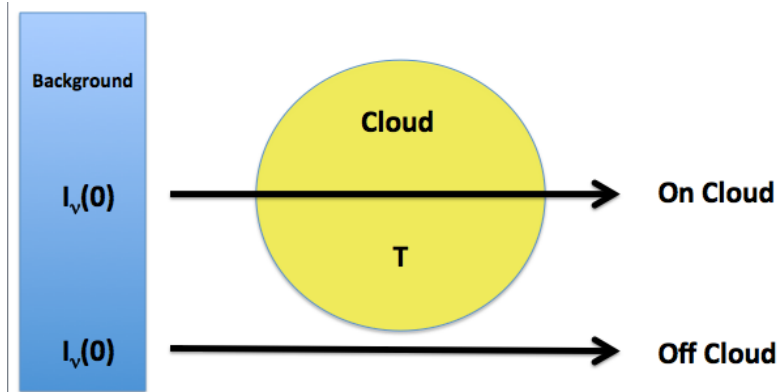


## AST 300B – Spring 2017

### In-class/take-home Problems Due: Monday January 30

8. 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?



9. The brightness temperature,  $T_B$ , of a source is the temperature that is directly proportional to the observed intensity given by the Planck function,  $B_\nu(T_B)$ , in the Rayleigh-Jeans limit ( $h\nu/kT_B \ll 1$ ). Radio telescopes 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  $\theta$ . Derive the equation for how  $T_B$  is related to observed flux density  $F_\nu$ . This expression is very handy for going from K to Janskys (Jansky is a unit of flux density:  $1 \text{ Jy} = 10^{-23} \text{ erg s}^{-1} \text{ cm}^{-2} \text{ Hz}^{-1}$ ).