AST 403 Problem Set #4 Due March 22 2011

You can do this in teams, by yourself, or as a whole class project.

Download the computer code `hms11.f` and associated README file from the course web page (http://www.astro.princeton.edu/∼gk/A403 - look under "codes"). There is also a description of the code. This is in FORTRAN-77 and can be compiled with a command such as "f77 hms11.f" on most unix or linux machines, and run by invoking "a.out". (This is Prof Bohdan Paczynski's code). Read the README file before running the code.

(a) Use the code to generate a series of main-sequence models covering the range $-1.0 \leq \log(M/M_{\odot}) \leq +2.0$ in steps of $\Delta \log M = 0.1$. Make plots of $\log L/L_{\odot}$, $\log R/R_{\odot}$, $\log \rho_{\rm c}$, $\log T_{\rm c}$, and $\log T_{\rm eff}$ versus $\log M/M_{\odot}$. Use the chemical composition $X = 0.7$, $Z = 0.02$. *Warning: If the code outputs* `iter=-16`*, then the model has not converged.*

(b) Compare the functional relations $L(M)$ and $R(M)$ as quantitatively as possible in terms of appropriate semi-analytic models, *e.g.* Eddington β models, in the appropriate range of masses. How well do the lower-mass models agree with $n = 1.5$ polytropes as judged by, *e.g.*, $R^3\rho_{\rm c}/M$ and $Rk_{\rm B}T_{\rm c}/GM\mu m_H$?

(c) Starting from $\log M/M_{\odot} = -1$ and creeping downward by small steps in mass, $\Delta \log M = -0.01$, generate the lowest-mass converged model that you can.