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Distances to six Cepheids in the LMC cluster NGC1866 from the near-IR surface-brightness method

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Abstract. We derive individual distances to six Cepheids in the young populous star cluster NGC1866 in the Large Magellanic Cloud employing the near-IR surface brightness technique. With six stars available at the exact same distance we can directly measure the intrinsic uncertainty of the method. We find a standard deviation of 0.11 mag, two to three times larger than the error estimates and more in line with the estimates from Bayesian statistical analysis by Barnes et al. (2005). Using all six distance estimates we determine an unweighted mean cluster distance of 18.30 ± 0.05. The observations indicate that NGC1866 is close to be at the same distance as the main body of the LMC. If we use the stronger dependence of the p-factor on the period as suggested by Gieren et al. (2005) we find a distance of 18.50 ± 0.05 (internal error) and the PL relations for Galactic and MC Cepheids are in very good agreement.

Key words. Cepheids – Magellanic Clouds – Stars: distances – Stars: fundamental parameters

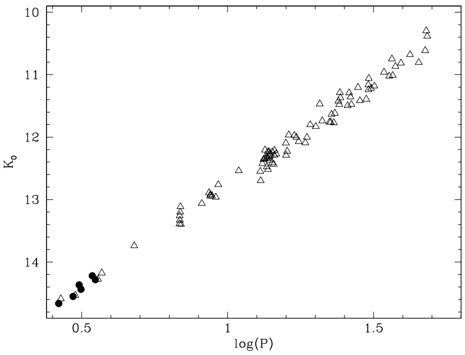

Fig. 1. Here we have over-plotted the dereddend mean K magnitudes for the NGC1866 Cepheids (full circles) on top of the mean K magnitudes for the LMC field Cepheids from Persson et al. (2004). The excellent agreement suggests that NGC1866 is located close the LMC mean distance and that depth effects must be small if at all present. This is in agreement with the model of van der Marel and Cioni (2001) which suggests that the LMC disk at the location of NGC1866 closer than the LMC barycentre by 0.06mag.

1. Observations

Storm et al. (2005) have obtained radial velocity curves as well as K-band light curves for six Cepheids in the young populous LMC cluster NGC1866. Combining these data with the optical light curves from Gieren et al. (2000) we can apply the near-IR surface brightness method as calibrated by Fouqué and Gieren (1997) to determine the distance to the individual stars.

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Table 1. Individual distance moduli for the NGC1866 Cepheids using the original and the new p-factor relations.

Star	$\log P$	$(m-M)$ org	$(m-M)$ new	σ
HV12199	0.421	18.34	18.55	0.09
HV12203	0.470	18.48	18.68	0.09
HV12202	0.492	18.29	18.49	0.07
HV12197	0.497	18.17	18.36	0.06
HV12204	0.536	18.20	18.39	0.04
HV12198	0.547	18.31	18.50	0.03
Unweighted mean:		18.30	18.50	s.d. 0.11

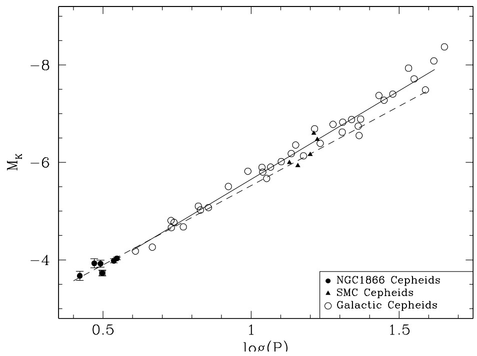

Fig. 2. Here we have over-plotted the absolute magnitudes of galactic Cepheids (open circles) on the NGC1866 Cepheids (filled circles). The results are based on the Fouqué and Gieren (1997) calibration presented in Storm et al. (2004) using a p-factor which is only weakly dependent on period [$p = 1.39 - 0.03\log(P)$]. Note the excellent agreement between LMC and Milky Way stars. The dashed line represents the observed LMC relationship from Persson et al. (2004) exactly as represented in Fig.1 for an assumed distance modulus of 18.30 and illustrates the apparent difference in slope between the LMC and galactic PL relations.

2. Discussion

Gieren et al. (2005) analyzed these stars together with additional LMC Cepheids with longer periods using the near-IR surface brightness technique. They found that the long period stars also follow the observed relations in both of the above diagrams, but not the dashed line in Fig.2. They also found the unphysical result that the distances for these long period stars were significantly longer than for the short period NGC1866 stars. By introducing a stronger period dependence of the p-factor which converts radial velocity into pulsations velocity [$p = 1.58 - 0.15\log(P)$] they could force the LMC stars to be at the same distance independent of period. As a consequence the slope for the PL relation in Fig.2 would become shallower leading to an excellent agreement with the Persson et al. (2004) relationship (dashed line). For the NGC1866 Cepheids this implies distance estimates which are about 0.2 mag longer than with the original p-factor relation.

References

Barnes, T.G., Storm, J., Jefferys, W.H., et al., 2005, ApJ, in press

Fouqué, P., and Gieren, W.P., 1997, A&A, 320, 799

Gieren, W.P., Gómez, M., Storm, J., et al., 2000, ApJS, 129, 111

Gieren, W.P., Storm, J., Barnes, T.G., et al., 2005, ApJ, 627, 224

Persson, S.E., Madore, B.F., et al., 2004, AJ, 128, 2239

Storm, J., Carney, B.W., Gieren, W.P., et al, 2004, A&A, 415, 531

Storm, J., Gieren, W.P., Fouqué, P., et al., 2005, A&A, 440, 487

van der Marel, R.P., and Cioni, M.-R.L., 2001, AJ, 122, 1807