

SPECTROSCOPY OF OVERLUMINOUS CEPHEIDS IN THE MAGELLANIC CLOUDS

Horace A. Smith
Michigan State University

Leo Connolly
Southeast Missouri State University

The Small Magellanic Cloud is known to contain types of short period Cepheid variable stars not yet discovered in either the Large Magellanic Cloud or, with the exception of a single star, in the Galaxy. These variables can be divided into two categories: anomalous Cepheids and Wesselink-Shuttleworth (WS) stars. The former, which have also been found in dwarf spheroidal systems and in the globular cluster NGC 5466, have periods of 0.4-3 days, but average 0.7-1.0 mag. brighter than RR Lyrae and BL Her stars of equal period. The stars we call WS stars have periods less than about 1.1 day and, at $M_V = -1$ to -2 , are brighter than anomalous Cepheids of equal period.

Connolly (1980, 1982) has recently proposed that some variables in the direction of the LMC, hitherto thought to be foreground RR Lyrae stars, are in fact LMC members, perhaps related to the WS stars of the SMC. This suggestion was based on the apparent existence of a period-luminosity relation for these stars, even though they had periods of under a day, and the determination that several of these variables have radial velocities consistent with LMC membership. However, in the direction of the LMC, radial velocity measures cannot always distinguish between stars in the LMC and stars in the halo of the Galaxy.

Butler, Demarque, and Smith (1982 -- BDS) reported results of low resolution spectroscopy of 3 anomalous Cepheids and 3 WS stars in the SMC. We have obtained new spectra of Wesselink and Shuttleworth (1965) variables 2, 4, and 5. Spectra have also been obtained for 5 of the suspected LMC variables of Connolly (1982). All spectra were obtained with the cassegrain Reticon spectrograph on the du Pont 2.5 m telescope of the Las Campanas Observatory.

Metal abundances for the variables have been determined by the ΔS method (Preston 1959, Butler 1975). These measures confirm the result of BDS that the SMC WS are, as a group, only mildly metal deficient, at $[Fe/H] = -0.6$. BDS estimated an age of 2.5×10^8 years for the WS stars in the SMC, and an age of 3×10^9 years for the more metal poor anomalous Cepheids ($[Fe/H] = -1.3$). If the stars examined so far are

representative, then the SMC interstellar medium may have been substantially enriched in heavy elements during the past few Gyr.

Four of the five Connolly variables are confirmed to have radial velocities consistent with LMC membership. Nonetheless, these stars range from $[\text{Fe}/\text{H}] = -0.7$ to -1.7 . They thus display no common metal abundance which might have served to establish their identity as a distinct group of variable stars. Neither can they be distinguished from galactic halo RR Lyrae stars on the basis of metal abundance alone.

This work has been supported in part by the U.S. National Science Foundation.

REFERENCES

- Butler, D. 1975. *Astrophys. J.* 200, pp. 68.
Butler, D., Demarque, P., and Smith, H. A. 1982. *Astrophys. J.* 257, pp. 592.
Connolly, L. P. 1980. *Sp. Sci. Rev.* 27, pp. 443.
Connolly, L. P. 1982. *Pulsations in Classical and Cataclysmic Variable Stars*, ed. by J. P. Cox and C. J. Hansen, pp. 188.
Preston, G. W. 1959. *Astrophys. J.* 130, pp. 507.
Wesselink, A. J. and Shuttlesworth, M. 1965. *M.N.R.A.S.* 130, pp. 433.