IMPACT OF NUCLEAR REACTIONS AT HIGH DENSITIES ON THE FATE OF INTERMEDIATE-MASS STARS

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Stars in the range of 8 to 12 solar masses represent the transition region between stars that end their lives either producing white dwarfs or those that undergo a core collapse, subsequently exploding like a supernova and leaving behind a neutron star.
The final phases of stellar evolution of these intermediate-mass stars are tightly connected to the behaviour of nuclear processes at high densities (above 10^9 g/cc). Despite their importance, the stellar evolution of intermediate-mass stars has received little attention in the past. The pioneering work goes back to Nomoto [1,2] and only recently two groups have started to look at these objects in detail, again [3,4].
We have evolved the super-AGB star progenitor models of Jones et al. [3] in order to determine the final fate of these stars and their explosion as electron capture supernova. We have determined the nuclear processes that are relevant for the modelling of these stars, starting from the neon burning stage. We show, that due to electron capture on ^{20}Ne, ^{20}O becomes abundant in the stellar core. This opens new reaction channels that have so far not been considered. These reactions modify the standard neon-burning that now proceeds by the reactions ^{20}Ne(γ,α) ^{16}O, followed by ^{20}O(α,γ) ^{24}Ne. Once the stellar core reaches sufficiently high temperatures, also the fusion reactions involving neutron-rich oxygen isotopes, ^{16}O+^{20}O and ^{20}O+^{20}O, become important.
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[2] K. Nomoto, Ap.J. 322, p. 206-214 (1987).
[3] S. Jones et al., Ap.J. 772, 150 (2013).
[4] K. Takahashi et al., Ap.J. 771, 28 (2013).