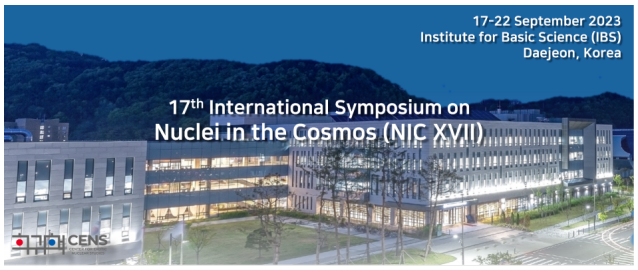

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Massive star models with the updated 12C+12C reaction rate

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The reaction rate of the carbon fusion reaction is one of the basic inputs in the stellar model to understand the final stages of the massive star evolution. However, this reaction rate is yet uncertain because it depends on the extrapolation methods. The cross-section measurement for this reaction is challenging because the energy range relevant to the stellar evolution is much below the Coulomb barrier, i.e., the Gamow window is only 1.5-2.5 MeV. In this study, we update the carbon fusion reaction rate by obtaining new extrapolation results based on the measurement data available in the literature to date. By adopting our new reaction rate, we calculate massive star models with the 1D stellar evolution code, MESA (Modules for Experiments for Stellar Astrophysics). We find that our updated nuclear reaction rate is about a half of the previous one (Caughlan and Fowler 1988), resulting in almost negligible changes in the HR-diagram of the massive star models in consideration. However, the updated rate has a significant impact on the temperature change in the core and thus on the neutrino cooling during the carbon burning stage. We find that our updated reaction rate reduces the lifetime of the carbon burning stage by a factor of ~ 0.7.

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