ASTR 300B – Spring 2019
<u>In-class/take-home Problems Due: Jan. 28</u>

8. A spherical cloud with radius R and a temperature T emits thermally (thermally means $S_\nu = B_\nu(T)$) with emissivity & absorption coefficients j_ν and α_ν. Assume that the cloud is at a distance d from the Earth with d >> R and a negligible background radiation field. Write all of you answers in terms of only constants, $B_\nu(T)$, j_ν, d, and/or R.

(a) **In the optically thick limit**, what is:
(1) the monochromatic specific intensity observed toward the center of the cloud and
(2) the emergent flux density from the surface of the cloud and
(3) the flux density observed at the Earth from the entire cloud?

(b) **In the optically thin limit**, what is:
(1) the monochromatic specific intensity observed toward the center of the cloud and
(2) the flux density observed at the Earth from the entire cloud?
[Hint: trying to integrate the specific intensity over solid angle is *painful*. It's possible, but there is an easier way to solve this. Since it is optically thin, all emitting volume elements in the cloud contribute to the total spectral luminosity L_ν. Think about units/definitions and start by asking how j_ν and L_ν are related to each other assuming each volume element radiates isotropically (same in all directions). Then, calculate how L_ν and flux density are related? This method involves no integration. Remember this derivation … we're gonna use it!]