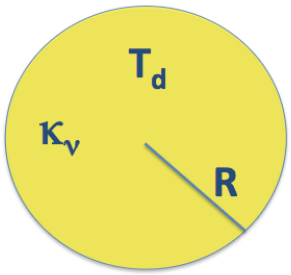
AST 300B – Spring 2019

In-class/take-home Problems Due: Monday Feb. 11

15. (a) Consider a spherical, optically thin dust thermal cloud with constant dust temperature T_d, constant dust opacity κ_ν, and a radius R. Using the results from a previous homework, derive an equation relating the observed flux density of this cloud at a distance d >> R to the mass of the cloud M. Write your answer in term of the mass opacity κ_ν of the cloud.



(b) Consider a millimeter mapping survey of the Rho Ophiuchus molecular cloud at λ = 1.3 mm (below). If the cloud is located at a distance of 135 pc (the nearest molecular cloud to the Earth) and the mapping has a 3-sigma flux density sensitivity of 0.1 Jy (N.B. 1 Jy = 10^{-23} erg s^{-1} cm^{-2} Hz^{-1}), what ***gas mass*** is the survey sensitive to (quote your answer in solar masses) for dense cores at T_d = 10K and 20 K. If dense cores are up to 50% efficient (meaning <= 50% of their mass goes into a forming star), could this survey detect dense cores capable of forming stars down to the hydrogen burning limit (M ~ 0.08 M_{sun})? $\kappa_\nu \sim 0.9$ cm^2/g of dust at 1.3mm (OH5).