ULTRAVIOLET STUDIES OF O AND B STARS IN THE LMC CLUSTER NGC 2100, THE SMC CLUSTER NGC 330 AND THE GALACTIC CLUSTER NGC 6530

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ABSTRACT

We have studied high a low resolution IUE spectra of O and B stars in the LMC cluster NGC 2100, the SMC cluster NGC 330, and the young Galactic cluster NGC 6530. Temperatures and luminosities were determined. In the LMC and SMC clusters the most luminous stars are evolved stars on the "horizontal" supergiant branch, while in NGC 6530 the stars are all still on the main sequence.

Extinction laws were determined. They confirm the known differences between LMC and galactic extinctions.

No mass loss was detected for the evolved B stars in the LMC and SMC clusters, while the high luminosity stars in NGC 6530 show P Cygni profiles.

INTRODUCTION

We try to determine the mass loss for early-type cluster stars for which distances are well known and for which the evolutionary stage can be well established. In the populous LMC and SMC clusters we have the opportunity to study stars along the evolutionary track for essentially one mass. We therefore may hope to see the mass-loss change during stellar evolution. A comparison of different clusters with different metal abundances may teach us something about the driving mechanism for the mass loss.

Figure 1 shows the measured color magnitude diagrams for the clusters studied here. The vertical scales were shifted so as to take into account the different distances and average extinctions. These diagrams are based on measurements by Robertson (1974), Walker (1957), and Chini and Neckel (1981). Colors for the LMC and SMC clusters were also measured by Westerlund (1961), Lucke (1974), Nemec (1982), and Olszewski (1983), Janes and Carney (1983). The color-magnitude diagrams of the three clusters look very similar.

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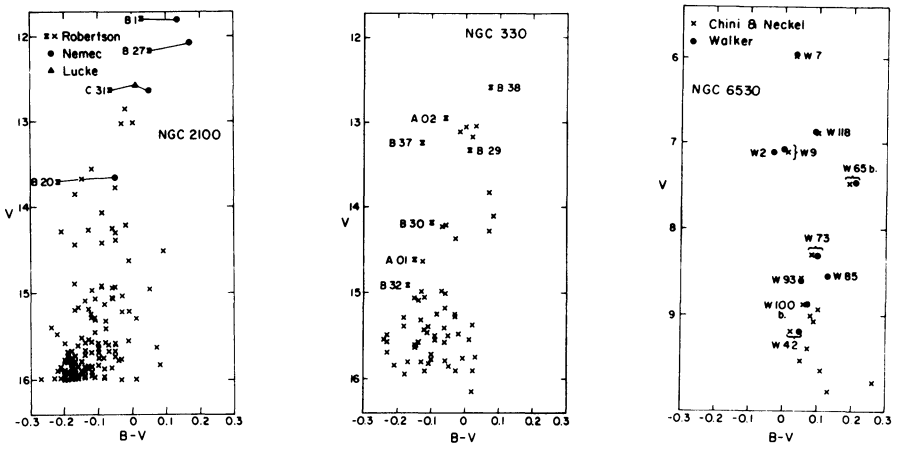

Figure 1: The color magnitude diagrams for the LMC, SMC, and Galactic clusters are shown.

THE T_{EFF}, LUMINOSITY DIAGRAMS

The conversison from color magnitude to T_{eff}, luminosity diagrams is seen in Figure 2. We used distance moduli m_V-M_V = 11.5, 18.6, and 19.0 for NGC 6530, NGC 2100, and NGC 330 respectively. In Figure 2 we also show the evolutionary tracks for stars with 10 to 40 solar masses according to the calculations of Brunish and Truran (1982) and Flower (1976).

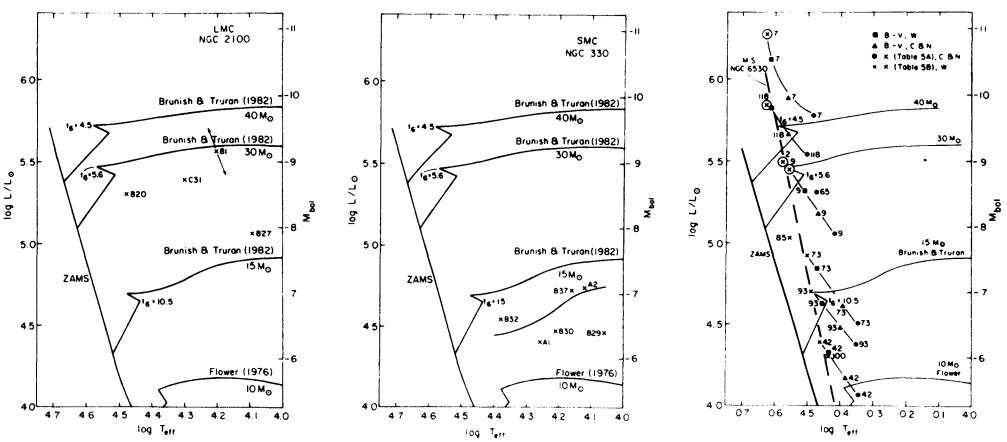

Figure 2 shows the T_{eff}, luminosity diagrams for the three clusters which look quite different.

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The T_{eff}, luminosity diagrams for the three clusters look very different, mainly because of the very different reddening corrections, which are E(B-V) = 0.35 for NGC 6530, 0.18 for NGC 2100, and 0.02 for NGC 330. The ages t of the clusters come out to be $t=5 \cdot 10^6$ years for NGC 6530, $t=10^7$ years for NGC 2100, and $t=2 \cdot 10^7$ years for NGC 330.

EXTINCTION DETERMINATIONS

Extinction laws were derived for the LMC stars and NGC 6530. For NGC 330 the E(B-V) is too small to be measured reliably, we can only give $A_\lambda - A_V$. For the LMC stars we see steep increase in the extinction for $\lambda < 1800$ Å. An increase in the UV extinction was also found for other LMC stars, for instance by Nandy et al. (1981), Hutchings (1982), and Koornneef (1982).

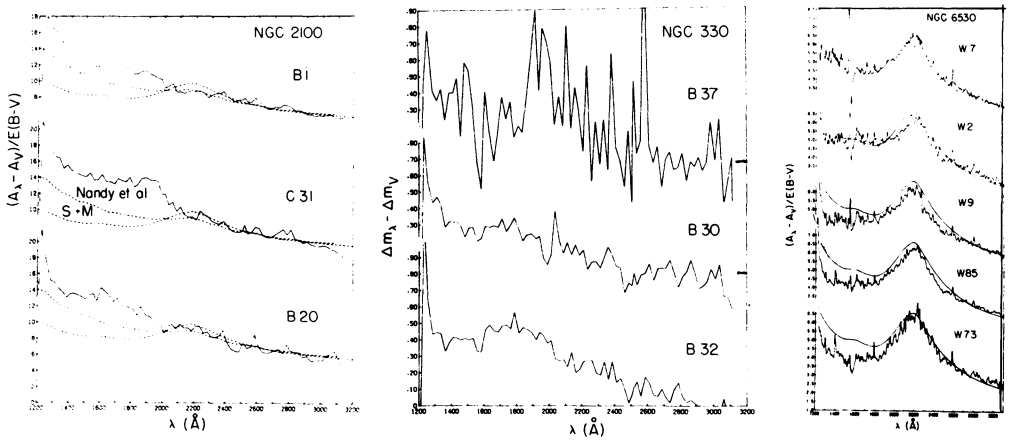

Figure 3 compares the extinction curves for the stars in the LMC and SMC clusters and in the Galactic cluster. The well known differences are obvious, but our UV extinction values are generally higher than those by Nandy et al. for instance. The average galactic extinction curve from Savage and Mathis 1979 is shown for reference.

MASS LOSS IN THE CLUSTERS

We did not detect any P Cygni profiles or profiles with extended short wavelength wings in the LMC and SMC stars, while the stars with $\log L/L_\odot \geq 5$ in NGC 6530 did show mass loss. As can be seen in Figure 4 the LMC stars are in a T_{eff}, L domain where Galactic stars show strong mass loss. If the LMC stars lose mass like the galactic stars the mass loss should be visible. The SMC stars are in a T_{eff}, L domain where the galactic stars show only weak mass loss, which could have escaped detection on our low resolution IUE spectra.

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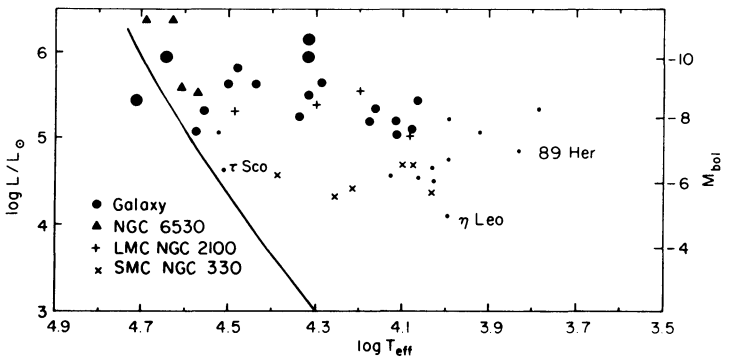

Figure 4. The positions of galactic stars with mass loss in the T_{eff}, luminosity diagram according to Cassinelli (1979). The size of the circles is a measure for the mass loss. ▲ NGC 6530 stars with strong mass loss. + NGC 2100 stars with no visible mass loss. x NGC 330 stars with no visible mass loss.

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