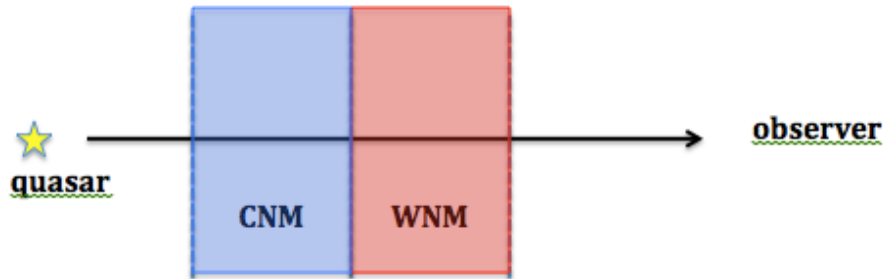


## AST 300B – Spring 2017

### In-class/take-home Problems Due: Wednesday Feb. 1

10. 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.  $F_\nu$  is the un-attenuated flux density ( $\text{erg s}^{-1} \text{cm}^{-2} \text{Hz}^{-1}$ ) of the quasar and  $\Omega$  is the solid angle of the quasar. If the HI peak optical depths of the WNM and CNM phases are  $\tau_w$  and  $\tau_c$ , then write down the formal expression for the flux density observed at the HI frequency.



11. A spherical cloud with radius  $R$  and a temperature  $T$  emits thermally with emissivity & absorption coefficients  $j_\nu$  &  $\alpha_\nu$ . Assume that the cloud is at a distance  $d$  with  $d \gg R$  and negligible background radiation field.

- (a) In the optically thin limit, what is (1) the intensity observed toward the center of the cloud and (2) the flux density observed at the Earth from the entire cloud [Hint: how are  $j_\nu$  and  $L_\nu$  related] ?
- (b) In the optically thick limit, what is (1) the intensity observed toward the center of the cloud and (2) the flux density observed at the Earth from the entire cloud?

