

## 0.001M TAU1 ATM

This test is to show how to switch very low mass models from using  $\tau = 100$  atmosphere tables to  $\tau = 1$  atmosphere tables. There are five inlists that are run consecutively, and if they have run successfully, the terminal output at the end of the run should read ‘‘finished all inlists for 0.001M\_tau1\_atm’’.

inlist\_tau1: This first inlist loads the pre-saved model 0.003Msun.mod from mesa/data/star\_data/very\_low\_mass-COND\_tau100\_models (where all models use  $\tau = 100$  atmosphere tables) and relaxes the mass (`relax.mass_scale = .true. ; new_mass = 0.002`), changes the atmosphere option (`which_atm_option = 'tau_10_tables'`), then runs for 10 steps (`save_model_number = 11`).

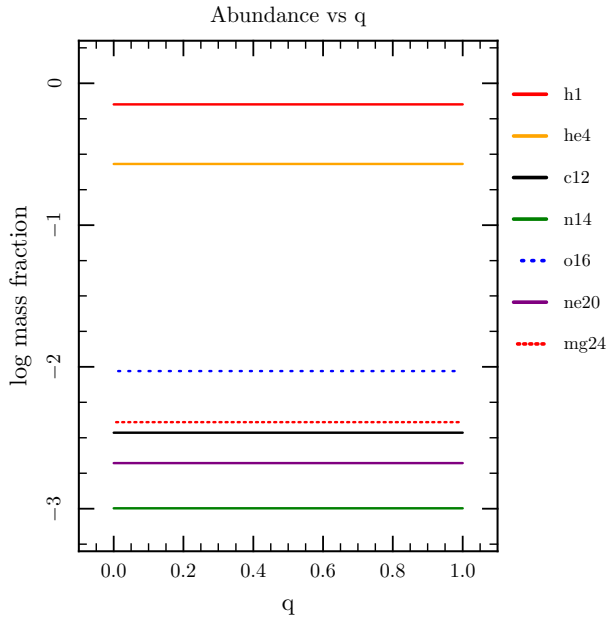
inlist\_tau2: This further relaxes the mass (`new_mass = 0.0017`), changes the atmosphere option (`which_atm_option = 'grey_and_kap'`), then runs for 10 steps.

inlist\_tau3: This changes the atmosphere option (`which_atm_option = 'tau_1_tables'`), then runs for 10 steps.

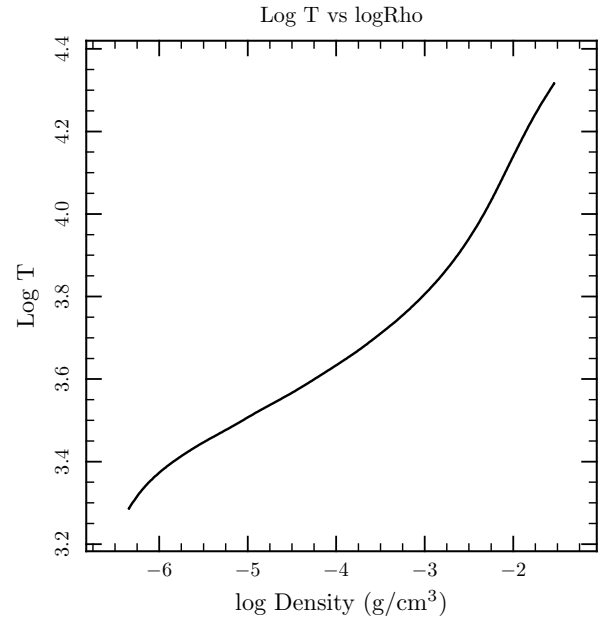
inlist\_tau4: This further relaxes the mass (`new_mass = 0.001`), then runs for 10 steps.

inlist\_tau5: This runs the model for an additional 60 steps.

The end result is a fully convective  $1.05 M_J$  planet, with abundances shown in log mass fraction in the profile below (figure 1). To the right is a temperature-density profile from the end of the run (figure 2).

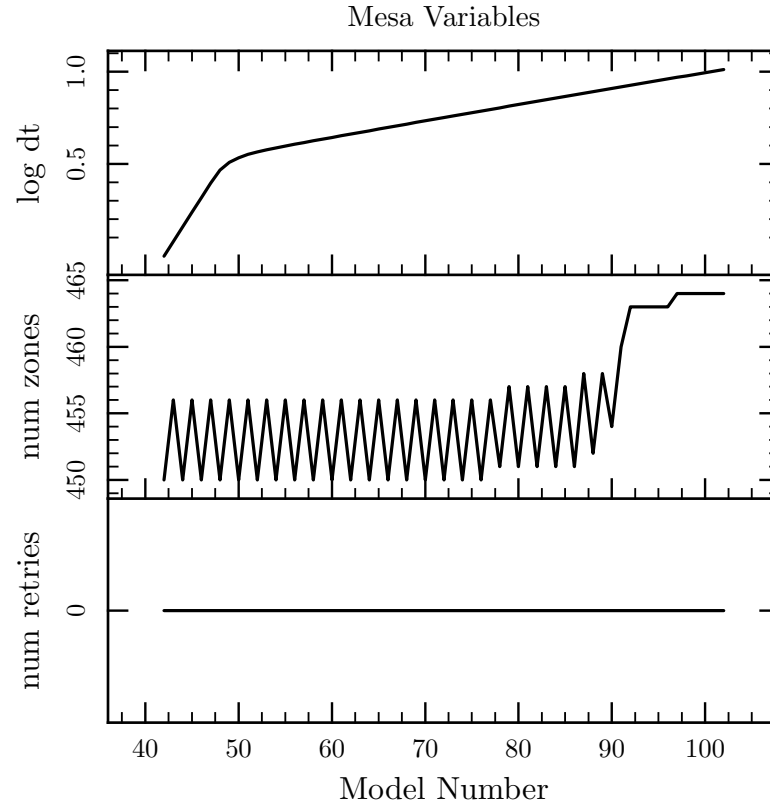


**Figure 1:** Abundance profile showing full convection



**Figure 2:** Temperature-density profile from end of run

This final plot (figure 3) 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 3:** MESA variables plotted against model number show how hard MESA is working