Electron capture processes in degenerate ONe cores

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In intermediate-mass stars (∼8–10 solar masses), carbon burning results in degenerate cores composed mostly out of oxygen and neon (ONe cores). Lighter stars in this mass range will shed their stellar envelopes and end as ONe white dwarfs. For heavier stars, the ONe cores will keep accumulating mass from the surrounding carbon-burning shell. The ultimate fate of this latter evolutionary path is still uncertain.
A crucial role is played by electron capture reactions that are triggered as the core contracts (see e.g. [1, 2]). These reactions do not only reduce the degeneracy pressure by removing electrons, but can also heat and cool the core in the form of double electron capture and Urca processes, respectively.
The electron capture on ^{20}Ne releases enough heat to ignite runaway oxygen burning. This scenario is called an electron-capture supernova and leads to either a collapse to a neutron star or a thermonuclear explosion, disrupting the star. The exact outcome is very sensitive to the density at oxygen ignition[3], meaning that the evolution up to this point must be studied carefully.
Following carbon burning, the main content of the core is ^{16}O, ^{20}Ne, ^{23}Na, ^{24}Mg and ^{25}Mg. In this contribution we will discuss the possible impact of electron capture processes on additional nuclei, for example those inherited from a non-zero metallicity of the progenitor. Excluding such effects would mean that the nuclear physics of degenerate ONe cores would be almost completely determined by experimental data.
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References

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