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Revised Empirical Formulae for the Absolute Magnitudes and Intrinsic Colors of RRab Stars

A. R. Walker
Cerro Tololo Inter-American Observatory, National Optical Astronomy Observatories, Casilla 603, La Serena, Chile

G. Kovács
Konkoly Observatory, P.O. Box 67, H-1525, Budapest, Hungary

Abstract. The relations between the physical parameters of the RRab stars and the Fourier parameters of their light curves have been reanalyzed on the basis of new CCD data. We show that the absolute magnitude M_V and the dereddened color indices $(B-V)_0$, $(V-I)_0$ are linear functions of the period and of the A_1 Fourier amplitude of the V light curve. Due to the large datasets, we are able to test the consistency of the formulae on independent sets. The present results are in good or fair agreement with our previous studies, despite the fewer number of significant parameters entering in the revised formulae.

We utilize recently published CCD light curves for RRab stars in globular clusters, together with previously-used datasets (339 stars in 16 systems, double the previous number), to derive accurate formulae which enable us to compute precise physical parameters from the light curves of RR Lyrae stars, using the method pioneered by Kovács & Jurcsik (1996, 1997). Here we utilize only the V light curves for the Fourier analysis, along with mean B and I magnitudes. For the complete sample, we find that 2-parameter regressions adequately represent the data, for example $M_V = -1.239P - 0.749A_1 + const.$ Defining the reddening-free parameter $W = V - 3.1(B-V)$ we find that a single-parameter fit is adequate; for $W = W_0 + d$, where d is the distance modulus, $W_0 = -1.823(\pm 0.055)P + const$ with much less dispersion than the V fit. These formulae suggest the existence of a simple PLC relation for RRab stars, while the dispersion shows the significance of differential reddening for most of the clusters. Two straightforward consequences are (1) from the M_V and [Fe/H] formulae of Jurcsik & Kovács (1996) it follows that the [Fe/H] – M_V relation has a natural width of 0.1–0.2 mag, and (2) as both the P–L–C relation and the basic pulsation equations are linear, the results indicate that RRab stars evolve on straight lines in the instability strip of the HR diagram.

References

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