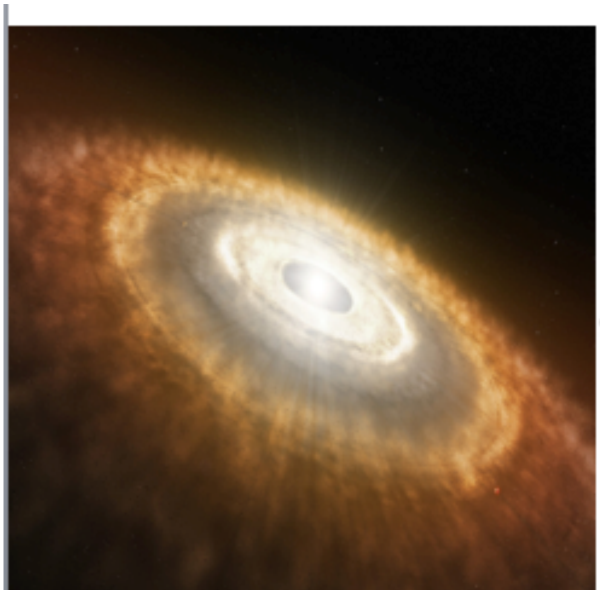
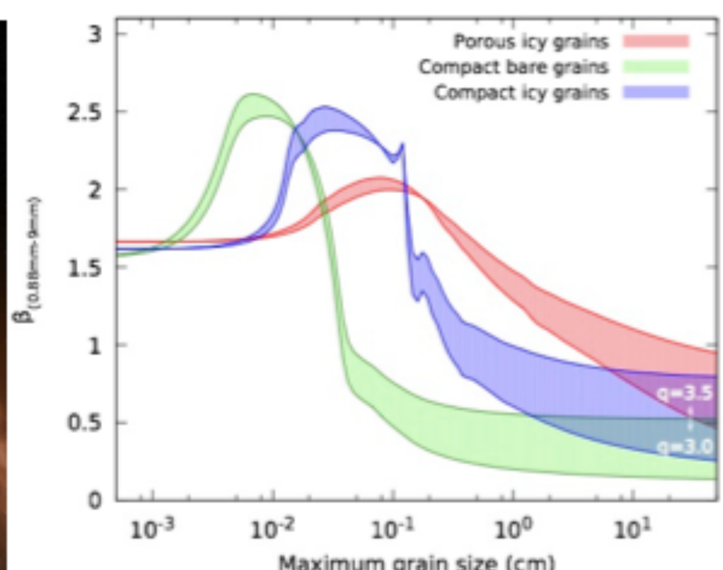
AST 300B – Spring 2019
<u>In-class Problem Due: Wed. Feb. 13</u>

16. Consider an optically thin dusty disk surrounding a young protostar with luminosity L_{star}. In this problem, you will derive how the temperature of dust grains varies with distance, r, from the star.

(a) Assume the dust opacity at long wavelengths is given by a power-law $Q_{abs} \sim \nu^{\beta}$. Derive the dependence of T_d with r and β. I just want you to write down how T_d is proportional to r and β (don't have to write out all the constants, etc.).

(b) In typical ISM dust $\beta \sim 2$, but in young protostellar disks where dust grain start to grow into mm sized grains ("dust coagulation"), we find that $\beta \sim 1$. Large (km) planetesimals would radiate closer to a blackbody and would have $\beta \sim 0$. Thus, there is significant evolution in the opacity (Q_{abs} or κ_ν) of dust grains in planet-forming disks (see Figure below for a calculation of how β at long wavelengths varies with size of grains). Calculate the power-law indicies of T_d with r for $\beta = 2$, 1, and 0 (simplify any fractions).





Testi et al. 2013 PPVI Review