Advanced burning stages and fate of 8-10 Mo stars

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The stellar mass range 8-12 Mo corresponds to the most massive AGB stars and the most numerous massive stars. It is host to a variety of supernova progenitors and is therefore very important for galactic chemical evolution and stellar population studies. In this paper, we study the transition from super-AGB star to massive star and find that a propagating neon-oxygen burning shell is common to both the most massive electron capture supernova (EC-SN) progenitors and the lowest mass iron-core collapse supernova (FeCCSN) progenitors. Of the models that ignite neon burning off-center, the 9.5Mo model would evolve to an FeCCSN after the neon-burning shell propagates to the center, as in previous studies. The neon-burning shell in the 8.8Mo model, however, fails to reach the center as the URCA process and an extended (0.6 Mo) region of low Ye (0.48) in the outer part of the core begin to dominate the late evolution; the model evolves to an EC-SN. This is the first study to follow the most massive EC-SN progenitors to collapse, representing an evolutionary path to EC-SN in addition to that from SAGB stars undergoing thermal pulses. We also present models of an 8.75Mo super-AGB star through its entire thermal pulse phase until electron captures on 20Ne begin at its center and of a 12Mo star up to the iron core collapse. We discuss key uncertainties and how the different pathways to collapse affect the pre-supernova structure. Finally, we compare our results to the observed neutron star mass distribution.

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