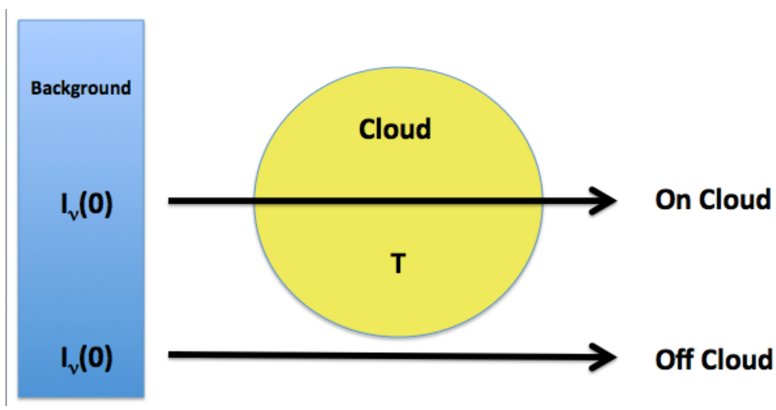
AST 300B – Spring 2018

In-class/take-home Problems Due: Monday January 29

9. Consider a thermally emitting cloud at temperature T with a background intensity given by $I_\nu(0)$. If we make an observations toward the cloud and subtract an observations made off the cloud, write down the formal 1D solution for the difference measurement $\Delta I = I_\nu - I_\nu(0)$.

(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?

(b) What is the condition required to see the cloud in absorption against the background?



10. The brightness temperature, T_B, of a source as the temperature that is directly proportional to the observed intensity given by the Planck function, $B_\nu(T_B)$, in the Rayleigh-Jeans limit ($h\nu/kT_B << 1$). Radio telescope don't actually measure specific intensity, but instead measure the flux density of the source observed within the diffraction beam of the telescope with solid angle $\Omega = \pi\theta^2/4\ln(2)$ for a FWHM "beam width" of θ. Derive the equation for how T_B is related to observed flux density F_ν. This expression is very handy for going from K to Janskys (Jansky is a unit of flux density: 1 Jy = 10^{-23} erg s^{-1} cm^{-2} Hz^{-1}).