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Astronomy 101: The Physics of Stars

Problem Set #6

Due in class Wednesday, November 27, 2002

Note : For this problem set you will need the stellar model calculator provided by Hansen & Kawaler's textbook "Stellar Interiors". This program takes the parameters Total Mass, Hydrogen and Helium mass fractions, a guess for central Pressure, Temperature, Radius and Luminosity and calculates a stellar model for them. The data is listed in the form of long tables, which by themselves are not very instructive. Hence you will also need to visualize your results by plotting the data using a plotting package of your choice. Some of your options are : *gnuplot, Maple, Mathematica, xvgr, pgplot.* etc. Tutorials on how to use some of these pakcages can be found at :
http://www.pma.caltech.edu/~physlab/Intro/graphing.html

The model can be downloaded via anonymous ftp. Here's how :
1. Log into a Unix machine
2. *ftp ftp.astro.caltech.edu*
3. login as "anonymous"
4. type your e-mail as password
5. *cd /users/milan/*
6. *mget **
7. *quit*

This will download all the files to your directory. Then, check the *read.me* file for furhter instructions. On a Unix machine, you will need to compile the *zams.for* code with :
f77 zams.for -o myoutputname

Alternatively, you can download them separately using your web browser, at the following URL : *http://www.astro.caltech.edu/~milan/ay101/* . If you are workin under Windows, you can use the zams.exe, which is a Windows/DOS compatible compiled file.

Problem 1.

Using the ZAMS model calculator, produce models of the interior of stars for a range of masses. Use M=0.1, 1.0, 10.0 Msolar . Also use two different metallicities, corresponding to Population I stars (X=0.7 and Y=0.24) and Population II stars (X=0.7598, Y=0.24). All together, you should thus have at least 6 models. Feel free to experiment and note any interesting features your models might have.

Problem 2.

Now calculate models for a larger range of masses, from 0.08 to 60 solar masses. You don't need to produce plots of the interior structure, as we are now only interested in the total luminosity and effective temperature of the stars. Using these results, plot the main sequence in the Log[L] vs. Log[Teff] diagram for both metallicites. How do they differ?