ASTRO C207 Radiative Processes in Astrophysics
Lydia Lee

Problem Set 5

1. Good Rovibrations

(1) Assume we end in $n = 0$.

$$\begin{aligned} k_{\text{center}} &= \frac{\nu_{\text{center}}}{c} \\ \nu_{\text{center}} &= c k_{\text{center}} \\ &\approx 3(10^{10}) \cdot 2145 \\ &\approx 6.4(10^{13})\text{Hz} \\ &\approx 1 \times \nu_{0,\text{CO}} \end{aligned}$$

where $\nu_{0,\text{CO}} \approx 6.7(10^{13})$Hz is the natural frequency of CO vibrational transition.

$$\Delta n = -1$$

(2)
- Boltzmann statistics for populations in each J state
- Line intensity $\propto n_{J_{\text{upper}}}$

$$\frac{n_{J+1}}{n_J} = \frac{g_{J+1}}{g_J} e^{-\frac{E_{J+1}-E_J}{k_B T}}$$

(3)

(4)

(5)