WD3

This test is to show a 1 $M_\odot$ white dwarf surviving ignition of the helium shell. The test should be cut off when the total thermal power from triple-alpha burning (excluding neutrinos) reaches 10^{16} $L_\odot$ (`power_he_burn_upper_limit = 1d16`).

The inlist for this test loads a pre-saved white dwarf model from `mesa/data/star_data/white_dwarf_models`, and accretes pure ^{4}He at a rate of 10^{-9} $M_\odot$/yr (`mass_change = 1d-9`) for about 337 Myr.

The following two profiles show the activity of the white dwarf during the start of triple-alpha helium burning. The left-hand profile (figure 1) shows the abundance of elements in the star. This profile shows that the bottom of the helium shell starts at about m=1, giving the helium layer a mass of 0.336 $M_\odot$. The profile on the right (figure 2), which plots the burning rates, given in log erg/g/s, shows that triple-alpha burning reaches its peak at m=1, the bottom of the helium shell.

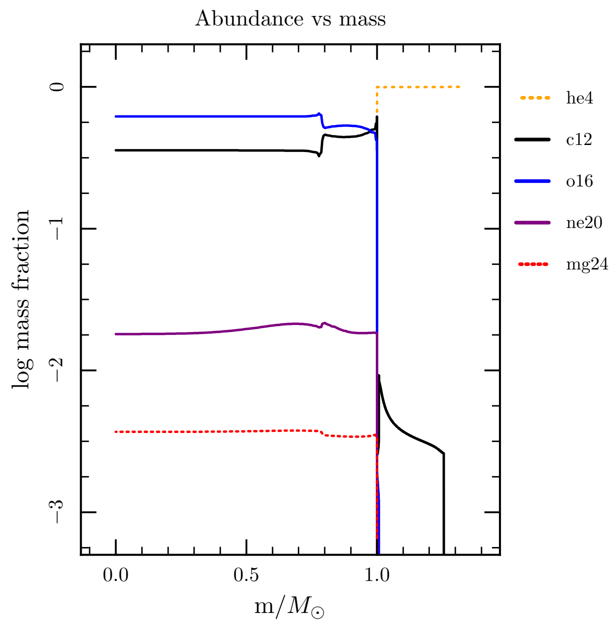

Figure 1: Abundance profile showing

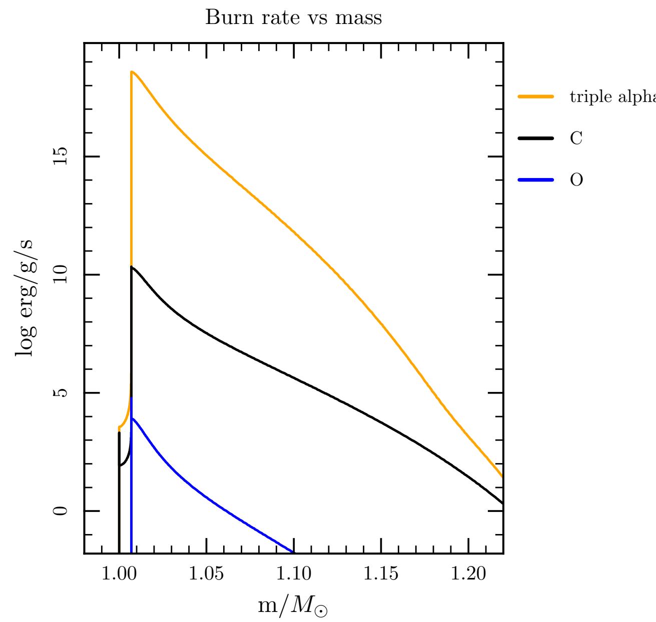

Figure 2: Burning rate profile, peak triple-alpha burning at bottom of helium shell

The helium luminosity (figure 3) starts very low and increases gradually throughout the run until the sharp peak at 337 Myr reaches 10^{16}. The temperature-density profile from the end of the run (figure 4) shows a temperature spike at the bottom of the helium shell.

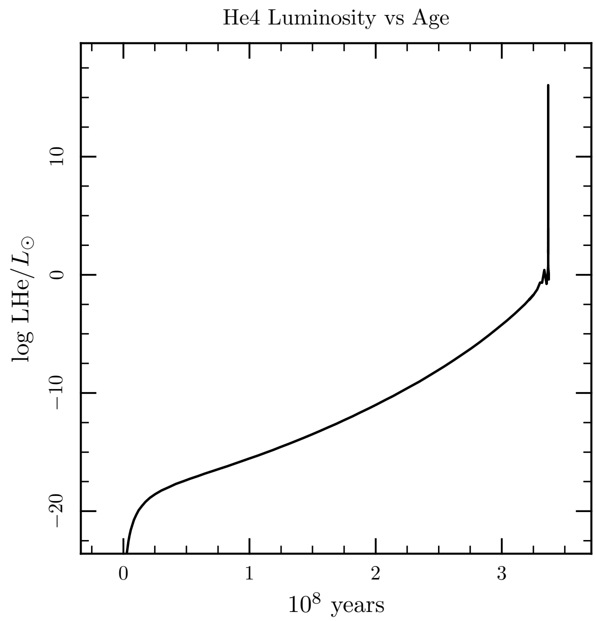

Figure 3: Helium Luminosity throughout the age of the model, gradual increase followed by a sharp peak at the end

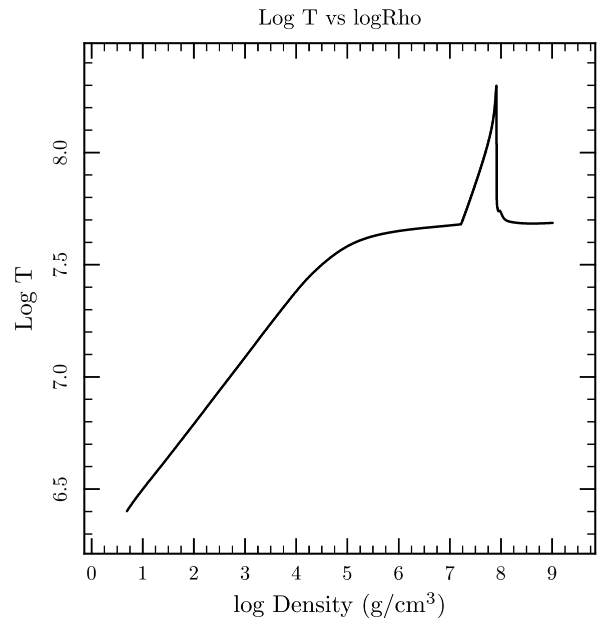

Figure 4: Temperature-density profile from end of run, temperature spike at bottom of helium shell

Before the peak in helium luminosity, however, overall luminosity (figure 5) and effective temperature (figure 6) are gradually inreasing due to heat released from the gravitational potential energy from the accreting helium.

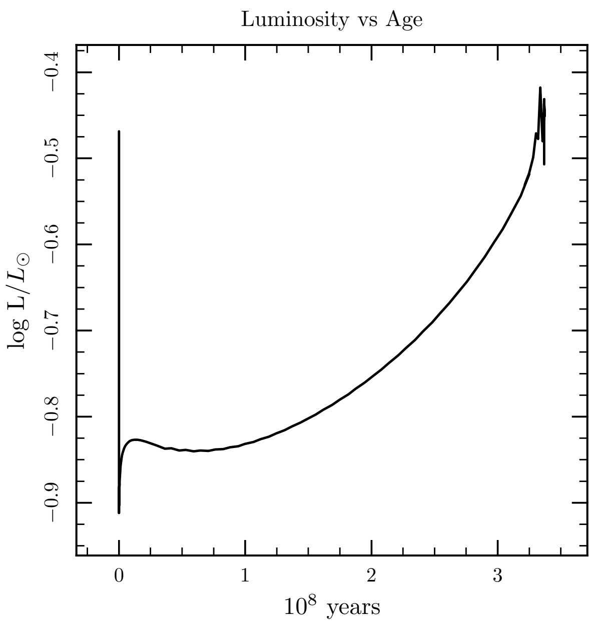

Figure 5: Gradual luminosity increase from gravitation potential energy from accreting helium

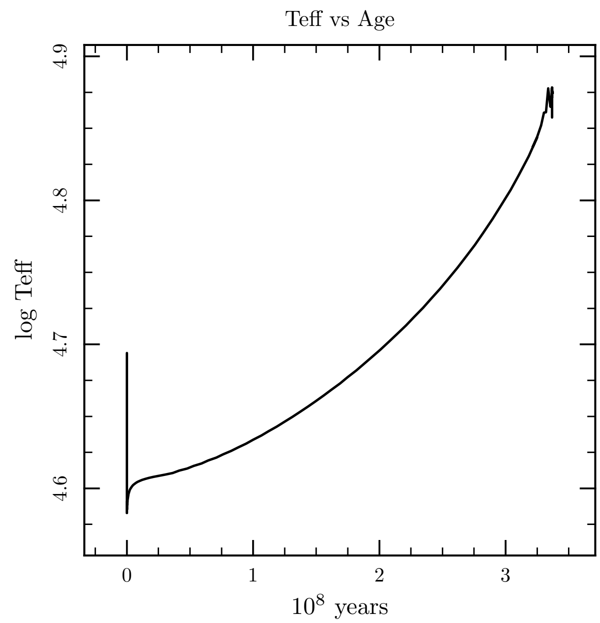

Figure 6: Gradual effective temperature increase from gravitation potential energy from accreting helium

This final plot (figure 7) 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.

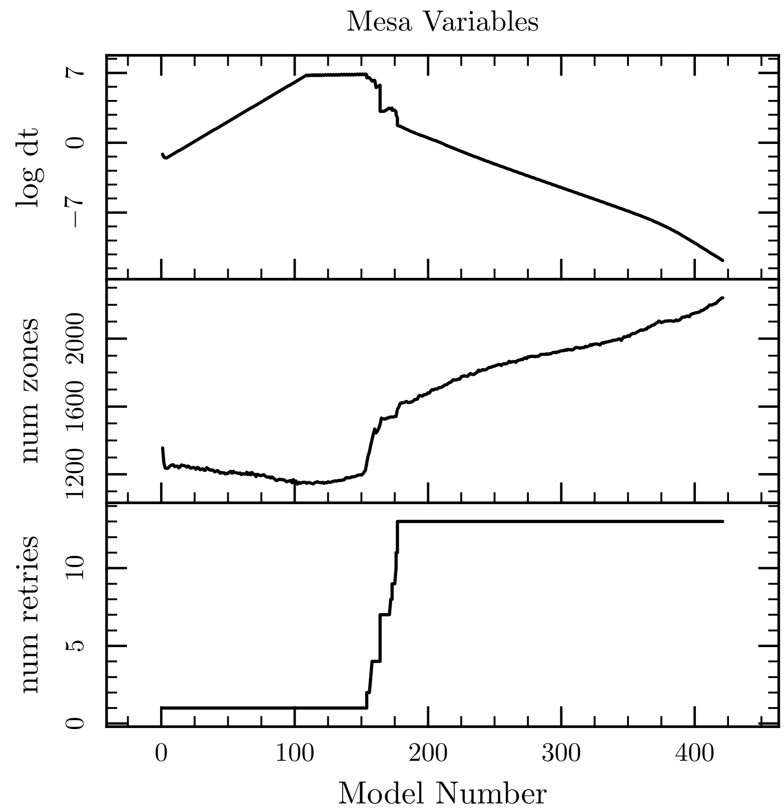

Figure 7: MESA variables plotted against model number show how hard MESA is working