Large Magellanic Cloud Distance from Cepheid Variables using Least Square Solutions

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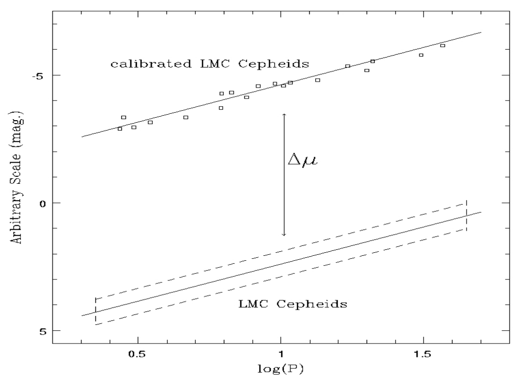
ABSTRACT: We determine the LMC distance using Cepheid variables in the LMC. We combine the individual LMC Cepheid distances obtained from the infrared surface brightness method and a dataset with a large number of LMC Cepheids. Using the standard least squares method, the LMC distance can be found from the ZP offsets of these two samples. We have adopted both a linear P-L relation and a ``broken'' P-L relation in our calculations. The resulted LMC distance moduli are 18.478±0.034 mag and 18.486±0.036 mag (the quoted errors are random error only), respectively, which are consistent to the adopted 18.50 mag.

I. Introduction

- Gieren et al (2005, hereafter G05): determined the distance to 13 LMC Cepheids (including 6 short-period Cepheids in LMC cluster NGC 1866) and derive the Cepheid period-luminosity (P-L) relation.
- LMC hosts >600 Cepheids available from the Optical Gravitational Lensing Experiment (OGLE) database.
- By combining these two datasets, it is possible to determine *both* of the LMC distance modulus and P-L relation simultaneously (see **Figure 1**).

Figure 1: Illustration of the *least squares method*. Introducing an offset of the ZP, Δμ, between the calibrated Cepheids from infrated surface brightness method and a large number of OGLE Cepheids will allow the LMC distance and the P-L relation to be solved simultaneously .



II. Data & Methods

- Data used: (1) G05 (2) OGLE data from Kanbur & Ngeow (2006).
- The least squares take the form:

$$m = \alpha\,\Delta\mu + a + b\log(P), \alpha = \begin{cases} 0, & \text{if G05} \\ 1, & \text{if OGLE} \end{cases}$$

- Recent studies have suggested the LMC Cepheid P-L relation is non-linear (Kanbur & Ngeow 2004,2006; Sandage et al 2004).
- We also adopt a "broken" P-L relation with a break period at 10 days.

III. Results

- For linear P-L relation:

V-band: Δμ= 18.468±0.059; a = -1.363±0.068; b = -2.761±0.036
I-band: Δμ= 18.483±0.041; a = -1.863±0.046; b = -2.981±0.024

- For non-linear P-L relation:

V-band: Δμ= 18.485±0.063 & *I*-band: Δμ= 18.486±0.043
Long period (P>10days): a_V = -1.228±0.208; b_V = -2.838±0.155
a_I = -1.688±0.143; b_I = -3.093±0.106
Short period (P<10days): a_V = -1.278±0.072; b_V = -2.939±0.061
a_I = -1.801±0.049; b_I = -3.092±0.041

- *V* and *I* band averaged distance modulus is given in the ABSTRACT.
- F-test (Kanbur & Ngeow 2004) results for non-linear P-L relation:

$F_V = 7.32$; $F_I = 6.87$
(null hypothesis [linear P-L relation] can be rejected with >95% CL if F > 3).

REFERENCE: (i) Gieren et al 2005, ApJ 627:224 (ii) Kanbur & Ngeow 2004, MNRAS 350:962 (iii) Kanbur & Ngeow 2006, MNRAS 369:705 (iv) Sandage et al 2004, A&A 424:43