

Homework Set 6

Due: May 2, 2016, *at noon*

Please do calculations and provide results using cgs units.

1. Studying Stellar Evolution with MESA

For each of the studies below,

- plot central evolution in the $T_c - \rho_c$ plane and indicate central H ignition, central H depletion, central He ignition, and central He depletion;
 - make a Hertzsprung Russell Diagram of the evolution starting at the Zero-Age Main Sequence (ZAMS). Indicate the same points as above;
 - discuss the features of and differences in the tracks.
- (a) **Compute a grid of stellar models from $5 M_\odot$ to $25 M_\odot$ in $2 M_\odot$ steps, from hydrogen burning to end of central helium burning (follow evolution until $T_c = 5 \times 10^8$ K to be sure) for one of the metallicities below.**
- (b) **Compute a grid of stellar models for an initial mass of one of the masses above, but varying initial metallicity, using $Z = 0, 10^{-6}, 10^{-4}, 10^{-3}, 0.002, 0.005, 0.01, 0.015, 0.02, 0.03, \text{ and } 0.04$.**

NOTES:

- There should be a total of 4 plots.
- H ignition may be defined as the point when 1% of the initial hydrogen is burnt. You may also use that as ZAMS.
- Similar for He ignition - 1% of the helium left after hydrogen depletion has been burnt.
- for depletion I take the point when the mass fraction has dropped to 1×10^{-4} .
- Some useful settings for MESA may be

```
! stop when the center mass fraction of he4 drops below this limit
xa_central_lower_limit_species(1) = 'he4'
xa_central_lower_limit(1) = 1d-10
```

```
! stopt before C ignintion
log_center_temp_limit = 8.7
```

```
! frequent history output
history_interval = 1
```