MAKE HE WD

This test is to show how a 0.15 $M_\odot$ helium white dwarf is created from a 1.5 $M_\odot$ star. After being created, the white dwarf is allowed to cool for a couple Gyr. This test should run through all four inlists and print to the terminal at the end `‘‘finished all inlists for make_he_wd’’`. This is because this test requires four distinct inlists, each with a separate purpose, which are run consecutively.

The first inlist, inlist_wd_1, creates a pre-main sequence model with uniform composition and evolves until the inner hydrogen has burned to helium (`h1_boundary_mass_limit = 0.15`). The second inlist relaxes the mass down to 0.15 $M_\odot$ (`new_mass = 0.15`), then runs for 100 steps in order to let the star adjust to the mass loss. The third inlist relaxes Y (`new_Y = 0.99`) making the star 99% helium, then runs for 100 steps. The final inlist sets initial model number and age to 0 (`initial_model_number = 0 ; initial_age = 0`) and evolves the star for 10 Gyr (`max_age = 10d9`).

Once the last inlist is called, the model behaves like a white dwarf should behave. The HR-diagram (figure 1) shows a temporary increase in effective temperature and luminosity from left-over burning and contraction, followed by a long period of cooling.

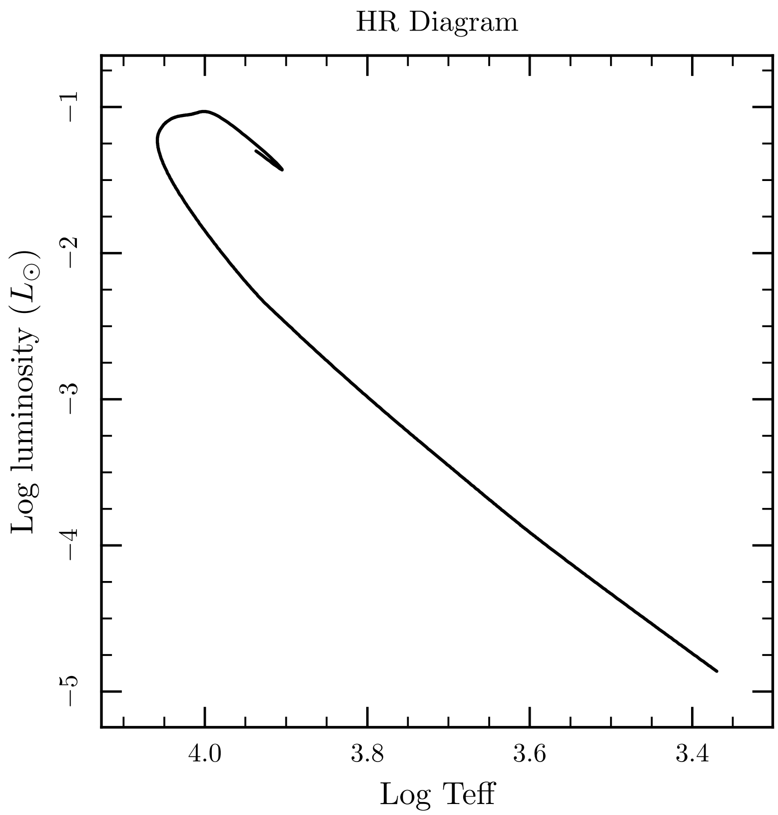

Figure 1

Below are two abundance profiles, one taken at maximum effective temperature (figure 2), and one taken at the end of the run (figure 3), with the log mass fraction plotted against q, where q is the fraction of star mass interior to outer boundary of each zone, moving outward from the core. The main difference is the amount of hydrogen between the core and the envelope.

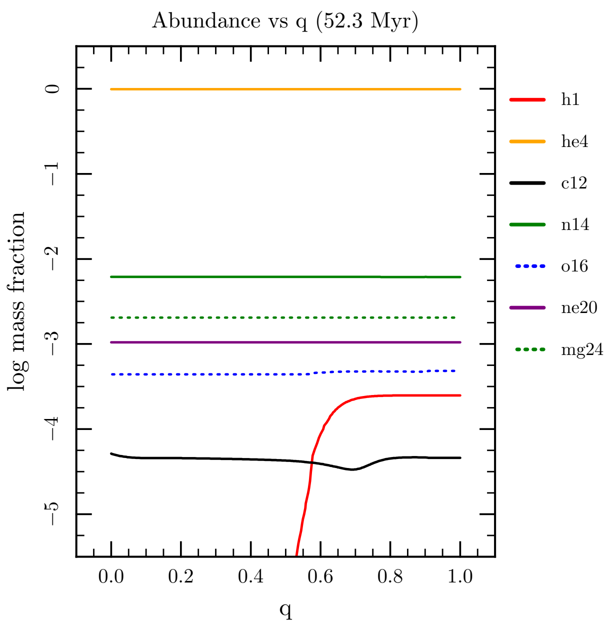

Figure 2: Abundance profile from peak effective temperature

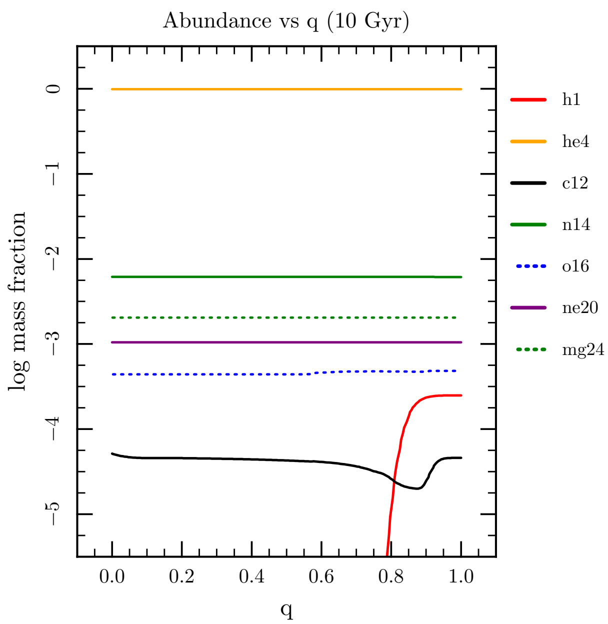

Figure 3: Abundance profile from end of run

The profile below, taken at peak effective temperature (figure 4), shows where in the star the power is being generated. Hydrogen is being burned, mainly through the CNO cycle, between the core and the envelope. Energy is also leaving the star through neutrino losses near the core. All of these power generation rates are negligible by the end of the run.

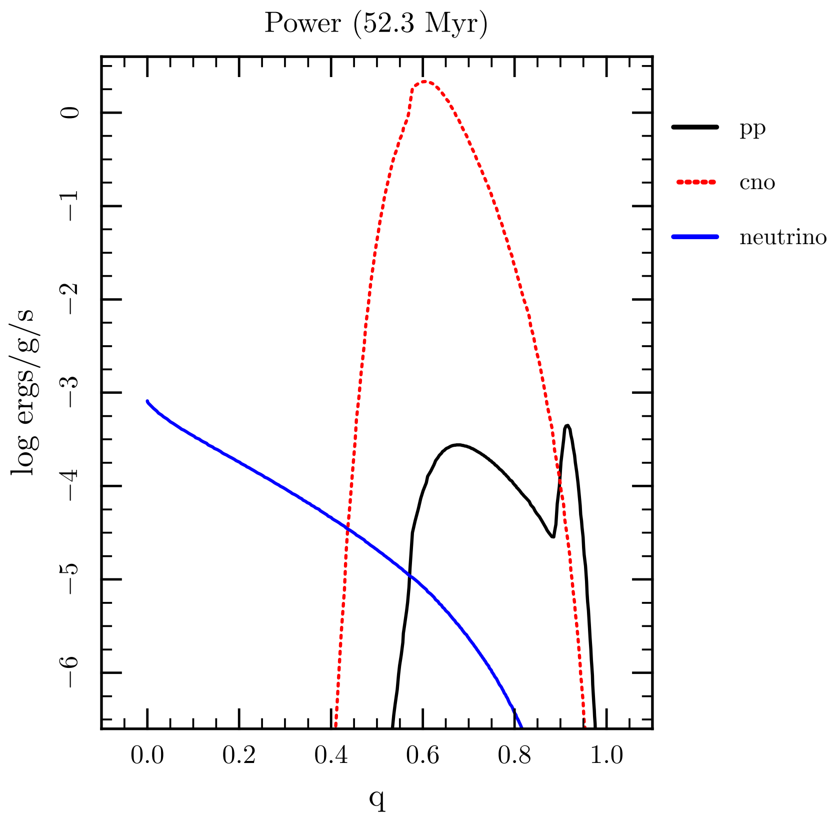

Figure 4: Burning rate profile from peak effective temperature

Below is a temperature-density profile taken at two ages: peak effective temperature and the end of the run (figure 5).

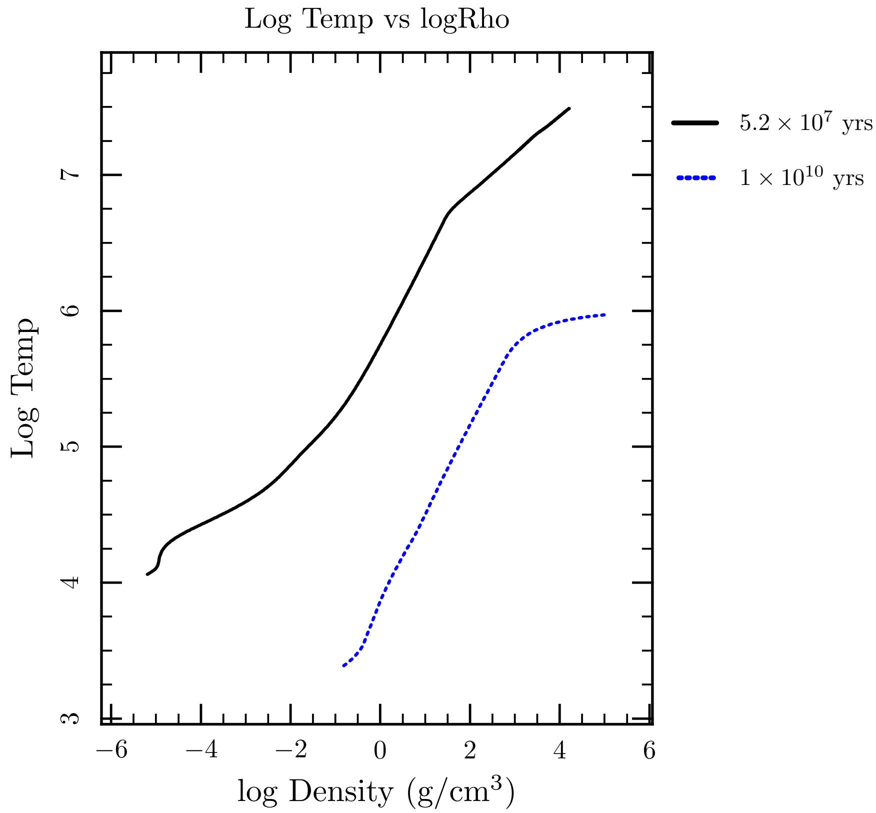

Figure 5: Temperature-density profile from peak effective temperature and end of run

This final plot (figure 6) shows a few internal `MESA` variables, such as the size of the time-step, the number of zones, and the number of retries against the model number in order to give some understanding of how hard `MESA` is working throughout the run and where some areas of problems/interest might be.

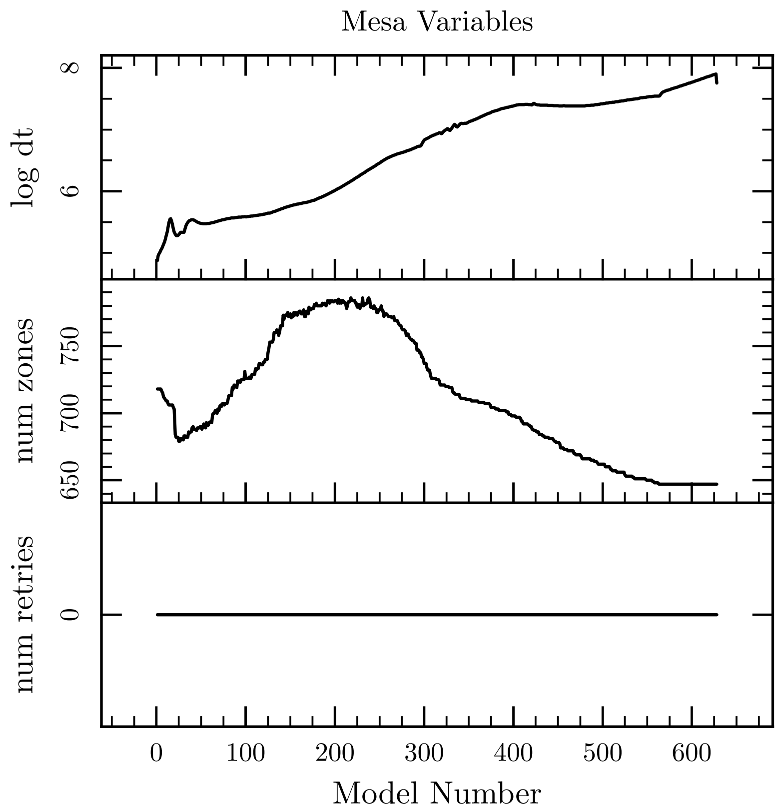

Figure 6: `MESA` variables plotted against model number show how hard `MESA` is working