386
0.368
0.360
0.351
0.326
0.318
0.305
0.294
0.255
0.245
0.236
0.219
0.205
0.199
0.189
0.162
0.160
MQS Quasars
OGLE / SAGE / ROSAT
1000
2000
3000
4000
5000
6000
7000
rest−frame wavelength (Å)

Linie Telluryczne

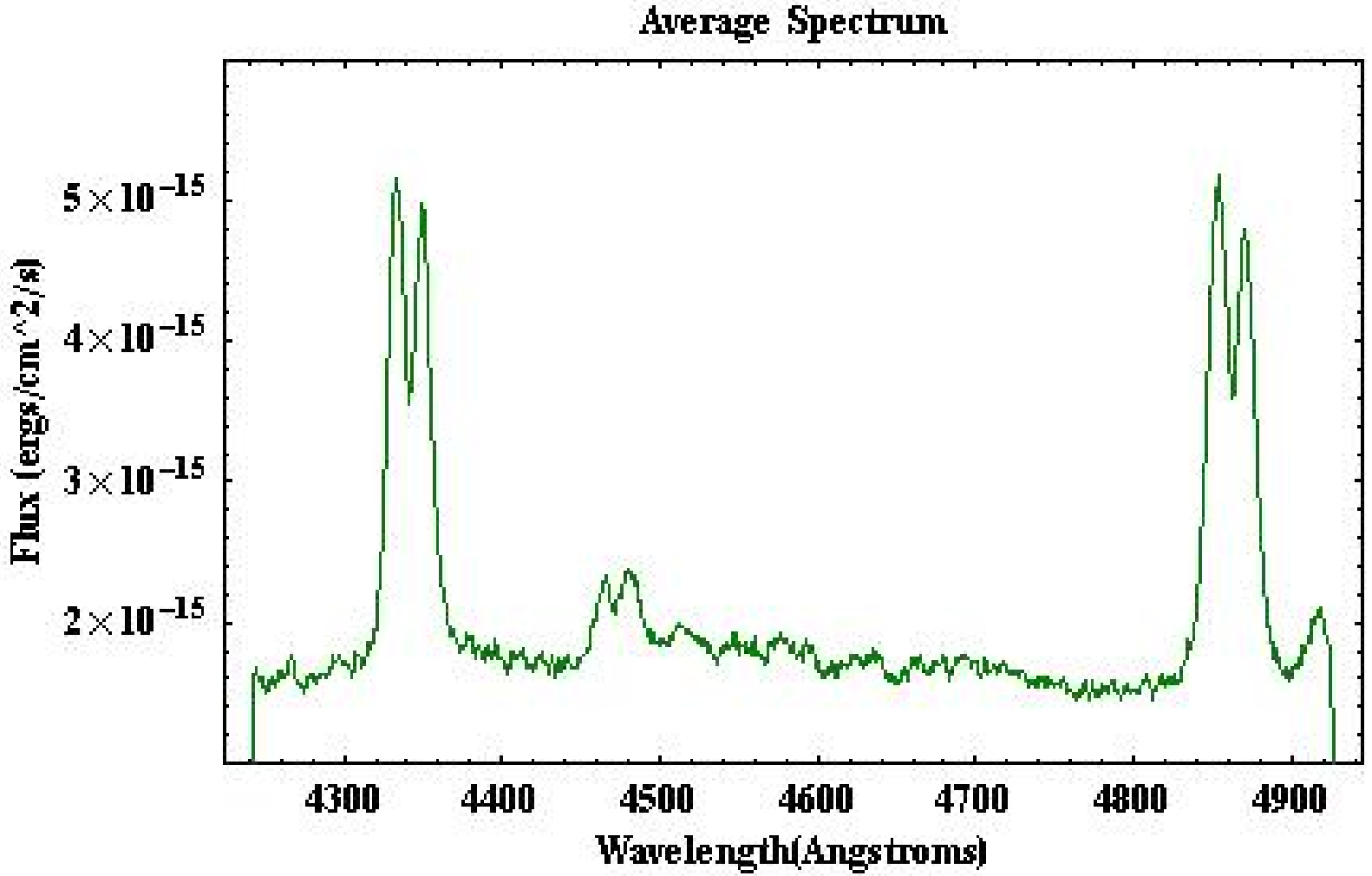


Poszerzenie rotacyjne linii

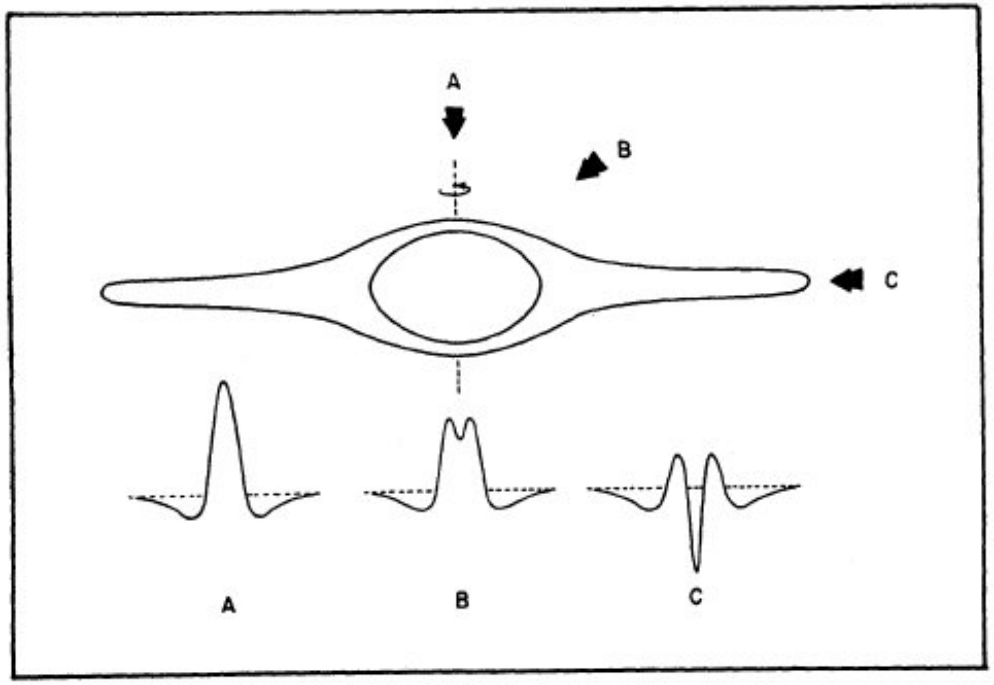


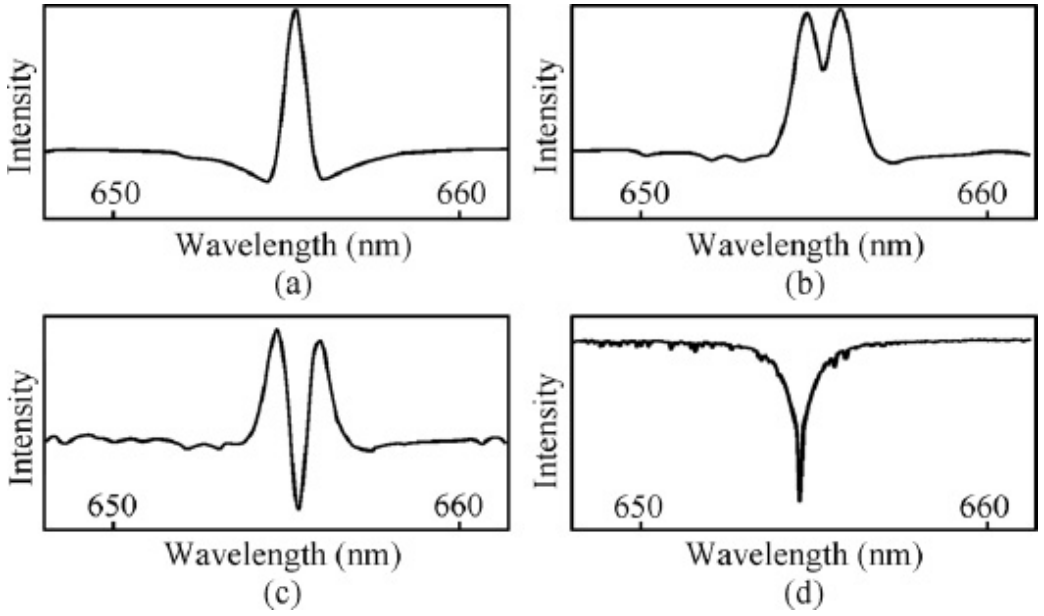


Dysk w CV

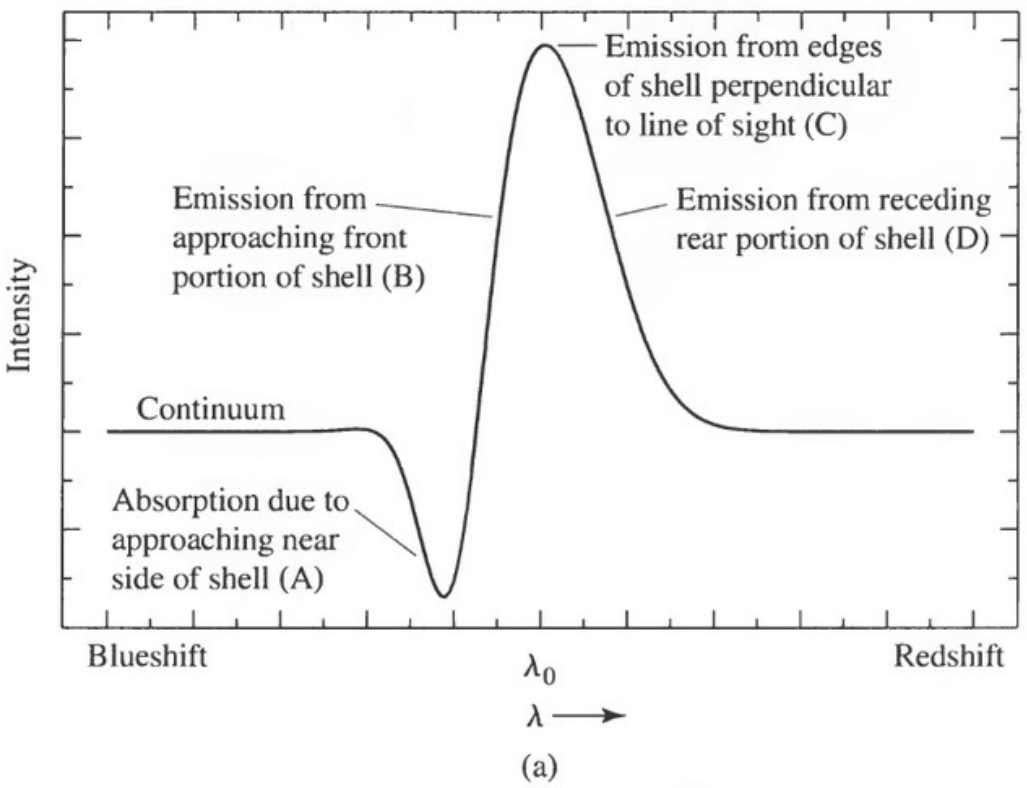

Average Spectrum
Flux (ergs/cm^2/s)
5×10^-15
4×10^-15
3×10^-15
2×10^-15
4300
4400
4500
4600
4700
4800
4900
Wavelength(Angstroms)

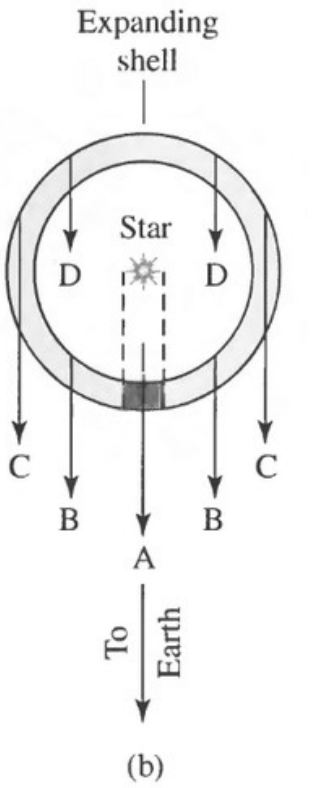
Gwiazdy Be (absorpcja emisji)





Profil P-Cygni





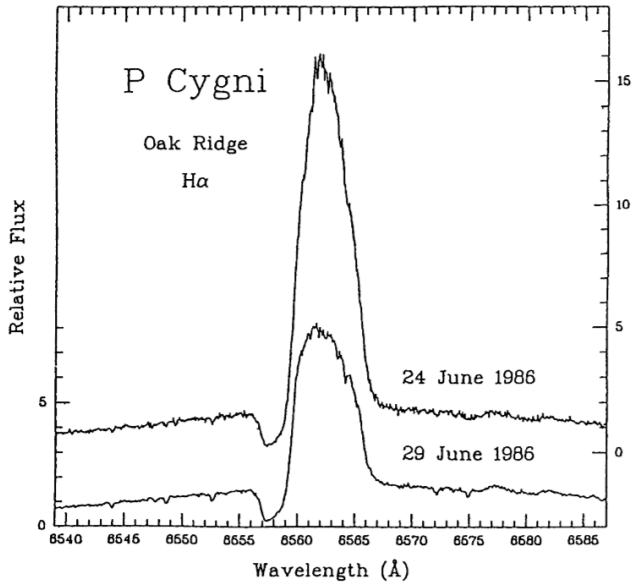
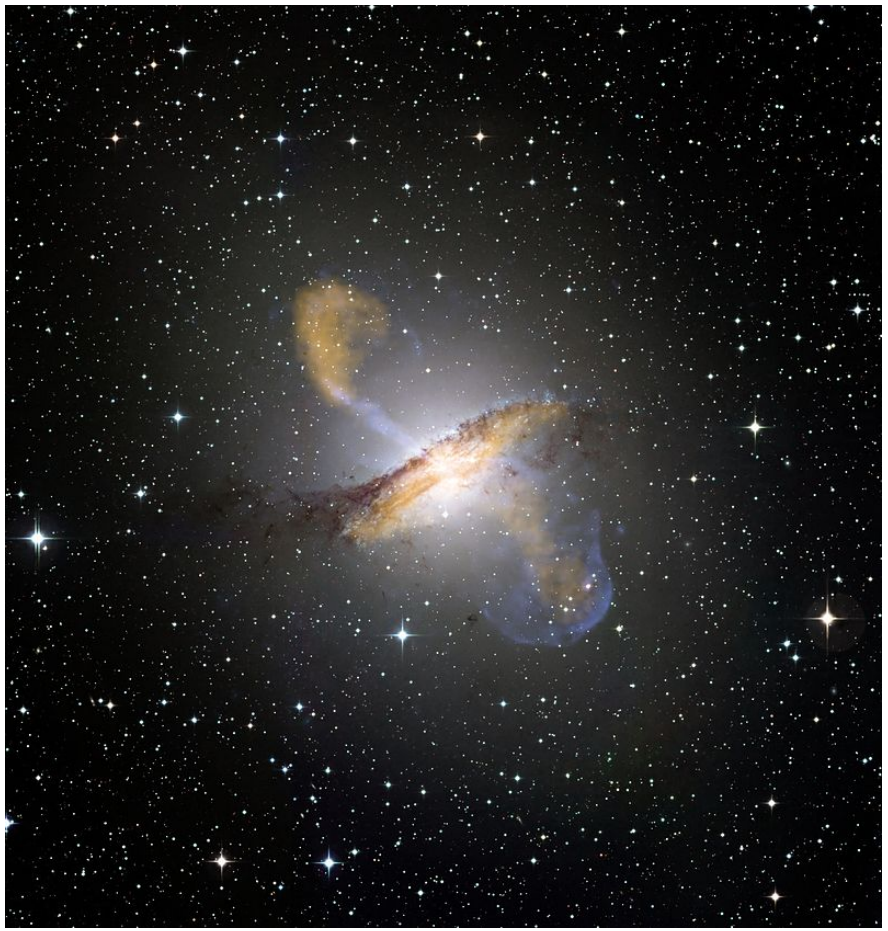
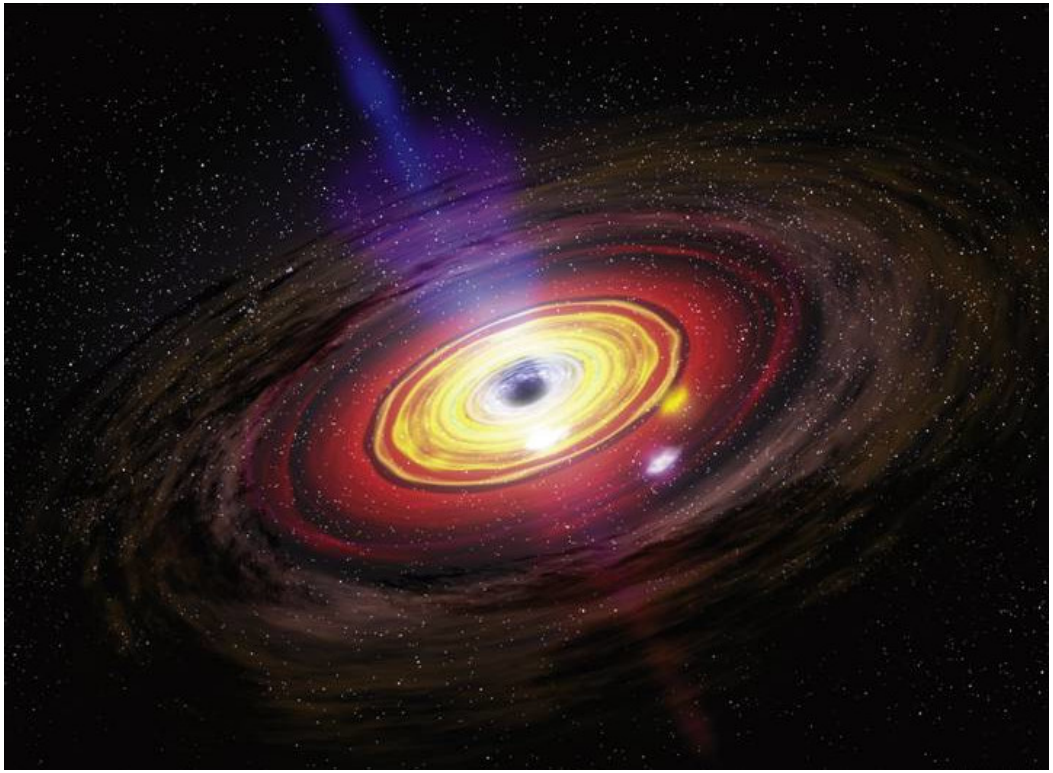


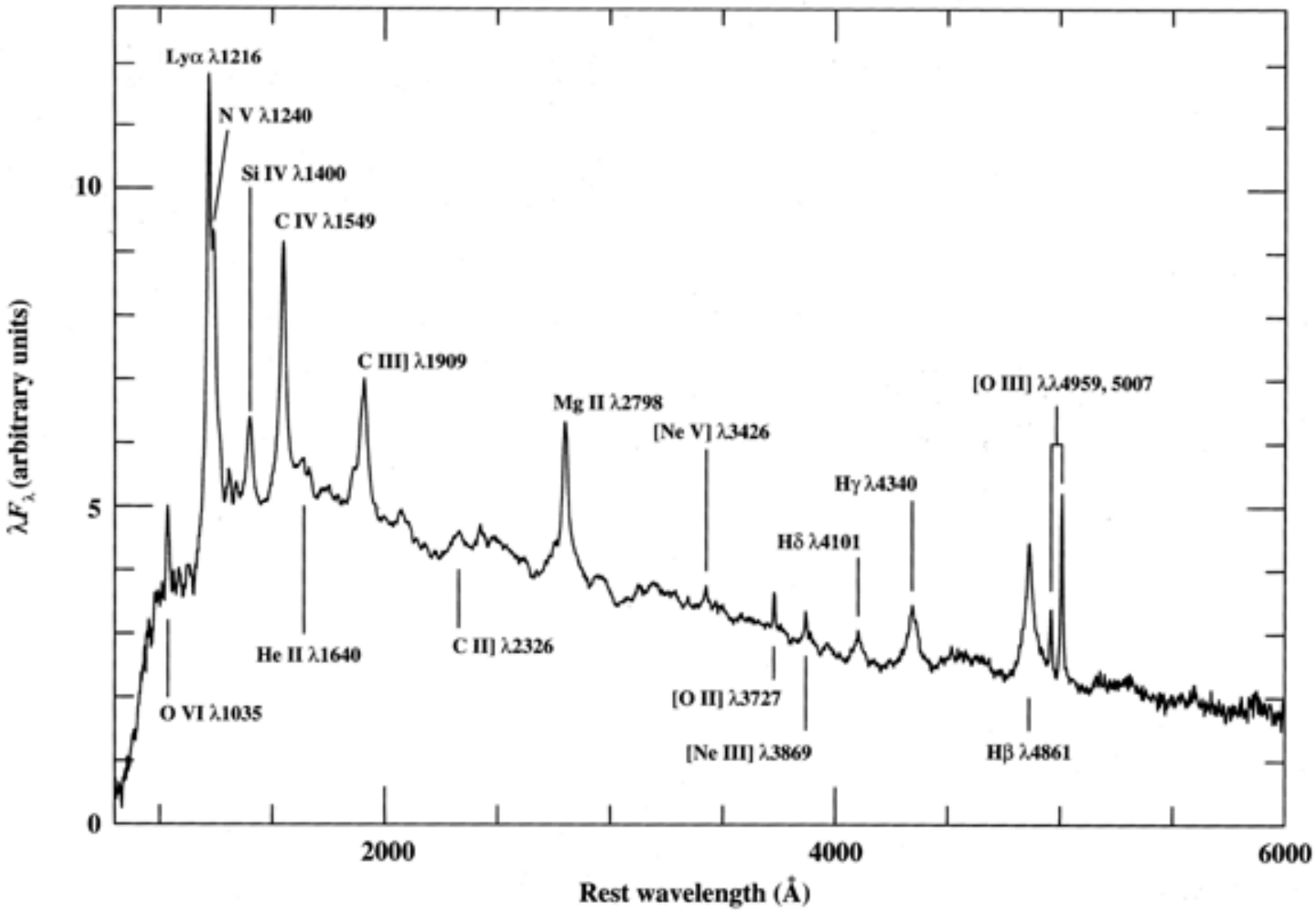
Figure 4. H-alpha profiles of P Cygni from Oak Ridge Observatory.

AGNy (poszerzenie linii)

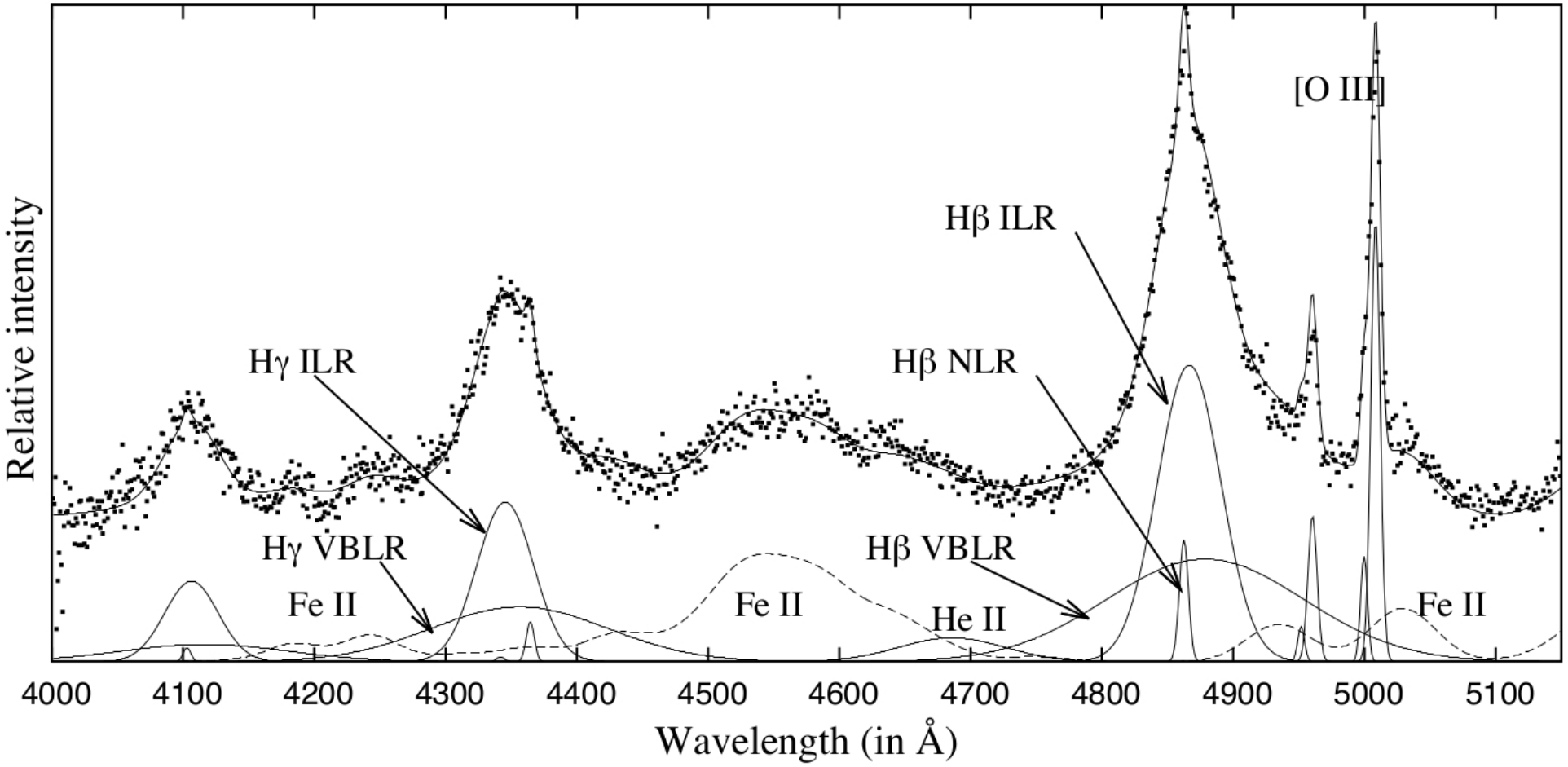




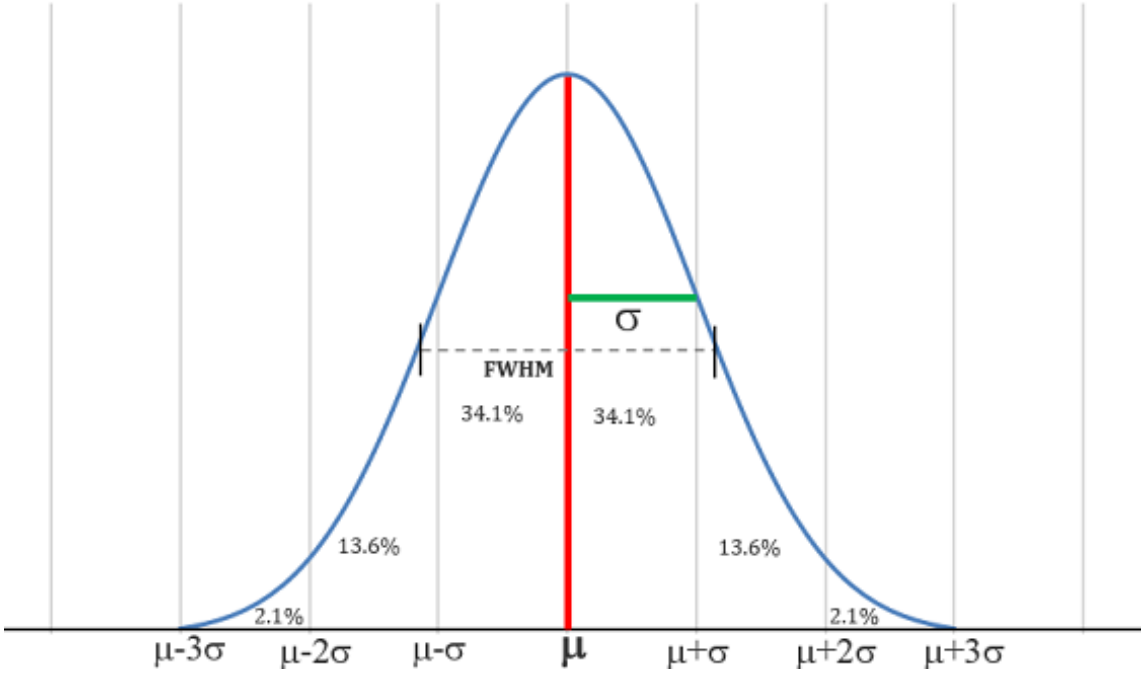
Widmo kwazara/AGNa



AGNy (poszerzenie linii)

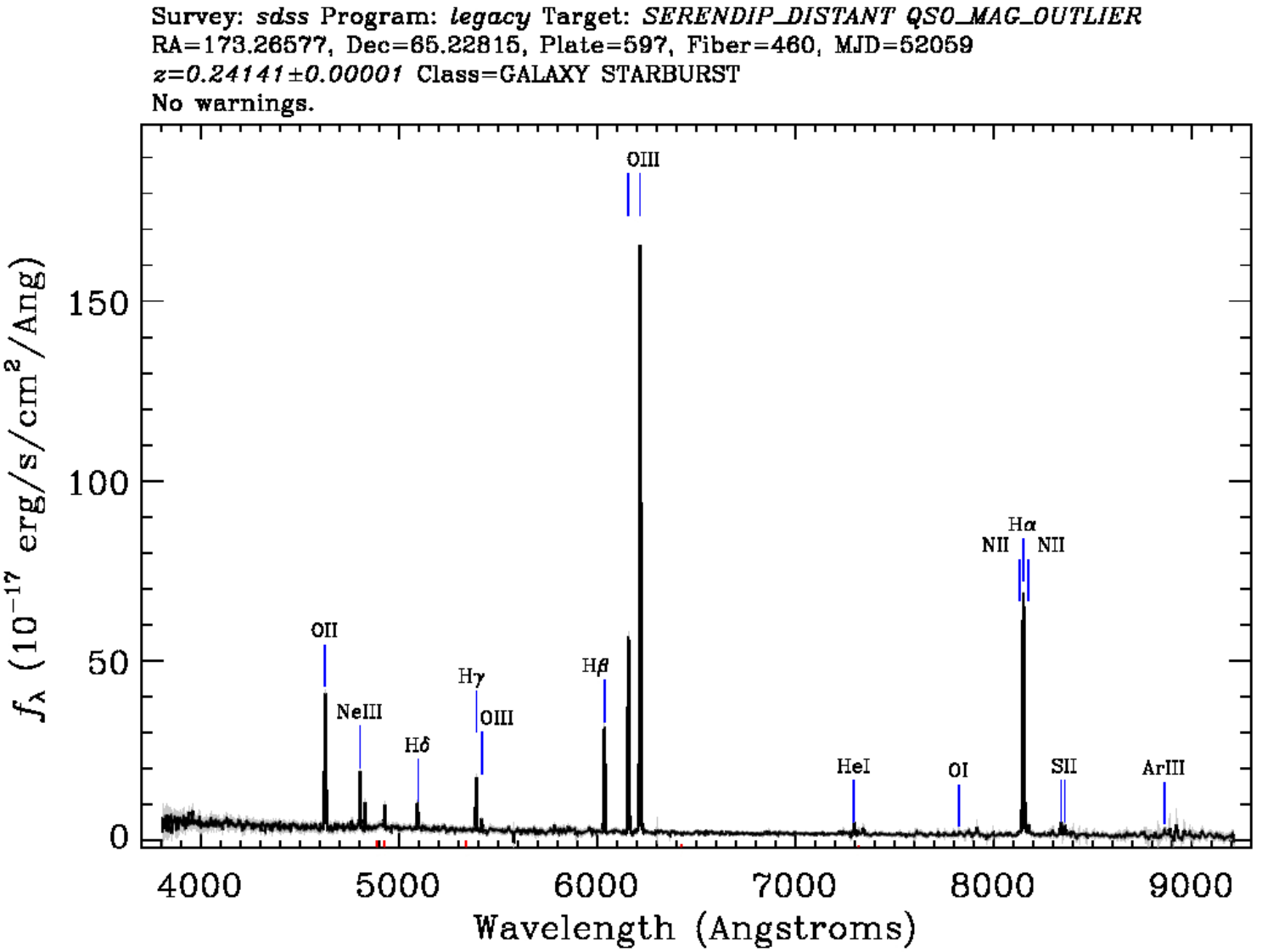


Pomiar masy czarnej dziury



$$\log\left(\frac{M_{\mathrm{BH}}}{M_{\odot}}\right) = a + b\log\left(\frac{L \times 10^{-44}}{\mathrm{erg\ s^{-1}}}\right) + 2\log\left(\frac{\mathrm{FWHM}}{\mathrm{km\ s^{-1}}}\right)$$

Podstawowe linie



Podstawowe linie

- [SII] – 6716Å i 6732Å
- Hα – 6563Å
- [NII] – 6548 i 6584Å
- [OIII] – 4959 i 5007Å
- Hβ – 4861Å
- [OII] – 3727Å
- MgII – 2800Å
- Lyα – 1216Å

Metaliczność

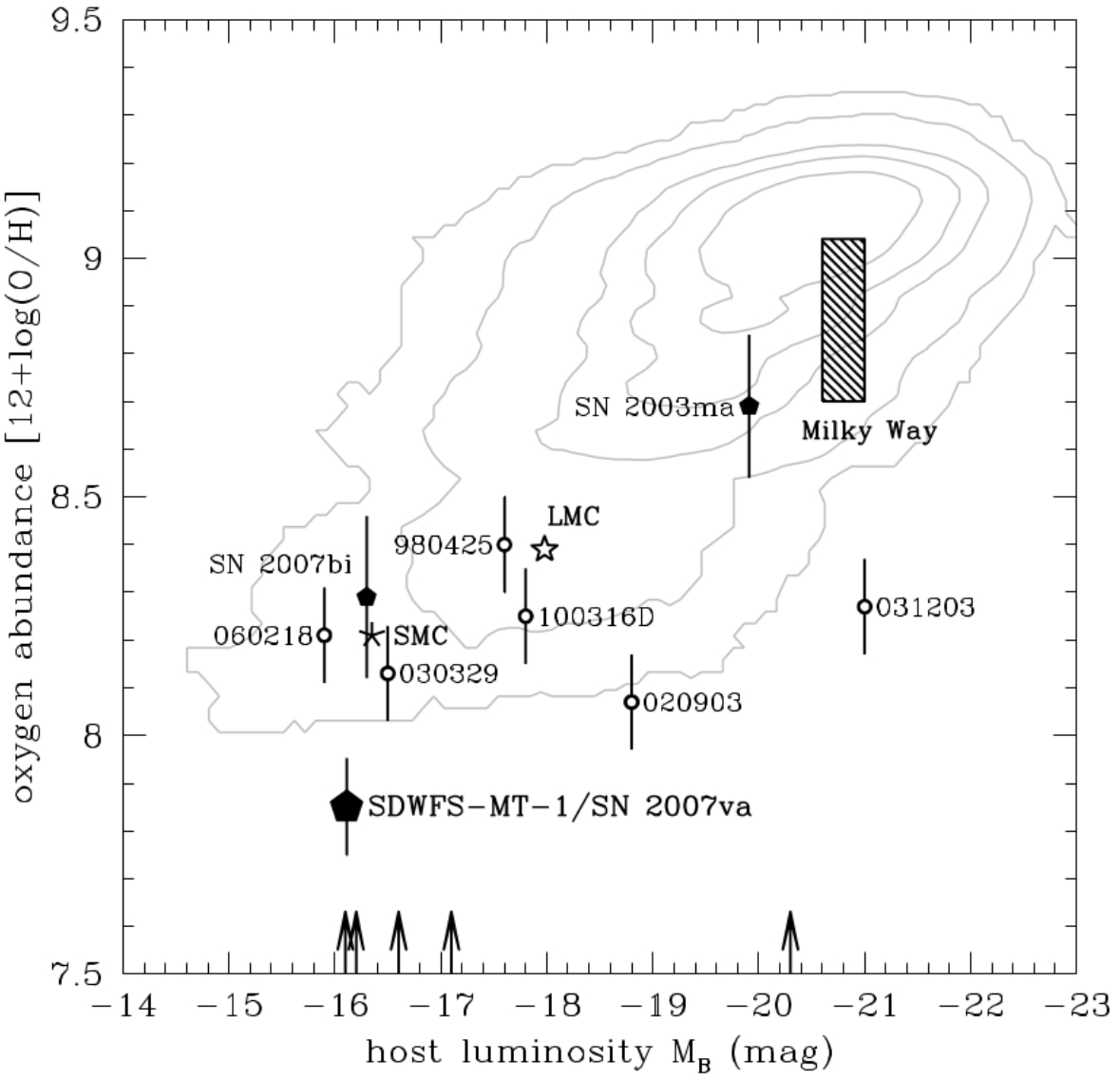
For the line fluxes, we will be using the following notations throughout the paper: $R_2 = I_{[\mathrm{O\,II}]\lambda3727+\lambda3729}/I_{\mathrm{H}\beta}$, $R_3 = I_{[\mathrm{O\,III}]\lambda4959+\lambda5007}/I_{\mathrm{H}\beta}$, $R = I_{[\mathrm{O\,III}]\lambda4363}/I_{\mathrm{H}\beta}$, and $R_{23} = R_2 + R_3$. With these definitions, the excitation parameter P can then be expressed as $P = R_3/(R_2 + R_3)$.

$$\begin{aligned} \mathrm{Z94}: \ \log(\mathrm{O/H}) + 12 = {} & 9.265 - 0.33\ R_{23} - 0.202\ R_{23}^2 \\ & - 0.207\ R_{23}^3 - 0.333\ R_{23}^4\ , \quad (8) \\ \mathrm{M91(u)}: \ \log(\mathrm{O/H}) + 12 = {} & 12.0 - 4.944 + 0.767\ R_{23} \\ & + 0.602\ R_{23}^2 \\ & - y(0.29 + 0.332\ R_{23} \\ & - 0.331\ R_{23}^2)\ , \quad (9) \end{aligned}$$

where

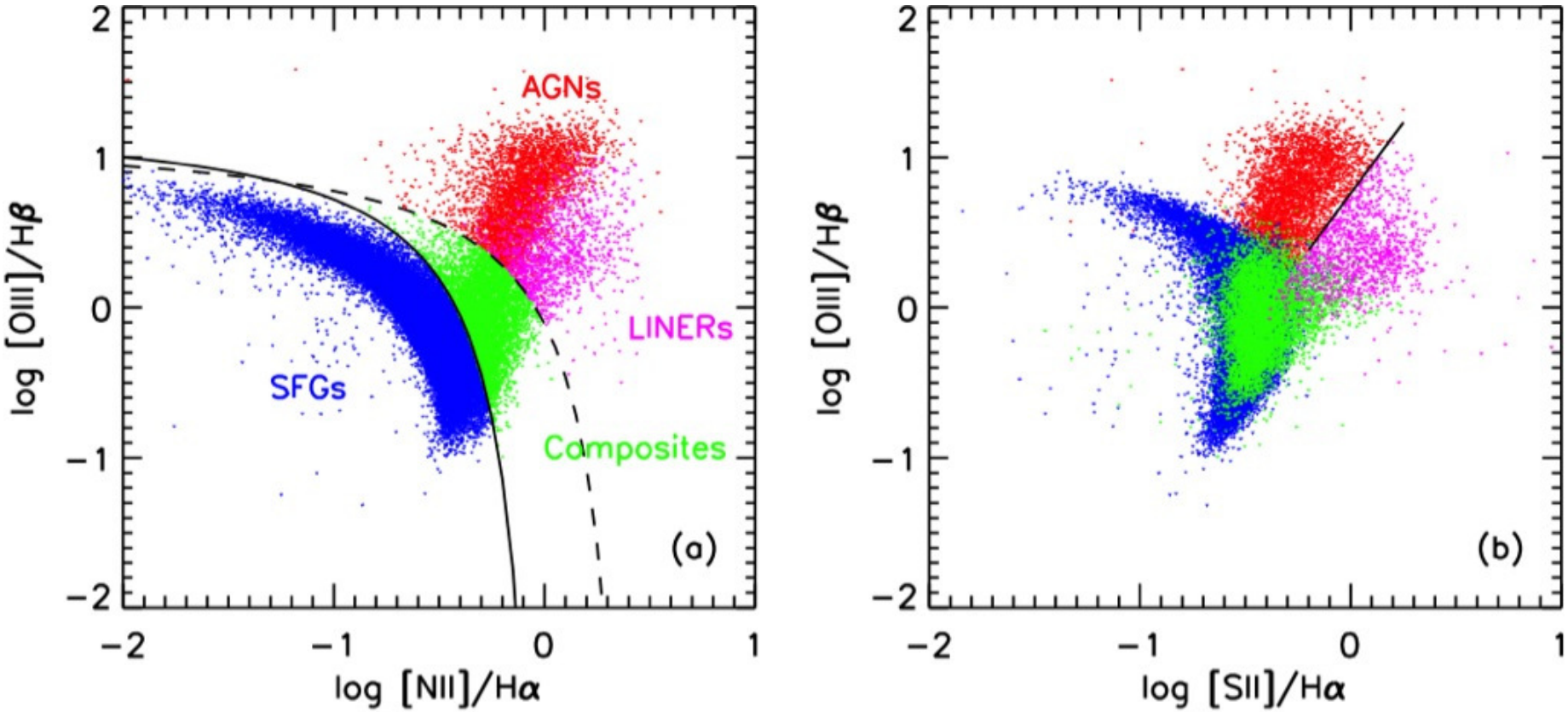
$$y = \log\left(\frac{[\mathrm{O\,III}]\ \lambda\lambda4959, 5007}{[\mathrm{O\,II}]\ \lambda3727}\right)\ , \quad (10)$$

Metaliczność

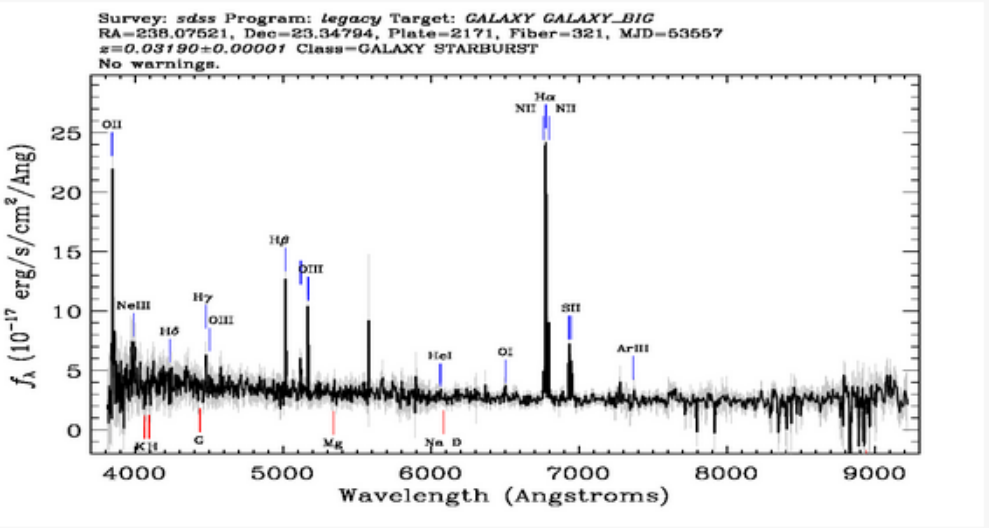


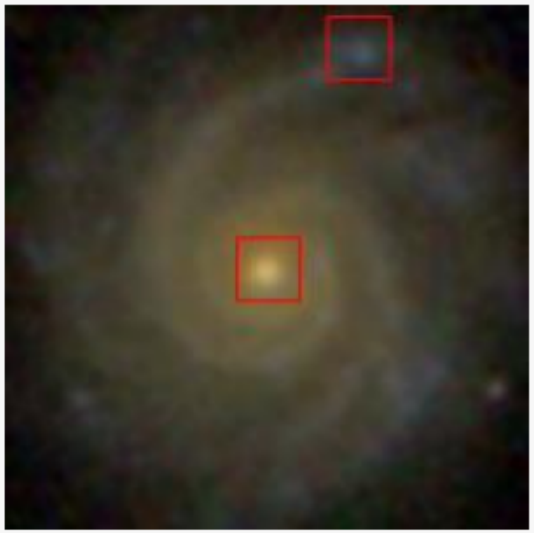
BPT diagram

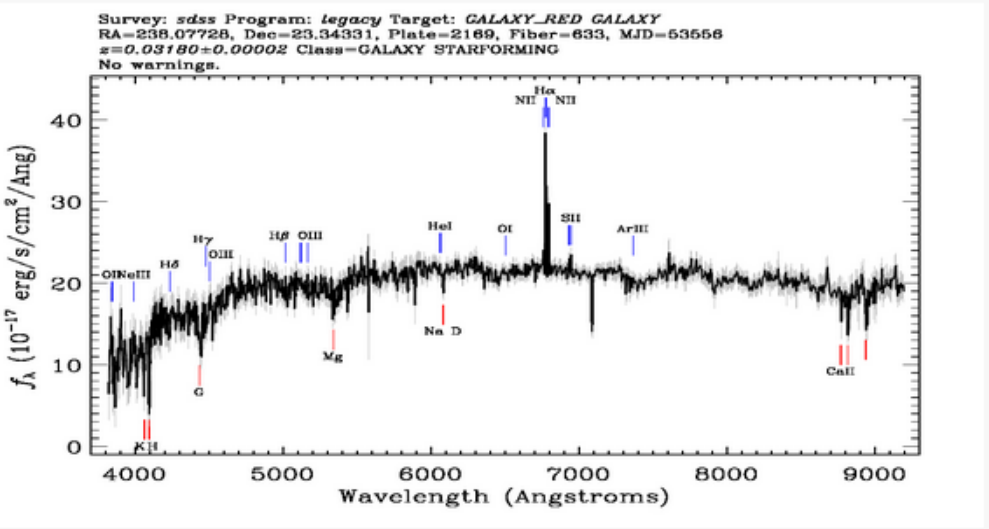
BPT = Baldwin, Phillips & Terlevich (1981)



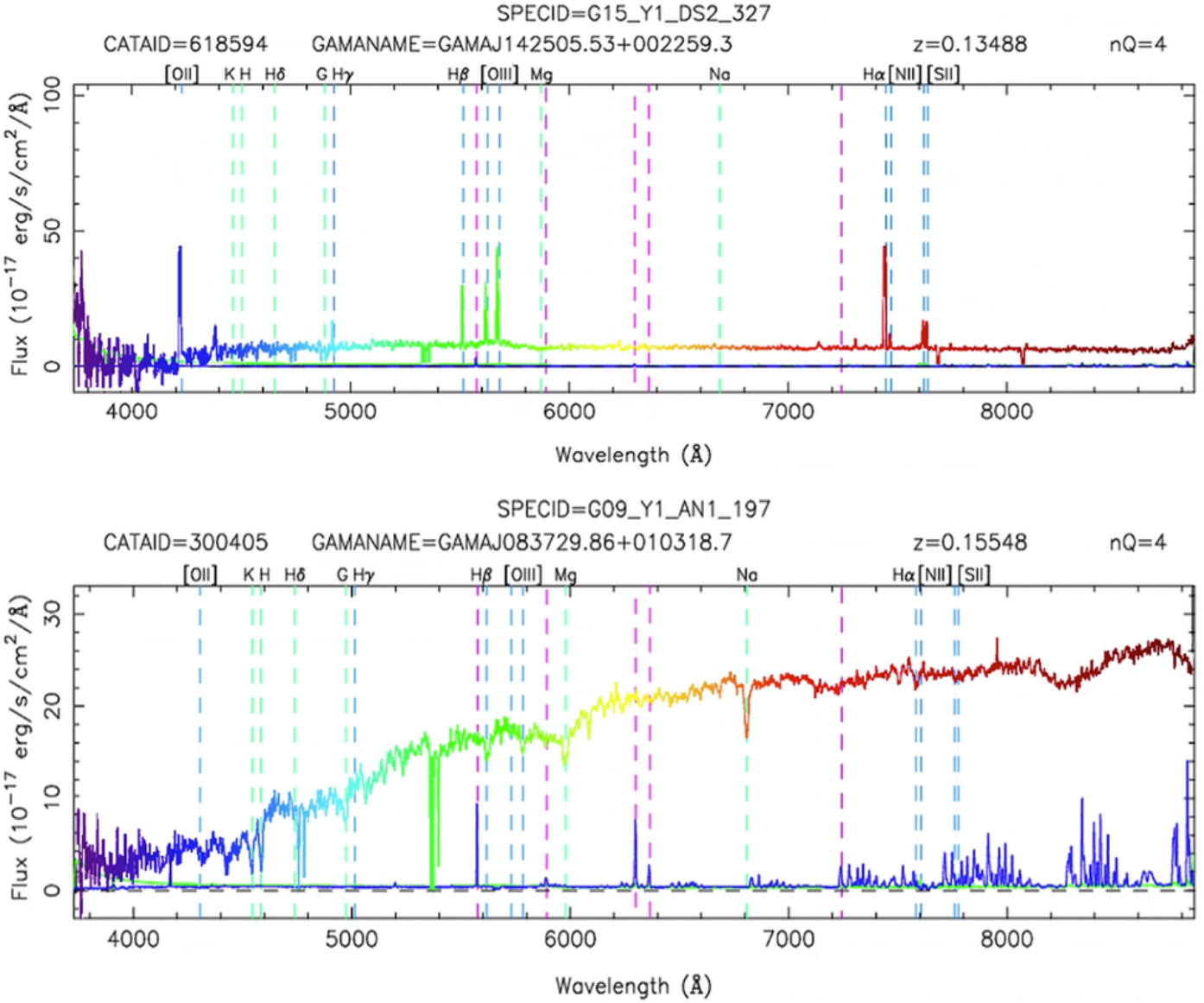
Widmo galaktyki



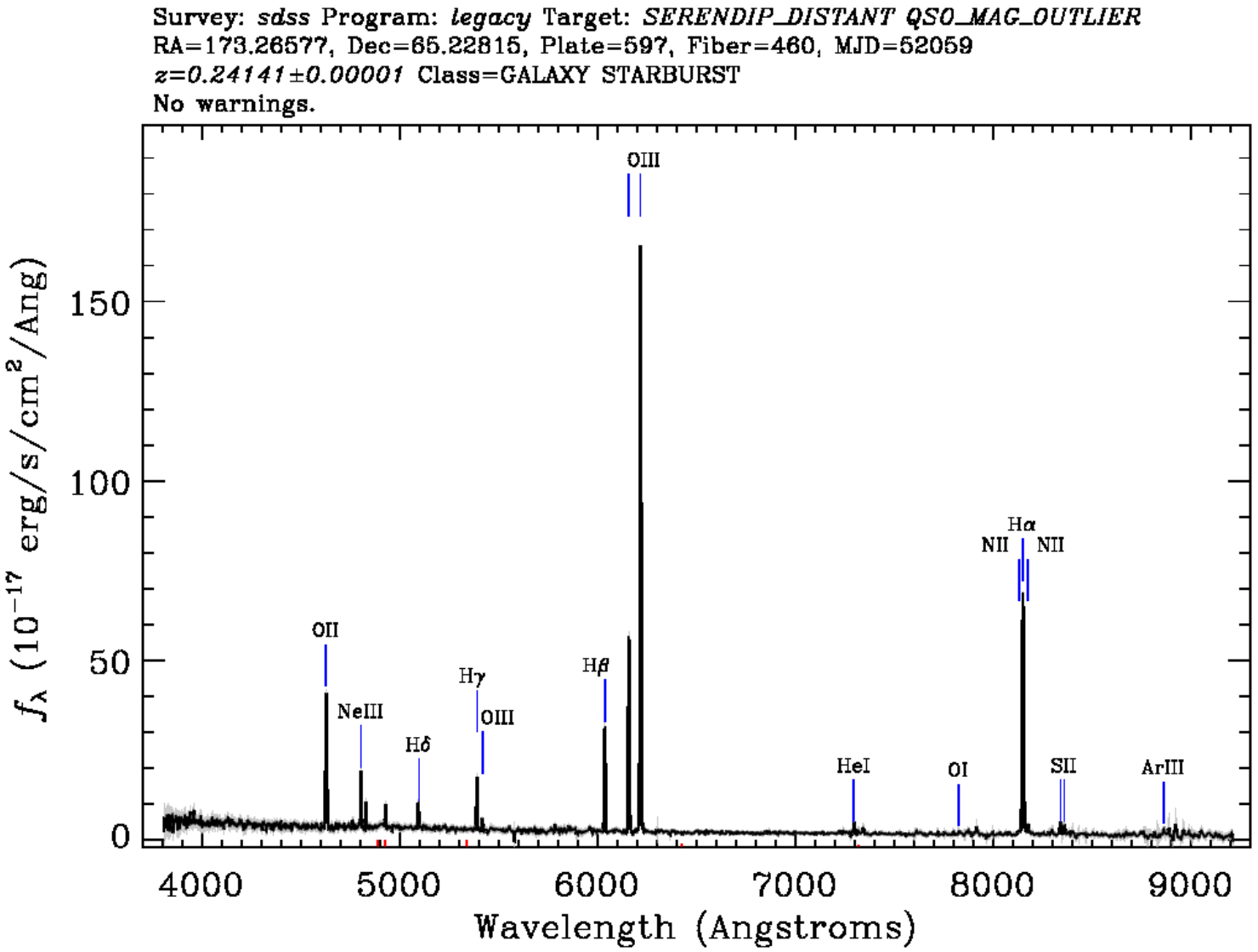




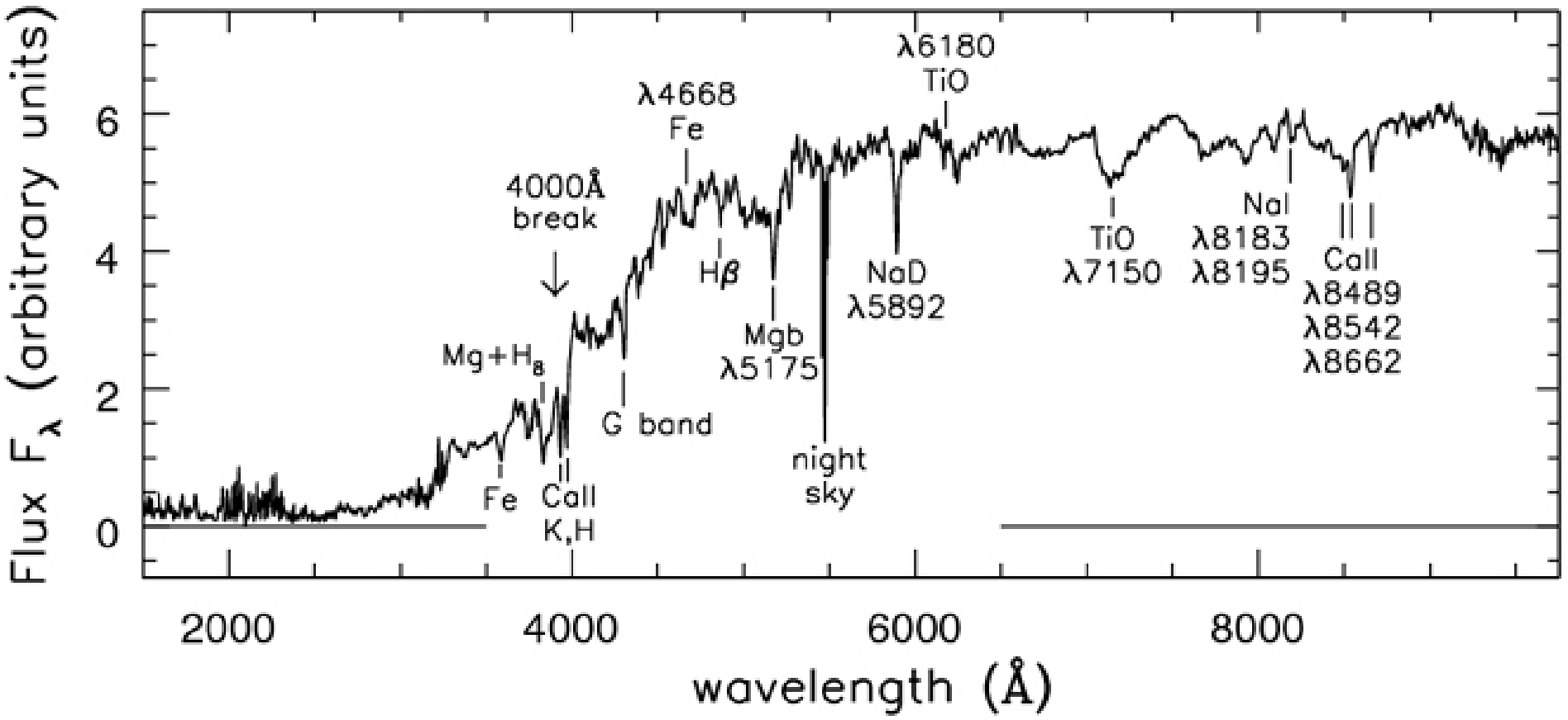
Widma galaktyk



Galaktyka formująca gwiazdy



Galaktyka eliptyczna



Widmo kwazara/AGNa