A LARGE SAMPLE OF EMISSION-LINE STARS IN THE LARGE MAGELLANIC CLOUD: THEIR LOCATION IN THE HERTZSPRUNG-RUSSELL DIAGRAM

Bruce Bohannan
Astrophysical, Planetary and Atmospheric Sciences
University of Colorado Box 391
Boulder, CO 80309 U.S.A.

The paths that massive stars follow in their evolution can potentially be determined by studying a homogeneous collection of luminous stars. In this investigation, mass-losing stars in a galaxy are studied through a sample of 59 H alpha emission-line stars in the Large Magellanic Cloud (LMC). The most luminous, most massive stars in the LMC, like their counterparts in the Galaxy, are losing mass at a rate that significantly alters their spectroscopic appearance and that affects their evolution.

What do emission-line stars tell us about the evolution of massive stars? Since the Humphreys-Davidson limit (Humphreys and Davidson 1979) cuts through the upper Hertzsprung-Russell (H-R) diagram at an angle, different mass stars will become unstable at different temperatures. One would then expect that there should be certain zones in the H-R diagram where stars of similar peculiar spectroscopic appearance are found.

Eighty-two LMC emission-line stars in the survey by Bohannan and Epps (1974) are brighter than V=12.6 (M_V=-6). Only 28 of the 82 had well established spectral types. New spectral classifications were made from image-tube spectra (43 A/mm) obtained at Cerro Tololo InterAmerican Observatory of 50 of these stars, while published types were used for 12 stars. Here, I consider 59 stars with published UBV photometry. The 13 Wolf-Rayet stars in this magnitude range were not re-observed.

I found four distinct groups of LMC emission-line stars with similar spectroscopic appearance.

- <u>O, B and A supergiants with</u> to varying degrees <u>relatively normal spectroscopic appearance</u> (51% of the sample).

- <u>O and B stars with strong emission features</u> (20%): ranging from stars with P Cygni-like hydrogen Balmer lines, but otherwise normal absorption lines, to stars with HeI 4471A in emission and no absorption features present in the blue.

C. W. H. De Loore et al. (eds.), Luminous Stars and Associations in Galaxies, 227–228.

https://doi.org/10.1017/S0074180900148922 Published online by Cambridge University Press

- S Doradus-like stars with FeII and [FeII] emission (12%).

- Wolf-Rayet stars (17%).

The sample of emission-line stars are plotted in the bolometric magnitude -- effective temperature diagram (Figure 1) for comparison with tracks of theoretical stellar evolution by Bressen, Bertelli and Chiosi (1981) that include convective overshooting and mass loss by radiation pressure. The Wolf-Rayet stars are not plotted.

No clear separation of spectroscopic groups into different regions of the H-R diagram is evident. Indeed, in any small range of luminosity and temperature, there are examples of several different spectroscopic groups. In general, the emission-line stars are found at temperatures cooler than the band of core hydrogen-burning models. In addition, all of the groups are found over a wide range of luminosities and extend to relatively lower masses than one would expect. For example, the S Doradus-like stars span a range of over 4 magnitudes in bolometric magnitude, from nearly -11 for S Doradus itself to -6.2 for BE 436 (HD 38489). Surprisingly, two apparently normal supergiants are above the Humphreys-Davidson limit.

Since there are large uncertainties in the derived effective temperatures, especially for stars with strong emission lines, these conclusions must be considered as extremely tentative and subject to re-evaluation when more direct measures of temperature are made.

REFERENCES:

Bressen, A.G., Bertelli, G., and Chiosi, C. 1981, Astron. Astrophys. 102, 25.
Bohannan, B. and Epps, H. W. 1974, Astron. Astrophys. Suppl. 18, 47.
Humphreys, R. M. and Davidson, K. 1979, Astrophys. J. 232, 409.

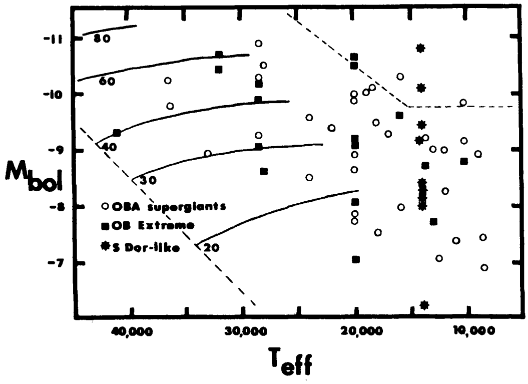

Figure 1: M_{bol}-T_{eff} diagram for 59 emission-line stars in the LMC with theoretical mass tracks of Bressen, Bertelli and Chiosi (1981). The Humphreys-Davidson limit is the dashed line in the upper right.

https://doi.org/10.1017/S0074180900148922 Published online by Cambridge University Press