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Electron Capture and Beta-Decay Rates for the Collapse of O+Ne+Mg Cores

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The electron (e^-) capture on ^{20}Ne and ^{24}Mg nuclei is important for the evolution of 8 – 12 $M_\odot$ stars [1]. We present a new set of e^- capture and β-decay rates that improves previous calculations by Takahara *et al.* [2] and Oda *et al.* [3] in three main aspects: (a) incorporation of recent charge-exchange and β-decay data [4], (b) contributions of forbidden transitions, and (c) inclusion of electron screening corrections [5]. The experimental nuclear input is supplemented by theoretical data based on large-scale shell model calculations in the full sd-shell space using the USDB interaction [6]. However, for the relevant temperature-density range, the rates are fully detemined by the experimental input. Comparing to previous calculations of Refs.[2,3], we find that the e^- capture on ^{20}Ne is enhanced by several orders of magnitude, in the density range $\rho = (4\text{–}10) \times 10^9$ g/cm^3 and temperatures below 0.7 GK, due to the contribution of the second forbidden transition from ^{20}Ne ground state to ^{20}F ground state. The e^- capture on ^{24}Mg is enhanced by about a factor of two due to the recent β-decay data from Nishimura *et al.* [4]. The impact of these new rates on the late stellar evolution will also be discussed.

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