Homework 3: Due Wednesday, February 18 (40 pts)

Meet EZWeb (30 pts)

EZWeb (www.astro.wisc.edu/ townsend/static.php?ref=ez-web), developed by Rich Townsend, is a stellar structure code with a user friendly interface. It is a simplified (but accurate enough for our purposes) version of another code called MESA (mesa.sourceforge.net). If your research calls for stellar models, you should consider attending the MESA Summer School and using MESA. For this problem, create a set of models spaced logarithmically at intervals of $.025 M_\odot$ in mass, ranging from $10^{-0.5} - 10^{1.5}$ $M_\odot$. Select solar metallicity ($Z = 0.02$). We're interested in the zero-age main sequence (ZAMS) here, so there is no need to evolve for long periods of time. You don't need the Detailed Structure Files, either. **Hint:** There are three common pitfalls in completing EZWeb homework assignments. One is not allowing enough time to run your models; normally turnaround is very fast but if usage is heavy or the server goes down you could be in trouble. The second pitfall is not downloading the zipped archive within 24 hr. The third is forgetting which model is which. This shouldn't be a problem here because mass is in the 3rd column of the output but you should make a habit of keeping careful notes.

1. Plot $\log L$ vs $\log M$. Try to fit the results to a single power law ($L \propto M^\alpha$). Can you get a better fit with a broken power law? Repeat with $\log R$ vs $\log M$ and $\log T_c$ vs $\log M$.

2. Use the equation of HSE to argue that P_c is related to M and R by $P_c \propto GM^2/R^4$. Assess (quantitatively) how well your models obey this relation, and empirically determine the constant of proportionality.

3. For each model, evaluate the contributions of electron scattering, bound-free, and free-free processes to opacity at the centers of the models (you can use the Kramers type formulae in HKT) and comments on trends as you vary M.

Radiative Cooling (10 pts)

Use the First Law of Thermodynamics to estimate the cooling time for a star if all energy sources are turned off and radiative diffusion is the only energy transport mechanism. Discuss the relationship to the Kelvin-Helmholtz time.