A close up of a map

Description automatically generated

*This figure shows convection time-scale profiles for different high mass primary stars at their maximum radius. MESA simulations provided the maximum radius and corresponding interior profile of each star. We used Equation 2 and Python to find the convective time-scale for each profile. As the distance from the center of the star increases along the horizontal axis, the convection time-scale goes to zero. The “step-like” appearance of the time-scale can be attributed to the different convection zones within the star.*

As the radius from the center of the star increases, the convection time-scale decreases because there is more and more mixing. At the surface of the star, the time-scale goes to zero. Different shells of the star have different convection times, which accounts for the flat lines and “step-like” appearance of the plots. Each horizontal level is a different shell. Transitions between the shells are generally smooth, with a curve down to the next level and fewer abrupt corners. This makes sense because the shells mix to some extent.

A close up of a map

Description automatically generated

*This figure shows binding energy profiles for high mass primary stars at their maximum radius. Binding energy refers to the amount of energy that would be needed to strip the common envelope of the star to a given radius. We used MESA simulations to determine the maximum radius and the interior profile of each star and Equation 4 to calculate the binding energy. As the distance from the center of the star increases along the horizontal axis and approaches the surface of the star, the binding energy approaches zero. As in the time-scale profiles, the “steps” in this plot show the different convective zones within the star.*

Has almost a similar shape to the time-scale plots. The horizontal lines from the time-scale are slightly slanted lines here – this makes sense because you’re talking about how much energy it takes to strip off the envelope to that radius, so obviously if the radius is smaller there’s more envelope to strip. However, the shells – where there’s a more drastic change in E\_bind – are still obvious even in this plot. Again, this makes sense, because denser materials require more energy to strip away.