SYNTHETIC AGB EVOLUTION IN THE LMC: THE ABUNDANCES OF PN

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We have developed a model to calculate the evolution of AGB stars in a synthetic way. The evolution is started at the first thermal pulse (TP) and ends when the envelope mass has been lost due to mass loss or when the core mass reaches the Chandrasekhar mass.

Our model is more realistic than previous synthetic evolution models in that more physics has been included. The variation of the luminosity during the interpulse period is taken into account as well as the fact that, initially, the first few pulses are not yet at full amplitude and that the luminosity is lower than given by the standard core mass-luminosity relations. The effects of first, second and third dredge-up are taken into account. Hot Bottom Burning (HBB) is included in an approximate way. Mass loss on the AGB is included through a Reimers Law. We also take into account mass loss prior to the AGB. Most of the relations used are metallicity dependent.

The free parameters in our calculations are the minimum core mass for dredge-up (M_c^{min}), the dredge-up efficiency (λ) and the Reimers mass loss scaling parameter (η_{AGB}).

The model has been applied to the LMC using a recent determination of the age-metallicity and Star Formation Rate history for the LMC. A model with M_c^{min} = 0.58 $M_\odot$, λ = 0.75, η_{AGB} = 5, including HBB fits the observed carbon star luminosity function, the C/M-ratio of AGB stars and the initial-final mass relation.

For this model the abundances of PN are calculated and compared to the observation in the N/O-He/H, C/O-He/H, C/O-C/N and N/O-N/H diagrams. The agreement in all four diagrams is good. There is a relation between the abundance of a PN and its main sequence mass. Our model predicts the high N/O and He/H ratios observed in some PN. To get agreement in the N/O-N/H diagram we have to assume that the main sequence oxygen abundance varies like $(O/Z) = 1 / (1 + 0.838\,(Z/Z_0)^{0.7})$, where Z_0 is the present metallicity in the LMC. The fact that the relative main sequence oxygen abundance was higher in the past is consistent with a recent chemical evolution model for the LMC and obervations of the oxygen abundance in our Galaxy.

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