The Evolution of Carbon Burning Flames Inside Super-Asymptotic Giant Branch Stars

CARL FIELDS, ROBERT FARMER, FRANCIS TIMMES, Arizona State University, SPIDER COLLABORATION — We explore how carbon burning impacts the bifurcation region separating stars whose final fate is a massive white dwarf from stars whose final fate is a massive star supernova. A dense grid of models with initial mass ($M_{\text{ini}}$) from 6.0\,$M_\odot$ to 11.0\,$M_\odot$ are evolved from pre main-sequence to the end of nuclear burning using the open-source toolkit, Modules for Experiments in Stellar Astrophysics (MESA). For stars between 7.0\,$M_\odot$ ≤ $M_{\text{ini}}$ ≤ 9.0\,$M_\odot$, energy losses at the center of the core due to neutrino cooling causes a temperature inversion resulting in off-center ignition. First ignition occurs where the minimum temperature of $7 \times 10^8$ K, and a density ($\rho_{\text{crit}}$) of $2 \times 10^6$ g/cm$^3$ is met. We conclude that for stars within this range, the location of first ignition decreases as a function of initial mass. Moreover, we show that there exist a unique ignition density of $2 \times 10^6$ g/cm$^3$. 

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