LOCAL CALIBRATORS AND H_0: THE DISTANCE TO M31 USING RR LYRAE STARS

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ABSTRACT. We have used the CFH 3.6 m telescope in excellent seeing to observe RR Lyrae variables in a halo field in M31. From 32 variables found, we obtain $(m - M)_0 = 24.34 \pm 0.15$ for M31.

1 INTRODUCTION

In another paper in this volume, Marc Aaronson points out how important the determination of accurate distances to nearby galaxies is to the precise measurement of the Hubble parameter H_0. With modern detectors and consistent subarcsecond seeing, it is now possible to greatly improve our confidence in the local distance scale, and hence in the zeropoint calibration of secondary distance indicators, by observing RR Lyrae variables. These stars are well-respected distance indicators locally, and it is now within the reach of some ground-based telescopes to observe these objects in most, if not all, Local Group galaxies. As part of an on-going program to improve the Local Group distance scale from observations of RR Lyrae stars, Sidney van den Bergh and I would like to report on the first observations of RR Lyrae stars in the nearby spiral galaxy M31.

2 OBSERVATIONS AND REDUCTIONS

Our observations were obtained on the Canada-France-Hawaii Telescope during a 6 night observing run with an RCA CCD and B filter. The final data set consists of 16 1 hour exposures of an area 2'.2 × 3'.3 located 40' SE of M31 (along the minor axis). Average seeing for the observations was 0".9. Reduction procedures were standard, and will be described elsewhere (Pritchet and van den Bergh 1987).

Variables were found by blinking independent pairs of frames. Magnitudes were measured both on individual 1 hour exposures, and also on a frame constructed by averaging all 16 1 hour exposures, using the crowded field photometry algorithm DAOPHOT (Stetson 1987). The mean

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frame magnitude provided an estimate of the phase-averaged, intensity-mean, blue magnitude <B> for each object, without needing to know the magnitude at minimum light on individual frames.

3 RESULTS

A total of 32 variables were found, of which 2 may be eclipsing systems. This number of objects implies a relatively high RR Lyrae star frequency, comparable to that found in the Galactic globular cluster M3. In turn this suggests a relatively blue horizontal branch, which is in contrast to expectations based on the relatively high metallicity of the M31 halo (Mould and Kristian 1986).

Our best estimate of <B> for all RR Lyrae stars is 25.68 ± 0.06 (error in the mean). Taking the recent determination of $\langle M_V(RR) \rangle = +0.77$ from statistical parallaxes, corrected for magnitude scale errors, reddening scale errors, and put on an intensity-weighted system (Barnes and Hawley 1986), and using <B-V> = 0.26 and $A_B = 0.31$ (Burstein and Heiles 1984), we obtain $(m - M)_0 = 24.34 \pm 0.15$ for M31. The principal uncertainty in this result is in the calibration of $\langle M_V \rangle$ for RR Lyrae stars.

This result is in good agreement with a number of recent determination of the M31 distance modulus. For example, Welch et al (1986) obtain $(m - M)_0 = 24.26 \pm 0.08$ from IR observations of Cepheids, Cohen (1985) finds $(m - M)_0 = 24.04 \pm 0.20$ from novae, and Mould and Kristian (1986) obtain 24.4 ± 0.2 from Population II stars in a halo field near ours.

Details of this work will be published in the Astrophysical Journal.

REFERENCES

Barnes, T.G., and Hawley, S.L. 1986, Ap. J. (Letters), in press.
Burstein, D., and Heiles, C. 1984, Ap. J. Suppl., 54, 33.
Cohen, J. 1985, Ap. J., 292, 90.
Mould, J., and Kristian, J. 1986, Ap. J., 305, 591.
Pritchet, C.J., and van den Bergh, S. 1987, in preparation.
Stetson, P. 1987, in preparation.
Welch, D.L., McAlary, C.W., McLaren, R.A., and Madore, B.F. 1986, Ap.J., 305, 583.

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