Evolution of a $10M_{\odot}$ Star With LMC Metallicities

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Why stars become red giants has been a subject of investigation in many contexts, most recently in the discovery of the progenitor of the Supernova 1987A. Sanduleak $69^{\circ}202$ was found to be a blue supergiant star although it was generally presumed that type II SNe arise from red supergiants. Immediately after SN1987A, it was suggested that the blue spectral nature was due to lower metallicity in the LMC ($Z = Z_{\odot}/3 - Z_{\odot}/4$) although the existence of many red supergiants in the 30 Doradus region where SN1987A took place and in particular the observation of low-velocity nitrogen-rich gas presumed to be a circumstellar shell indicates that mass loss may also have played a significant role in bringing SK $69^{\circ}202$ from red to blue. We report here work in progress on the evolution of massive stars in the LMC with and without mass loss which can ultimately produce type II SNe. The number of red supergiants in a homogeneous group of stars at a given time depends on t_{RSG}/t_{Total} and the mass function N(M). With a view to seeing how the evolutionary behaviour on the colour-magnitude diagram changes with and without mass-loss, composition, and convection criteria, we evolved a $10M_{\odot}$ star with initial composition of X = 0.715, Y = 0.28 and Z = 0.005, with updated nuclear reaction rates implemented in a code originally due to Icko Iben. We report here the structure, chemical composition, and other thermodynamic variables throughout the constant $10M_{\odot}$ star at different stages of evolution. At the time of central carbon exhaustion, the model has $\log (L/L_{\odot}) = 4.47$ and $\log T_c = 4.07$. The value of t_{RSG}/t_{Tot} is 0.15 as compared with the value 0.08 obtained by Maeder (1987) for a $20M_{\odot}$ star evolved with substantial mass loss.

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