NEW DISTANCES TO THE MAGELLANIC CLOUDS

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Abstract. The mean phase magnitudes at the IV waveband (1.05 micron) of thirteen Cepheids in the SMC and the LMC and nine Cepheids in groups and clusters in the Galaxy, are used in conjunction with periods, to construct P-L(IV) relations in these galaxies. The slopes and the dispersions of the relations are nearly the same. We derive a distance modulus of 19.11±0.07 for the SMC and 18.82±0.07 for the LMC.

The classical Cepheid has the unique property that the absolute luminosity is related to its period. This property has been used to determine distances to external galaxies in the Local Group. In this paper, we derive distances to the LMC and the SMC using IV mag (1.05 micron luminosity) corrected to the mean phase of the Cepheid, with the aid of V mag. The extinction in the IV waveband is four times lower than that in the B waveband. Further, the spread in the P-L(IV) relation due to the width of the instability strip in the H-R diagram as well as the metallicity variations from galaxy to galaxy, is smaller by a factor of ~2, compared to that in the P-L relation in optical wavelengths. Hence we believe that the P-L(IV) relation will lead to better distances to external galaxies compared to those derived using optical luminosities.

The absolute calibration of the P-L(IV) relation has been achieved through the observations of Cepheids in galactic clusters whose distances are known. On total, nine Cepheids in the Galaxy, thirteen Cepheids in the SMC and fourteen Cepheids in the LMC have been observed at the one metre telescope and the Anglo-Australian Telescope at the Siding Spring Observatory. A Varian photomultiplier tube with an InGaAsP cathode which is sensitive to IV(1.05 micron) and V wavebands has been used. For each Cepheid, both, IV and V magnitudes have been measured. The V mag has been used to identify the phase of the Cepheid from the published V light curve. Assuming the ratio of the amplitudes of Cepheids from V to IV, as ~3, the observed IV mag has been corrected to the mean phase.

The mean phase mag <IV>, of galactic Cepheids have been corrected further for the extinction and their absolute magnitudes in IV and $M_{<IV>_o}$ have been derived using the distance moduli given by Fernie and McGonegal (1983). A value of 0.02 mag and 0.04 mag for the reddening

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in the direction of the SMC and the LMC has been used. The mean phase and reddening corrected absolute mag $M_{<IV>_o}$ for the galactic Cepheids and mag $m_{<IV>_o}$ for the LMC and the SMC are combined with their periods to form a P-L(IV) relation for the Cepheids in the Galaxy, the LMC and the SMC. The least-squares regressions of these relations are given below:

Galaxy

$M_{<IV>_o}$ = -2.21 - 3.136 log P; σ = 0.15 mag

LMC

$m_{<IV>_o}$ = 16.56 - 3.089 log P; σ = 0.14 mag

SMC

$m_{<IV>_o}$ = 16.97 - 3.195 log P; σ = 0.18 mag

It can be seen that the slope and the dispersion in the P-L(IV) relation is nearly the same in the SMC, the LMC and the Galaxy. Hence we take the mean of the three slopes to represent the best slope of the P-L(IV) relation (-3.14). If we fit this slope to Cepheids in the LMC and the SMC, we derive a distance modulus of 18.82 for the LMC and 19.11 for the SMC. These distances are based on a distance modulus of 3.29 for the Hyades.

Our distance modulus for the LMC (18.82) is in agreement with that derived using 1.6 micron luminosity (18.71; McAlary et al. 1983) and with the extinction and abundance corrected distance modulus computed by Martin et al. (1979; 18.95). As regards the SMC, our distance modulus (19.11) is again in agreement with that corrected for extinction and metallicity difference between our Galaxy and the SMC by Gascoigne (1974) and strengthens the fact that the SMC has a lower metal content than our Galaxy. However, our moduli are higher by ~0.4 mag than those derived by de Vaucouleurs (1978). A part of the difference ~0.2 mag, is due to the high reddening correction adopted by de Vaucouleurs.

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