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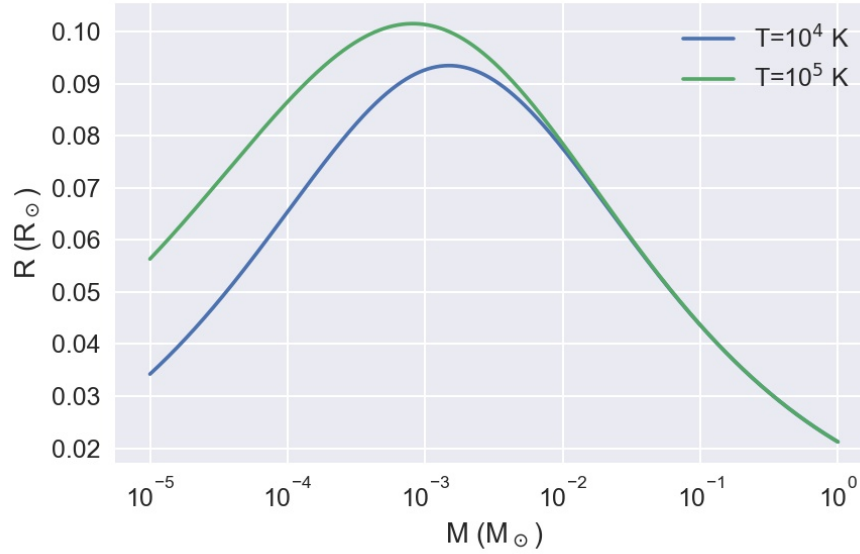Tom Quinn
Astro 507: Thermodynamics
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HOMEWORK 4

1. (a) In the one-zone model, $P_c \sim GM^2/R^4$. We also assume $\rho \sim M/R^3$.

$$\frac{GM^2}{R^4} = K_{\text{ideal}}\left(\frac{M}{R^3}\right)T + K_e\left(\frac{M}{R^3}\right)^{5/3} - K_C\left(\frac{M}{R^3}\right)^{4/3} \tag{1}$$

$$G = K_{\text{ideal}}M^{-1}RT + K_eM^{-1/3}R^{-1} - K_CM^{-2/3} \tag{2}$$

$$R = \frac{GM + K_CM^{1/3} - \sqrt{(K_CM^{1/3} + GM)^2 - 4K_{\text{ideal}}K_eM^{2/3}T}}{2K_{\text{ideal}}T} \tag{3}$$

(b) Plot of radius as a function of mass:

(c) I assume that "branches" refers to the radii above and below the turning point near 10^{-3} $M_\odot$.