

## AST 300B – Spring 2018

### In-class/Take-home Problems Due: Wednesday Mar. 28

31. Consider the level populations of a 2 level system (labeled level 1 and level 2) where the density of colliding particles is very large ( $n_c \rightarrow$  huge) and collisions dominate in determining the level populations. In this limit,  $T_{\text{ex}} \rightarrow T_k$ , the gas kinetic temperature of the colliding particles. Derive the mathematical relationship between the upward and downward collisional rate coefficients ( $\gamma_{12}$  and  $\gamma_{21} \text{ cm}^3 \text{ s}^{-1}$ ). Note: due to the principle of detailed balance, the relationship you just derived is valid even when  $n_c$  is not large – you can use this relationship to turn a  $\gamma_{12}$  into a  $\gamma_{21}$  and vice versa in statistical equilibrium calculations

