Emissivity vs density, temperature

- **Recombination line, O III forbidden lines**

Two level atom AGN3 Sec 3.5

- **Excitation, deexcitation rates**
- **Transition probabilities**
- **Critical density**
- **Two limits**
  - Low densities, every excitation leads to emission of a photon
  - high densities, levels are n LTE, photon emission proportional to $n_u A_{ul}$

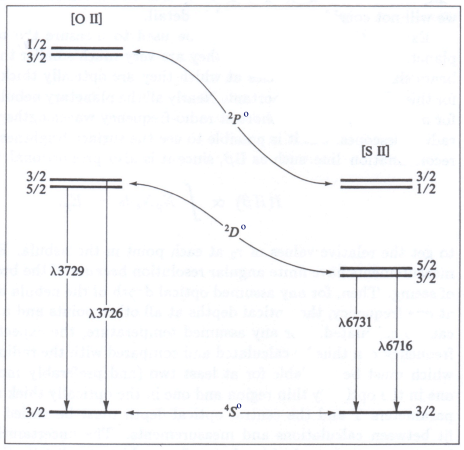
Recombination lines

- $H^+ + e \rightarrow H^{0*} \rightarrow H^0 + photons$
- Critical densities of H I, He I, and He II optical lines are very high, n > 1e15 cm^{-3}, so they are usually in LDL
- Emissivity goes as n^2

Forbidden lines

- [O III]
- $O^{++} + e \rightarrow O^{++*} \rightarrow O^{++} + photons$
- Critical densities of many forbidden lines n ~ 1e3 cm^{-3}, so they can be in LDL or HDH
- Emissivity goes as n^2 or n

Density indicators



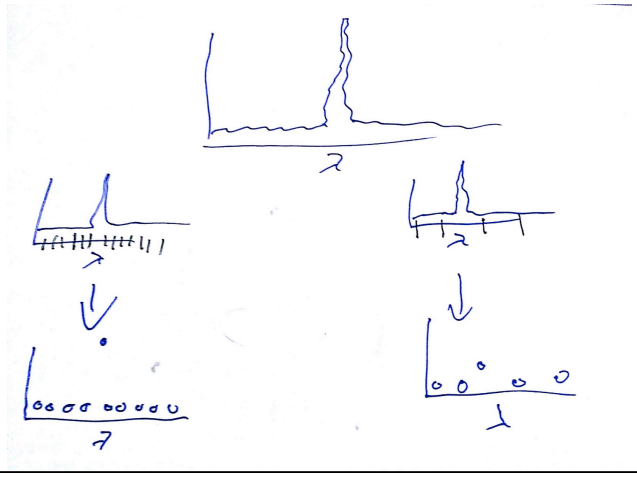
AGN3 Fig 5.7

Inward vs total emission

- **"Inwd" label for line**
- **Inward/outward emission computed on second and later iterations**
  - Iterate to convergence
  - Print last

Line to continuum contrast

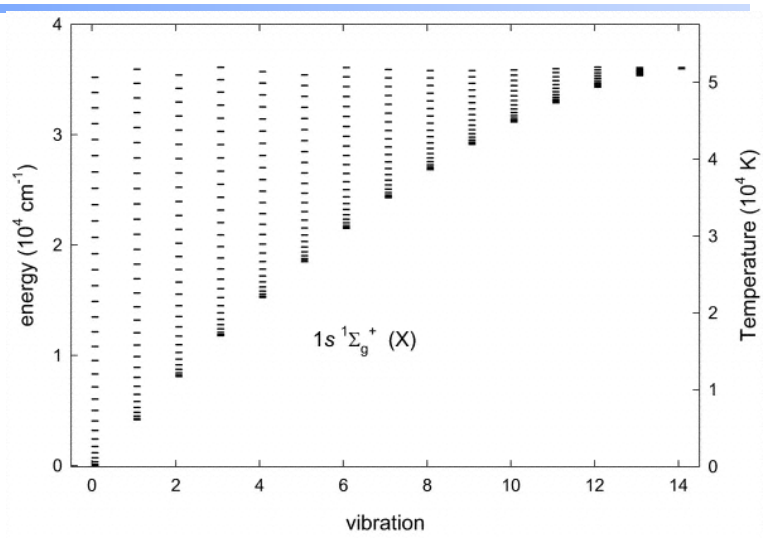
- **Hazy 1, sec 19.14.44**
  - Line to continuum contrast in save continuum



Databases in Cloudy

- **Stout (atoms & low ionization)**
- **Chianti (higher ionization)**
- **LAMDA (heavy-element molecules)**

H_2 (Shaw+05) "species H2"



Controlling model atoms

- **Series of SPECIES XXX commands**
- **Compare exec time species limit vs small**