SEMICONVECTION

This test is to show the capability of `MESA` to allow mixing from semiconvection according to the Ledoux criterion. This test should be cut off when the mass fraction for center hydrogen drops below 0.3 (`xa_central_lower_limit_species(1) = 'h1' ; xa_central_lower_limit(1) = 0.3`). To verfiy that this test ran successfully, `MESA` checks the mixing types at four points and average temperature and density between m/$M_\odot$=0.05 and m/$M_\odot$=0.1 (target values and ranges listed in `src/run_star_extras.f`). If the mixing types match and the temperature and density values fall within the given range, the terminal output at the end of the run should read ``‘‘all values are within tolerances’’``.

To allow semiconvection, the inlist for this test case sets `use_Ledoux_criterion = .true.`. There are few other controls related to semiconvection, such as `alpha_semiconvection = 1d-3`, which determines the efficiency of semiconvective mixing (`1d-3` is a typical value), and `use_gradmu_alt_for_mlt = .true.` and `gradL_comp_term_logRho_switch = 3` which control settings for computing certain gradients.

This test case starts with a 1.5 $M_\odot$ ZAMS star. To the left is an HR-diagram (figure 1) with the evolution track starting at the bottom-right. To the left is a plot of the evolution of the radius of the star (figure 2).

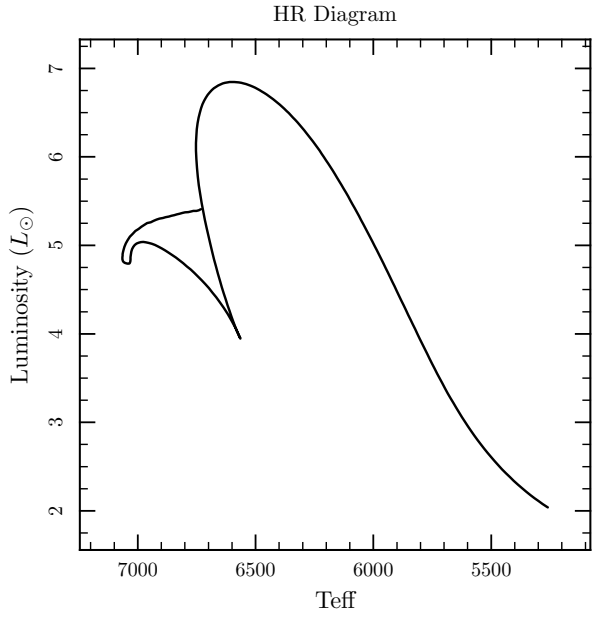

Figure 1: HR-diagram, starts bottom-right

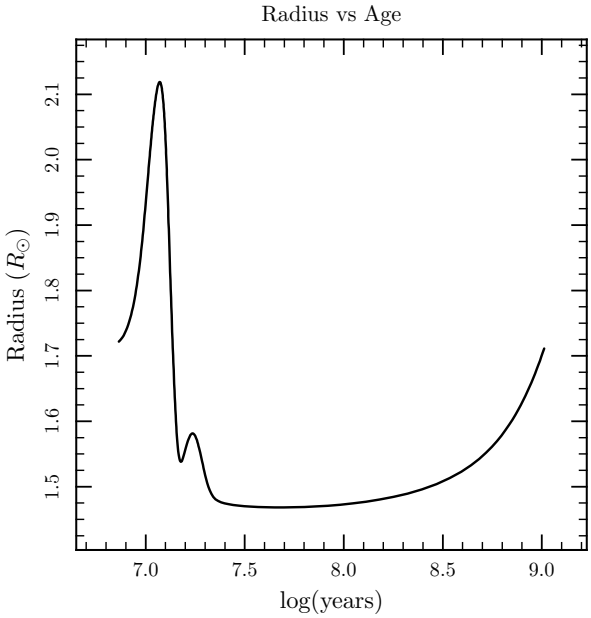

Figure 2: Radius plot

After about 22 Myr, the semiconvection layer becomes stable and grows as the core convecion layer shrinks (figure 3).

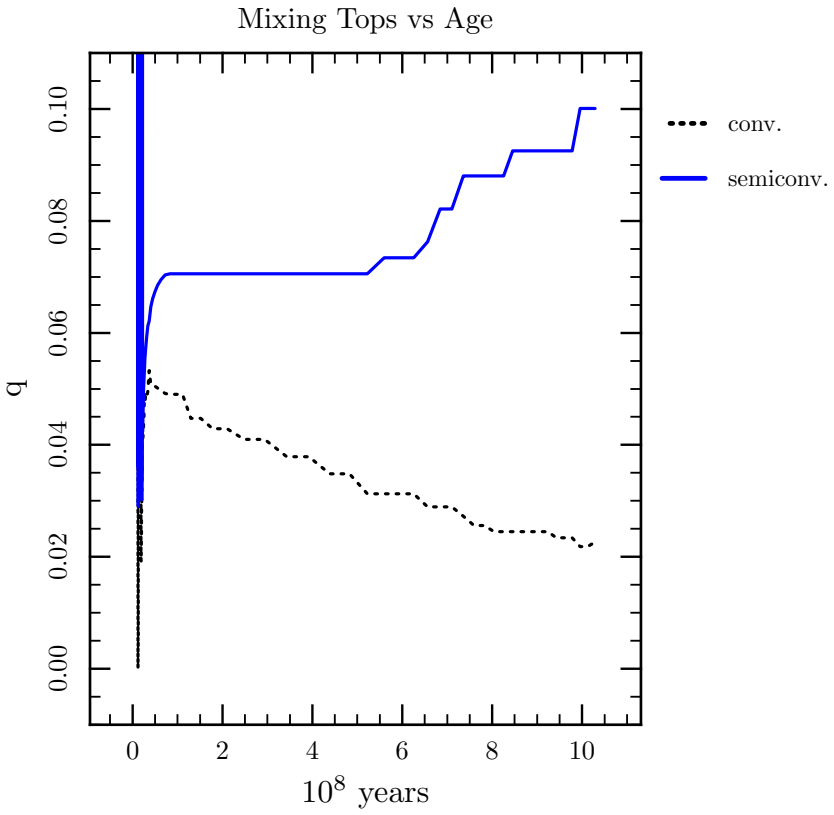

Figure 3: Top of convection zones

To the left is an abundance profile take from the end of the run (figure 4), with log mass fraction plotted against q, where q is the fraction of star mass interior to outer boundary of each zone, moving outwards from the core. To the right is a plot of the evolution of center temperature and density (figure 5).

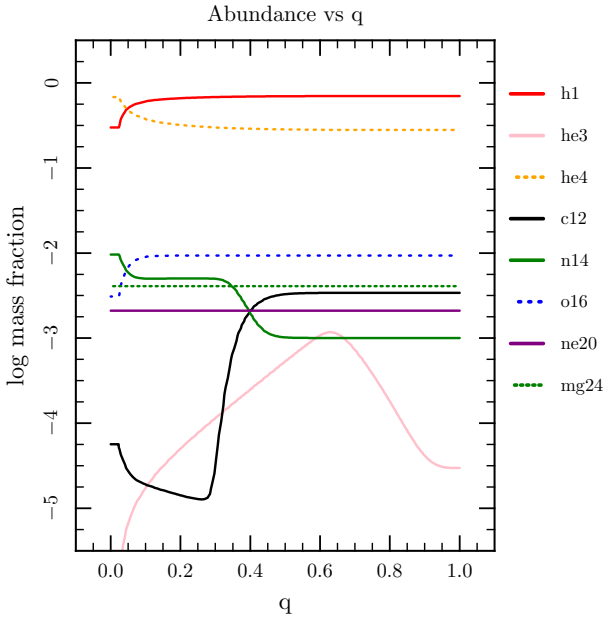

Figure 4: Abundance profile from end of run

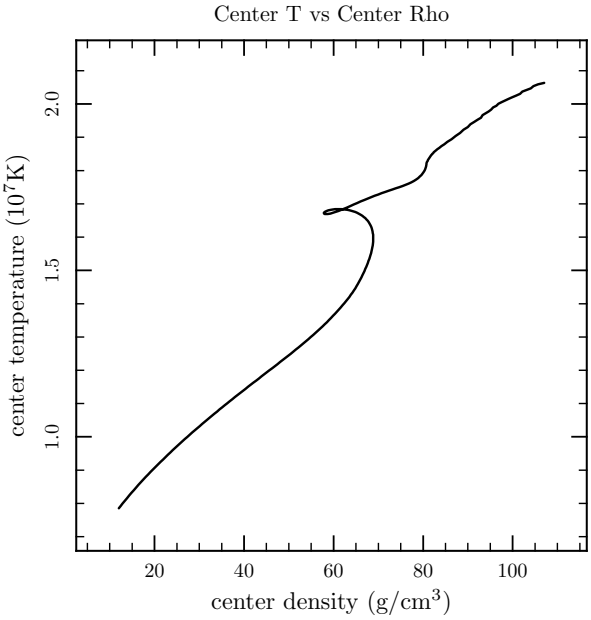

Figure 5: Center temperature-density evolution

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.

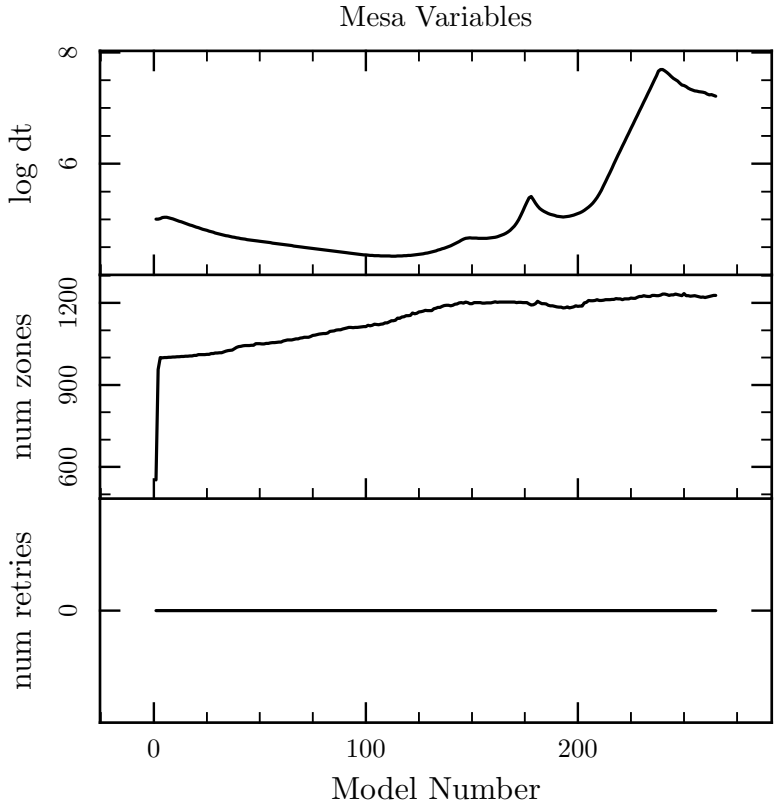

Figure 6: MESA variables plotted against model number show how hard MESA is working