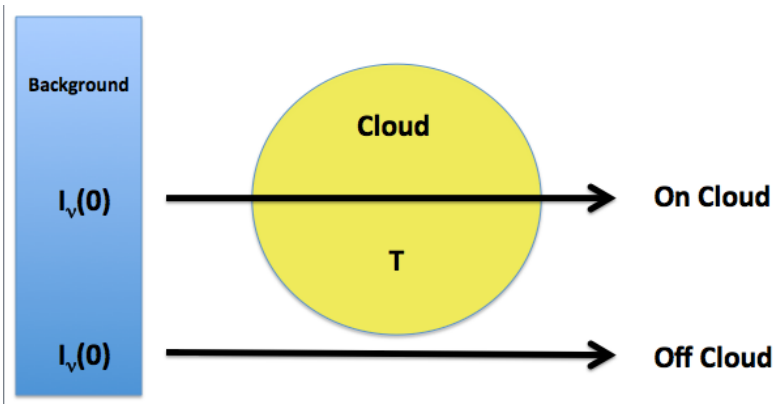
AST 300B – Spring 2019

In-class/take-home Problems Due: Friday January 25

6. Consider a thermally emitting cloud with Source function, S_ν, in front of a background intensity given by $I_\nu(0)$. If we make an observation toward the cloud and subtract an observation made off the cloud, write down the formal 1D solution for the background subtracted intensity $\Delta I = I_\nu - I_\nu(0)$.

(a) If you group your factors such that one factor is $(1 - e^{-\tau})$, then the other factor tells you the criteria for when you will see emission from the cloud ($\Delta I_\nu > 0$) or absorption from the cloud ($\Delta I_\nu < 0$). What is the condition required to see the cloud in emission above the background? What is the condition required to see the cloud in absorption against the background?

(b) Now assume that the intensity of the Background and that the Source function of the Cloud are well described by blackbodies at T_{bg} and T respectively. Rewrite the equation for ΔI. What do the criteria you derived in (a) imply about the relationship between T_{bg} and T for emission to be observed and for absorption to be observed of the cloud in front of the background.



7. Neutral Hydrogen (HI) may be observed through the 21 cm (1.420 GHz) spin-flip transition. A quasar is observed through two thermal phases (CNM and WNM) of Galactic HI with temperatures T_c and T_w that are constant in each phase. I_q is the un-attenuated intensity (erg s^{-1} cm^{-2} $ster^{-1}$ Hz^{-1}) of the quasar at 21 cm with solid angle Ω. If the total optical depths of the WNM and CNM phases are τ_w and τ_c respectively at 21 cm, then write down the formal expression for the flux density observed at the HI frequency.

HINT: For each ISM phase, think about what is the background for that phase and what is the source function for that phase.