

Stellar Astronomy and Astrophysics (SS08):

Exercise 4 (for June 05, 2008)

1. Period-Luminosity relation for Cepheids:

In the lecture we derived

1. the period-density relation $P \propto \rho^{-1/2}$,
 2. A Mass-Luminosity relation $L \propto M^\alpha$,
 3. and have shown that the instability strip for pulsation is restricted to a narrow strip of almost constant T_{eff} in the HRD.
- a) If we assume that for Cepheids $\alpha = 4$ (a somewhat higher value than for main-sequence stars), show that a period-luminosity relation ($\log L$ vs. $\log P$) exists. Hint: Use Stefan-Boltzmann's law.
- b) Assume that the instability strip is not at $T_{\text{eff}} = \text{const.}$ but more accurately given by $\log L = \beta \log T_{\text{eff}} + \delta$. How does the period-luminosity function look like in this case?
- c) Is this relation sufficient to determine the distance of a Cepheid from measuring its period and an apparent magnitude?

2. Download and installation of STATSTAR:

STATSTAR is a very simplified computer program to solve the equations of stellar structure. The program assumes a fixed chemical composition throughout the star, i.e. it calculates homogeneous zero-age main-sequence models (ZAMS).

The input to the program consists of the stellar mass, a chemical composition (XYZ), a trial luminosity L and a trial effective temperature T_{eff} . Only certain combinations of L and T_{eff} lead to a consistent solution (Voigt-Russel theorem).

Please install the STATSTAR program on your laptop. The Windows executable programs can be obtained from

http://wps.aw.com/aw_carroll_ostlie_astro_2e/48/12319/3153834.cw/index.html

For Linux or Mac: If a FORTRAN or C-compiler is installed on your computer you can also download the C++ code from this side or the Fortran77 source code from

<http://homepages.wmich.edu/~korista/statstar.f>

The Fortran 95 source code does not seem to work. It would be of great advantage if you also install gnuplot on your computer (<http://www.gnuplot.info/download.html>).