WD COOL

This test is to show a 1 $M_\odot$ white dwarf peacefully cooling for billions of years. Therefore, this test cuts off when the luminosity drops below $10^{-3} L_\odot$ (`log_L_lower_limit = -3`).

This test case starts with a 1.025 $M_\odot$ carbon-oxygen white dwarf that cools for approximately 1.2 Gyr. There are two inlist files, inlist_wd_cool1 and inlist_wd_cool2, which are called consecutively. The first inlist uses `which_atm_option = 'grey_and_kap'`, and the second inlist switches it to `which_atm_option = 'WD_tau_25_tables'`. The second inlist also turns up the spatial resolution (`mesh_delta_coeff = 0.8`).

This particular white dwarf has more helium than most on its surface (about 7×10^{-4} $M_\odot$), indicated by this profile (figure 1), which plots fractional mass against logxq where logxq = log(1-q) and q is the fraction of star mass interior to outer boundary of each zone, moving outward from the core. (Note: The Ne20 shown here actually represents Ne22, this is because `MESA` is using a simplified nuclear reaction network.)

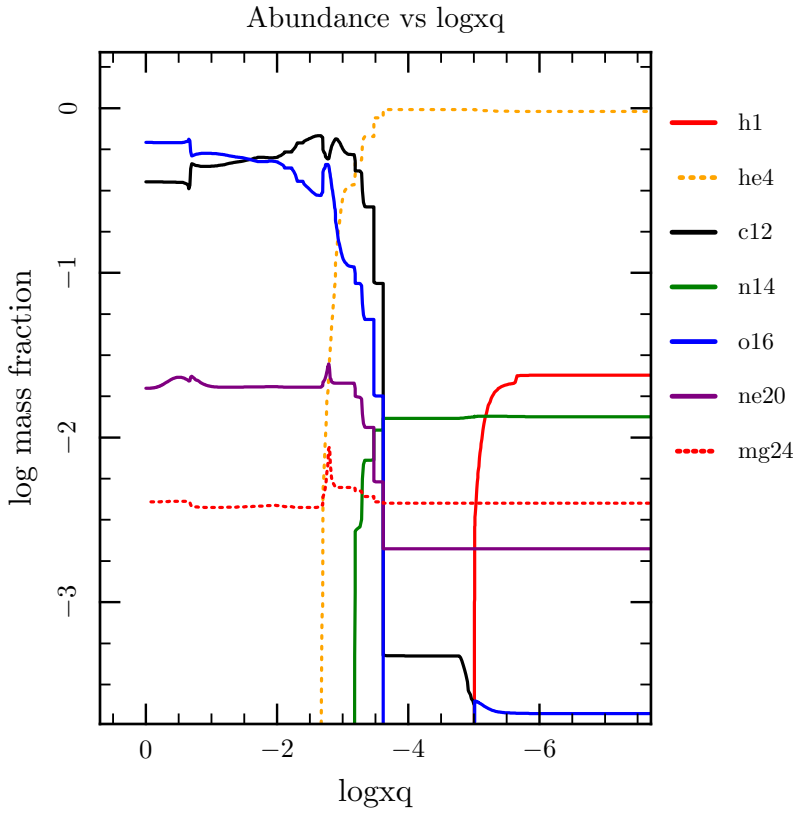

Figure 1: Abundance profile from end of run

Because the white dwarf has no major heat sources, temperature slowly falls throughout the star's core and envelope, as is shown in the profile below to the left (figure 2), causing its luminosity to decrease as well (figure 3).

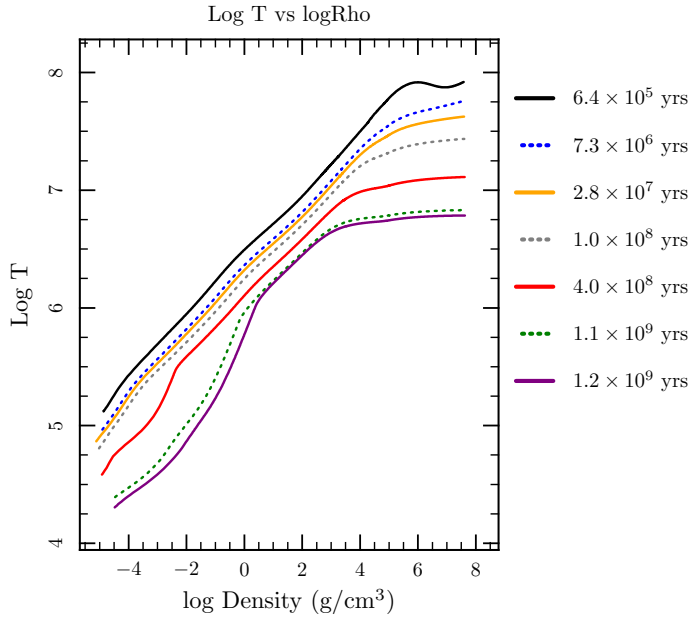

Figure 2: Temperature-density profile at different stages, showing cooling throughout interior and envelope

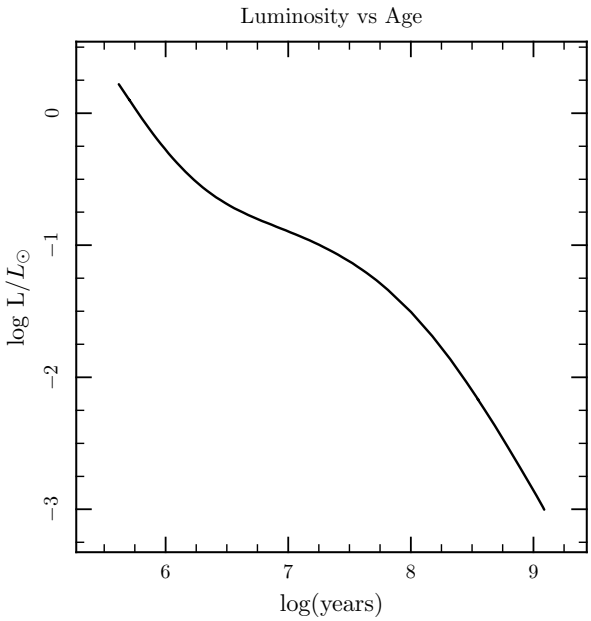

Figure 3: Luminosity decreases as the white dwarf cools

Below is a plot of the evolution of the center temperature and density (figure 4).

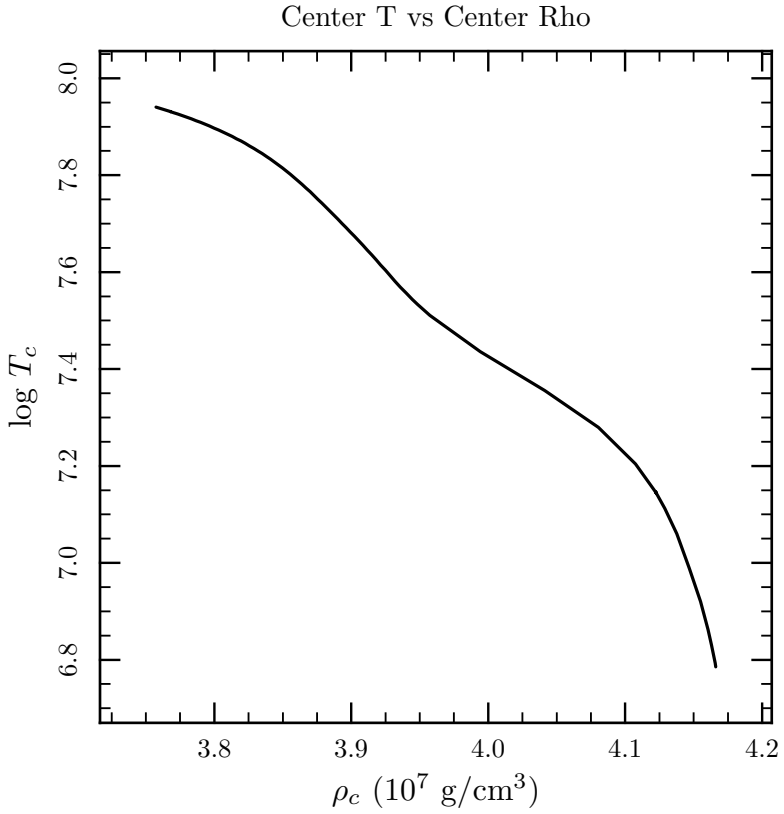

Figure 4: Evolution of the center temperature and density

This plot (figure 5) 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.

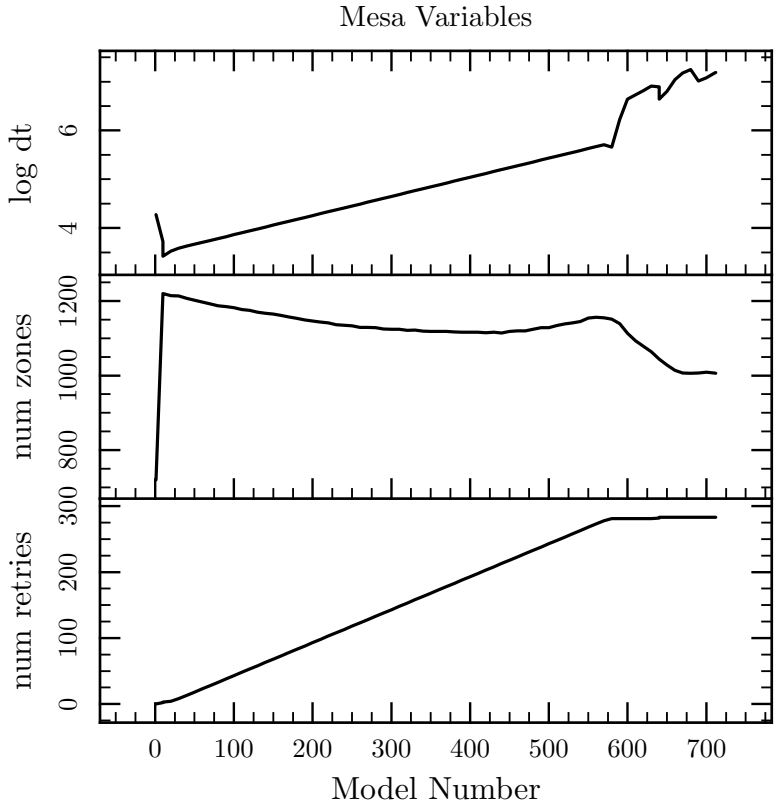

Figure 5: MESA variables plotted against model number show how hard MESA is working

This is a copy of the same plot run with a lower spatial resolution (`mesh_delta_coeff = 2`) and a different ending condition (`logQ_limit = 5.1`).

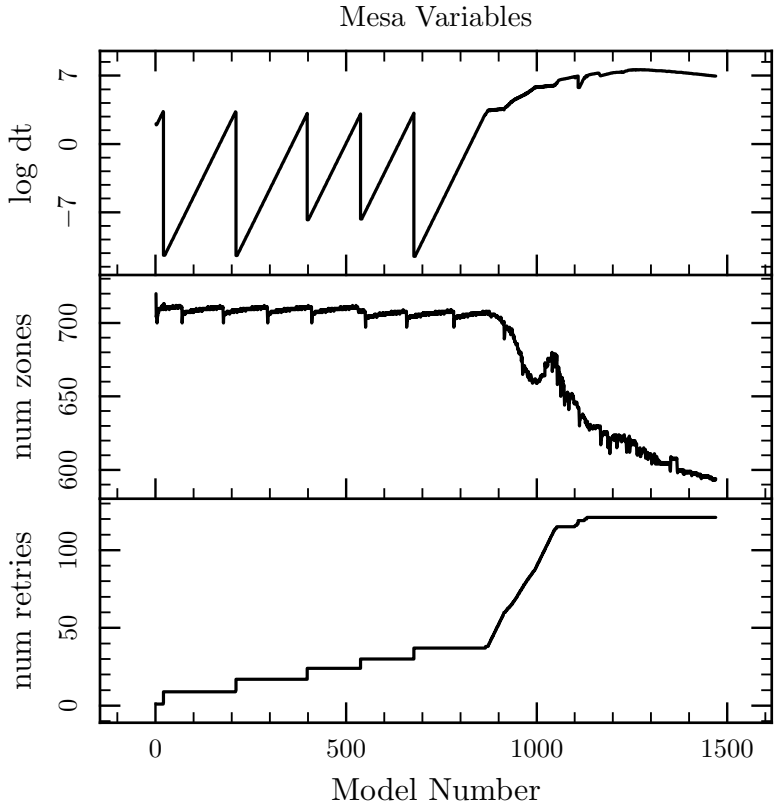

Figure 6: `MESA` variables from run with different spatial resolution and ending condition