EXAMPLE SOLAR MODEL

This test is to show how MESA can create a model that matches solar observations. It loads a pre-main sequence model and evolves it until it reaches an age of 4.57 Gyr (max_age = 4.57d9). Then MESA checks a few parameters to see if they match solar observations. If the values fall within set tolerances, the terminal output at the end of the run should read ‘‘all values are within tolerances’’.

The inlist sets the following nuclear reaction and opacity controls in the &star_job section:

- change_net = .true.
- new_net_name = 'pp_and_cno_extras.net'
- set_rate_c12ag = 'Kunz'
- set_rate_n14pg = 'Imbriani'
- kappa_file_prefix = 'OP'
- kappa_lowT_prefix = 'lowT_fa05_gs98'

The &controls section contains many other controls, including a maximum timestep (max_years_for_timestep = 1d7), and some diffusion controls (see documentation for 1.5M_with_diffusion for discussion of diffusion controls).

This test is very similar to the test case solar_calibration, but does not include calibration controls, so it cannot search a parameter space to find a model that matches observations. It checks the same values as solar_calibration, but they are listed in run_star_extras.f. The pre-saved model that this test loads is slightly different from the one in solar_calibration, and the inlist contains an extra overshooting control (overshoot_f_below_nonburn = 0.01157256164430d0) and a different mixing_length_alpha.

The HR-diagram below (figure 1) shows the model from the pre-main sequence to the middle of the main sequence.

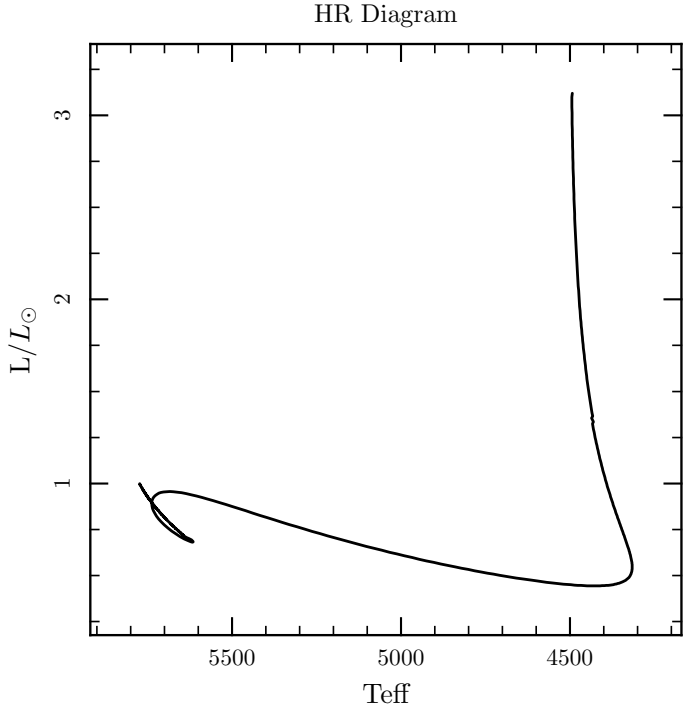

Figure 1

The profiles below show the abundances (figure 2) and burning rates (figure 2) from the end of the run.

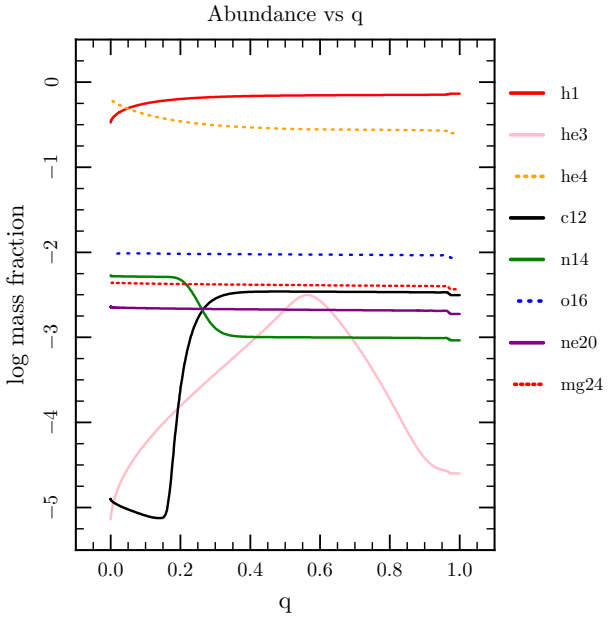

Figure 2

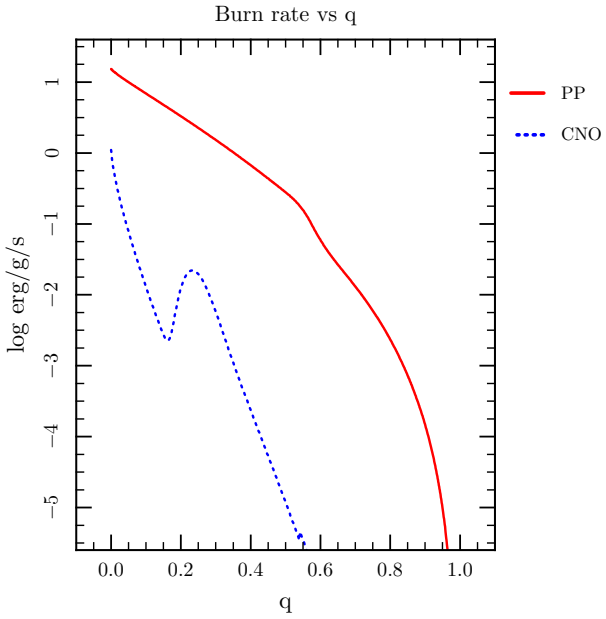

Figure 3

To the left is a plot of the evolution of the radius of the star (figure 3). The plot to the right shows the evolution of the center temperature and density (figure 4).

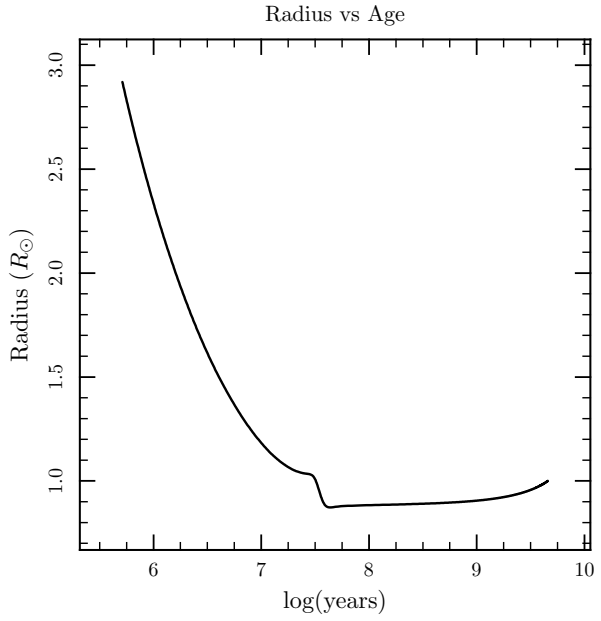

Figure 4

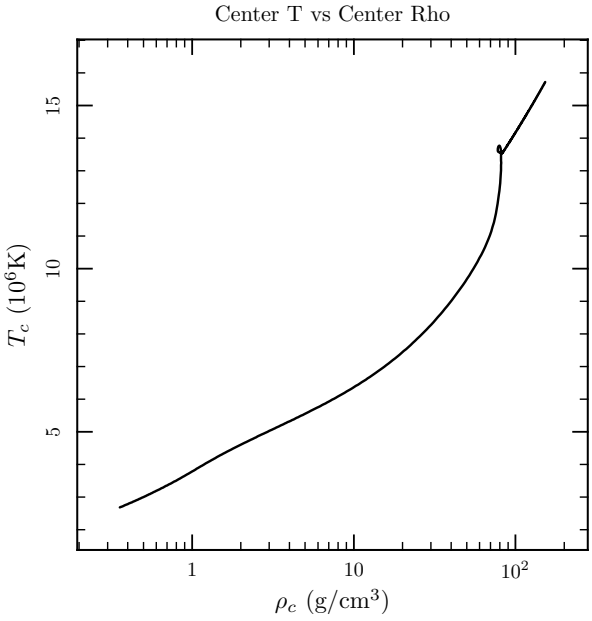

Figure 5

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.

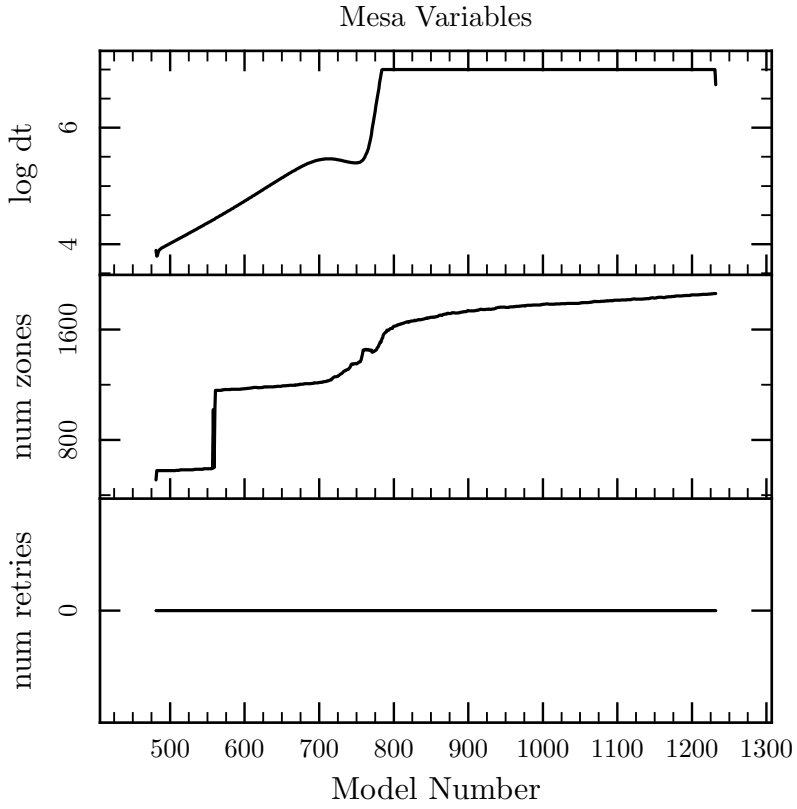

Figure 6: MESA variables plotted against model number show how hard MESA is working