C13 POCKET

This test is to show a 1.6 $M_\odot$ AGB star developing a pocket of ^{13}C between the carbon-oxygen core and convective envelope. This test should be cut off when the cell with the highest concentration of ^{13}C reaches a mass fraction of 0.065. `MESA` then calculates the mass of the ^{13}C pocket (the combined mass of each cell that has a mass fraction of ^{13}C larger than 0.01) and the mass coordinate of the highest concentration of ^{13}C. If both values fall within set tolerances, the terminal output at the end of the run should read ``` ``all values are within tolerance'' ```.

The inlist sets the following nuclear reaction rate controls in the `&star_job` section:

- `set_rates_preference = .true.`
- `new_rates_preference = 1`
- `set_rate_c12ag = 'Kunz'`
- `set_rate_n14pg = 'Imbriani'`
- `set_rate_3a = 'Fynbo'`

The `&controls` section contains many other controls, organized in the following groups: mesh, resolve the C13 pockets, timesteps general, TP, DUP, time step controls for interpulse, overshooting, C13 pocket, He-shell flash convection zone, atmosphere option, mass loss, and opacities.

The development of the ^{13}C pocket from the loaded model, `AGBpreDUP2M.mod`, takes almost 5000 years. The plots below show the evolution of the star's luminosity (figure 1) and effective temperature (figure 2) over this time period.

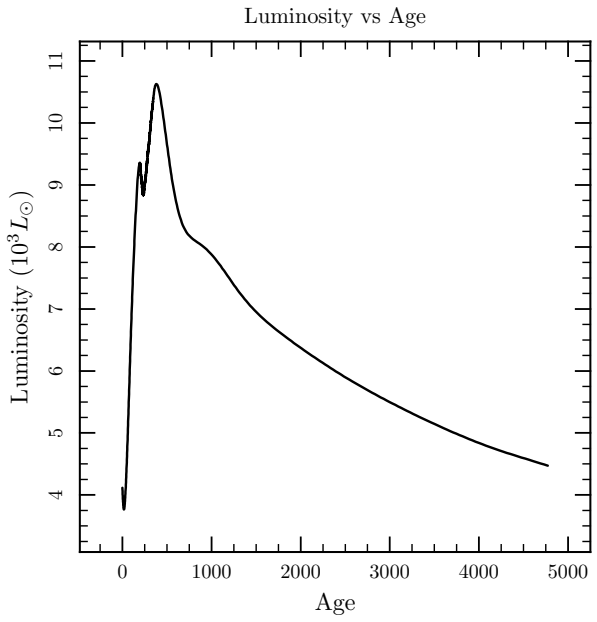

Figure 1

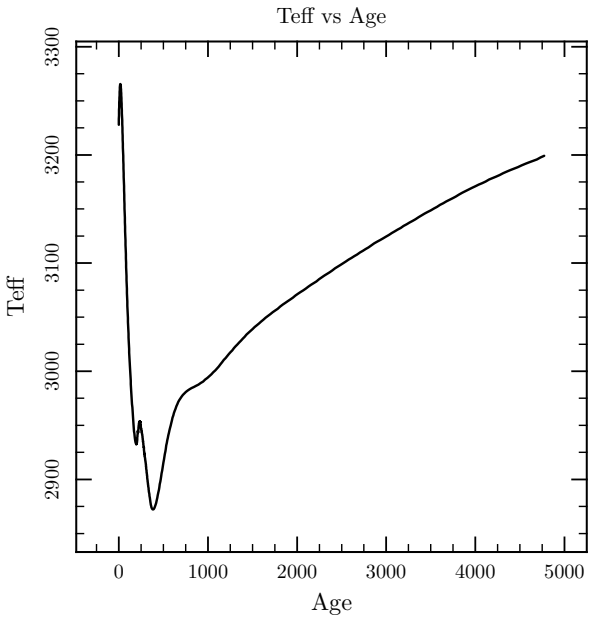

Figure 2

To the left is an abundance profile from the start of the run (figure 3). The abundances throughout the run only change in the small region between the core and the envelope where burning is happening, shown by the burning rate profile from the end of the run (figure 4).

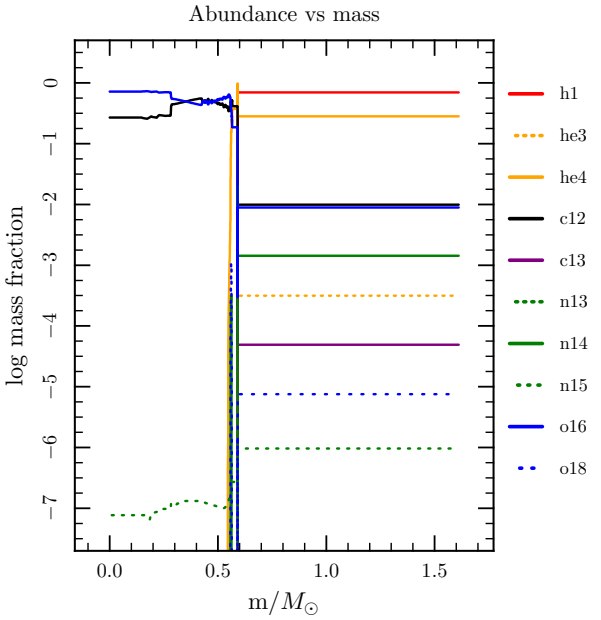

Figure 3: Abundance profile from start of run

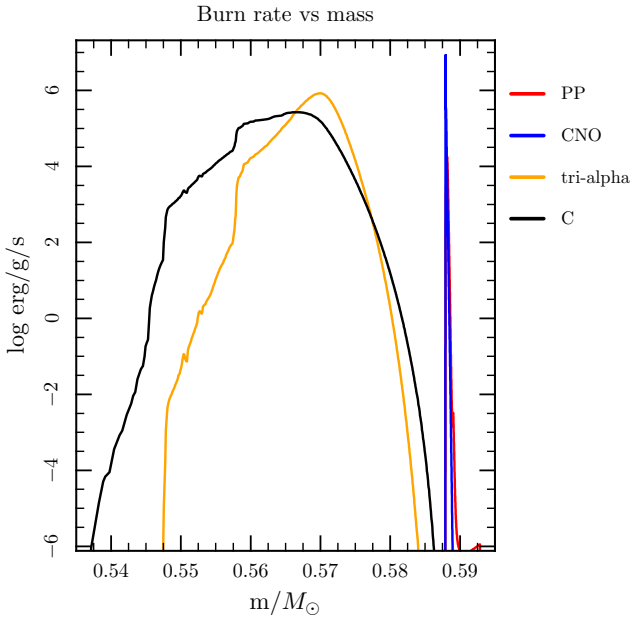

Figure 4: Burning rate profile from end of run

The abundance profile below (figure 5), taken from the end of the run, centers on the region of the star with the highest concentration of ^{13}C.

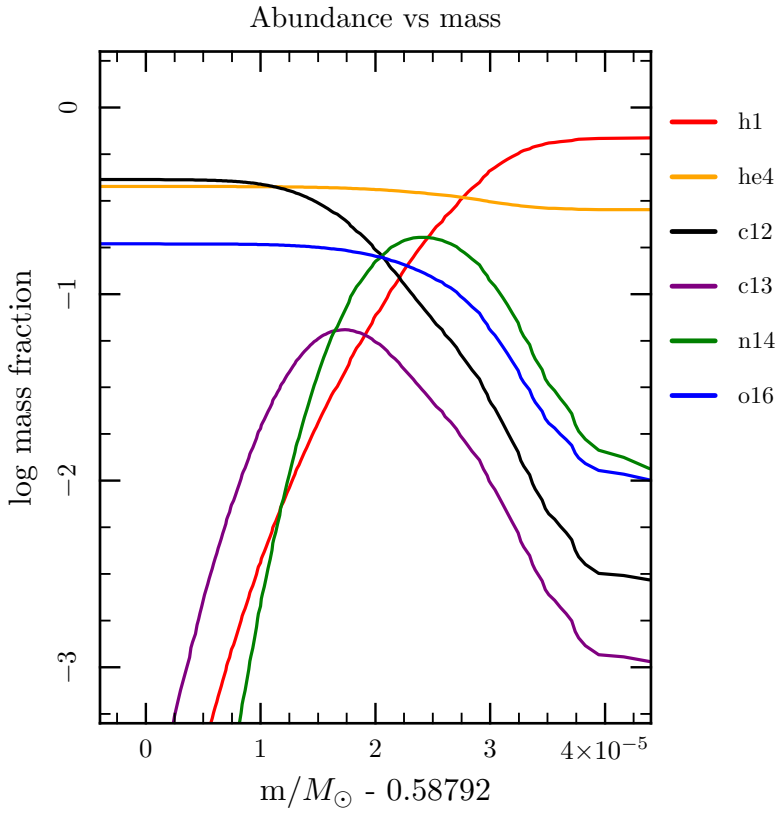

Figure 5: Region of star with highest ^{13}C concentration

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.

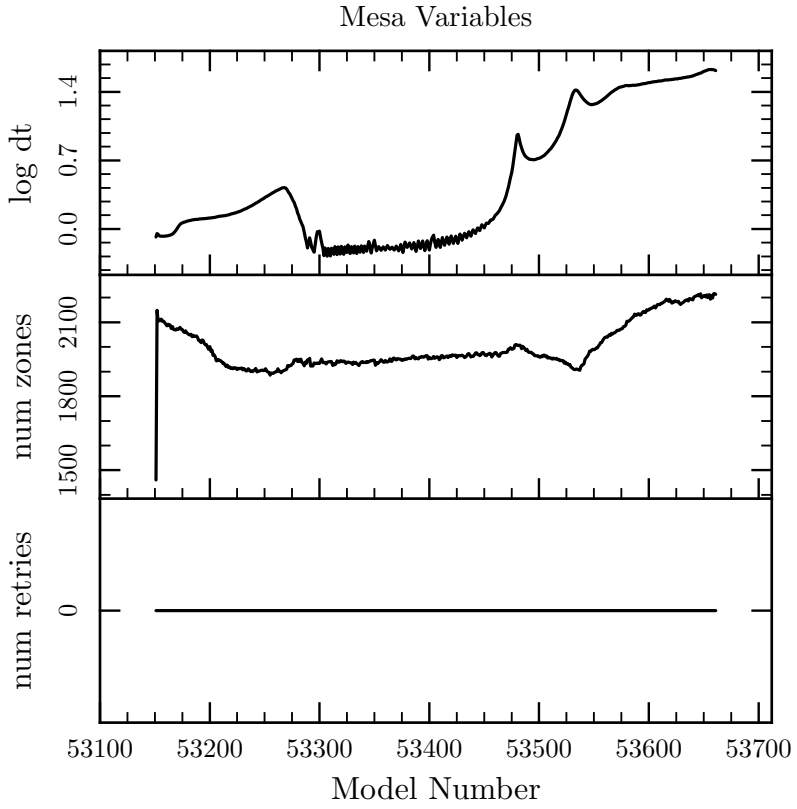

Figure 6: MESA variables plotted against model number show how hard MESA is working