THE CHARACTERISTICS OF THE FIELD RR LYRAE STARS IN THE MAGELLANIC CLOUDS

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Abstract. The Magellanic Clouds are well known as being very suitable for observing the various stages of stellar evolution. During the last few years, I have been studying the RR Lyrae variable stars in each of the two Clouds. Some first results were reported at *IAU Colloquium* No. 21 in 1972 (Graham, 1973). Here, I would like to update these results on the basis of more recent data and to comment on some of the characteristics of the field RR Lyrae stars in each system. Periods and light curves are now available for 63 RR Lyrae stars in a $1° \times 1.3°$ field centered on the cluster NGC 1783 in the Large Magellanic Cloud (LMC) and for 62 stars in a $1° \times 1.3°$ field centered on the cluster NGC 121 in the Small Magellanic Cloud (SMC). Both ab and c type variables are represented and, viewed individually, the Cloud RR Lyraes are identical in characteristics to those known in our Galaxy. Studied as groups, however, there are small but significant differences between the RR Lyrae stars in each system. The following four specific features seem to be emerging from the study.

(1) The mean apparent magnitudes seem to cluster very closely about a single value. In the LMC, the time averaged mean visual magnitude $\langle V \rangle$ is $19^{m}.20$ and in the SMC, $19^{m}.65$. Using the best available distances for the Clouds (see Graham, 1973), these correspond to $M_{\langle V \rangle} = +0^{m}.5$ and $+0^{m}.45$ respectively, with a probable uncertainty of $\pm 0^{m}.2$ in each value. These absolute magnitudes are somewhat brighter than those predicted by the simple application of the often used Christy (1966) formula to the values of the transition period in each case.

(2) ab type variables with large amplitudes and periods less than $0^{d}.45$ are very rare or absent in both Clouds. Not one is found among the 125 stars studied. Such variables would need to have maxima fainter than blue magnitude 20.0 to have missed being detected in this study.

(3) There is an obvious difference in the period distribution and in the relative numbers of ab and c types. This is best summarized by noting that the transition period is $0^{d}.48$ for the LMC sample and $0^{d}.52$ for the SMC sample. c type variables seem to be approximately twice as common among the SMC sample as compared with that in the LMC. Following the trend seen in Galactic globular clusters, this seems to indicate an average metal deficiency of 2 or 3 in the SMC old population near NGC 121 as compared with that in the LMC sample. However, it is important to note that the RR Lyrae absolute luminosities appear to be about the same in both cases.

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(4) There is considerably more dispersion in the LMC period-amplitude diagram than in the corresponding one for the SMC variables. In the LMC, there seems to be no correlation between the scatter of points representing individual stars and their apparent magnitudes. The scatter may be due to an age dispersion, a composition dispersion, or a mixture of both in the LMC field, but whatever the cause, the mean absolute luminosity of an RR Lyrae star does not appear to be affected by it.

References

Christy, R. C.: 1966, *Astrophys. J.* **144**, 108.
Graham, J. A.: 1973, in J. D. Fernie (ed.), 'Variable stars in Globular Clusters and Related Systems', *IAU Colloq.* **21**, D. Reidel, Dordrecht, Netherlands, p. 120.

DISCUSSION

Cox: Can you tell me what is the value for the transition period in the galaxy? I gather it's less than 0.45 days.

Graham: Yes. It depends on what part of the galaxy you look at and what sort of sample you take, but you do get many stars going right down to 0.4 days.

Cox: But not less than 0.4 days.

Graham: No.

Bessell: Derek Jones looked at these stars in our Galaxy shorter than 0.4 of a day and claimed that they probably had absolute magnitudes of about +1.5. Do your observations in the Clouds suggest a similar situation?

Graham: It's on the limits of my observations, but these things have large amplitudes, I'm surprised that I didn't discover them when they hit maximum. When you take ten plate pairs your completeness is pretty high. For the ab type stars it was over 90% in both cases.

Iben: How again did you obtain the distance moduli?

Graham: Various ways. Firstly I used Gascoigne's colour-magnitude diagrams for globular clusters; secondly I used the Sandage-Tammann PLC data.

Iben: Did those two give identical results?

Graham: More or less. There was a dispersion of 0.1–0.2 mag.

Iben: But there is still then the possibility that the modulus and the magnitudes are off by 0.2 or so?

Graham: At the most, yes. 18.7 is possibly the most stable modulus for the LMC.

Rodgers: With the mass-luminosity ratios appropriate to NGC 6397 and ω Cen HB stars, your RR Lyrae luminosities lead to a mass of 0.61 $M_{\odot}$. This seems a good number.

Graham: Yes.

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