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What is the Final Fate of Intermediate Mass Stars: Thermonuclear or Core-Collapse Supernova?

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The fate of stars with intermediate mass ($\approx 7-11\ M_\odot$) is still not certain. In their final stages, they develop degenerate oxygen-neon cores, potentially culminating in electron capture supernovae. Both a thermonuclear explosion, as well as a collapse to a neutron star are possible, critically depending on the oxygen ignition density. Understanding the oxygen ignition process is crucial to draw further conclusions and 3D hydrodynamical simulations are needed. In the late stages of evolution, forbidden electron captures, like the second forbidden transition between the ground states of ^{20}Ne and ^{20}F, play a key role and significantly influence the density profile at the time of oxygen ignition. In addition, heating due to electron capture processes on ^{24}Mg and ^{24}Na leads to convectively unstable regions, which may not be correctly described in 1D stellar evolution codes like MESA. We aim to evaluate the impact of these convectively unstable regions and their impact on the later ignition of oxygen burning by employing the 3D hydrodynamical Seven-League Hydro code, while also considering the relevant electron capture rates.

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