THE HR DIAGRAM OF LMC SUPERGIANT STARS

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ABSTRACT. We analyze the HR diagram of LMC supergiant stars using a new set of evolutionary models for massive stars.

The synthetic HR diagram of LMC supergiant stars

New set of stellar models have been computed for massive stars (Alongi et al. 1991) with the following input physics: overshoot from the convective core and at the base of the convective envelope; Los Alamos Opacity Library modified according to Iglesias et al. 1990 around Log T $\simeq$ 5.3; density inversion inhibited by imposing a maximum temperature gradient ∇_T such that the density gradient $\nabla_\rho \geq 0$: $\nabla_{T_{Max}} = \frac{1-\chi_\mu \nabla_\mu}{\chi_T}$, where ∇_μ is the molecular weight gradient and χ_μ and χ_T have the usual meaning; H, ^{3}He, ^{4}He, ^{12}C, ^{13}C, ^{14}N, ^{15}N, ^{16}O, ^{17}O, ^{18}O, ^{20}Ne, ^{22}Ne, ^{25}Mg, ^{26}Mg, followed in detail (reaction rates from Caughlan and Fowler 1988); mass-loss by De Jager et al. (1988), or $10^{-3} M \odot yr^{-1}$ when LBV, or Langer (1989) when WR.

Due to envelope overshoot the evolutionary tracks for M $\leq$ 15 $M_\odot$ (Z=0.02) and M $\leq$ 20 $M_\odot$ (Z=0.008) exhibit a blue loop during the central He-burning phase. While in the loop, the models show CNO processed material at the surface, due to convective dredge-up. More massive stars either end helium burning as red supergiants or, because of mass-loss, enter the stage of WR star.

Using a Monte Carlo method we simulated the HR diagram of LMC supergiant stars (Fitzpatrick & Garmany 1990) adopting the composition Z=0.008 Y=0.25, a uniform age distribution and a Salpeter IMF. While the *Ledge* (Fitzpatrick & Garmany 1990) is well reproduced and corresponds to the *red side of the core He-burning band in the loop.* a major point of disagreement are the many stars falling in the so-called "Blue Hertzsprung Gap" predicted by the theory.

We found that opacity enhancements like those suggested by Iglesias et al. (1990) or binary evolution as proposed by Tuchman and Wheeler (1990) cannot remove the discrepancy. On the other hand we suggest that the gap could be masked by the uncertainties in the photometry, in the dereddening technique, and in the transformation from colours and magnitudes to effective temperatures and luminosities.

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