Abstract

Aim: Calibration of BVIJHK Galactic Leavitt Law by determining systematic errors in reddening and distance of individual Cepheids.

Method: Inspired by Madore's (2017) Leavitt Law calibration algorithm, this research compares the systematic errors yield by four versions of Wesenheit functions based on (B-J), (B-K), (V-J) and (J-K) color indicies. Starting with residual correlation of period-luminosity relations with period-wesenheit relations, bandwise extinction error for given distance moduli trails being calculated for each of the four cases. Distance error trail with the least variance in reddening error across the bands selected as the systematic error pair and adjusted to the luminosities. Calibration with (B-K) and (V-J) based wesenheit yields the tightest Leavitt Law for all the bands. The results demonstrate improved internal consistency in the near-infrared bands and contribute to a more precise calibration of the extragalactic distance scale—thus reinforcing the reliability of the cosmic distance ladder as a tool for precision cosmology.

Result: The calibrated BVIJHK Leavitt Laws using 95 Galactic Cepheids are as follows.

Leavitt Law: BK based	**Leavitt Law: VJ based**
$M_B = -1.86(\log P - 1)(\pm 0.011) - 3.22(\pm 0.003)$	$M_B = -1.85(\log P - 1)(\pm 0.009) - 3.22(\pm 0.003)$
$M_V = -2.26(\log P - 1)(\pm 0.003) - 3.95(\pm 0.001)$	$M_V = -2.26(\log P - 1)(\pm 0.010) - 3.95(\pm 0.003)$
$M_I = -2.57(\log P - 1)(\pm 0.014) - 4.74(\pm 0.004)$	$M_I = -2.56(\log P - 1)(\pm 0.018) - 4.73(\pm 0.005)$
$M_J = -2.79(\log P - 1)(\pm 0.011) - 5.22(\pm 0.003)$	$M_J = -2.78(\log P - 1)(\pm 0.010) - 5.22(\pm 0.003)$
$M_H = -2.92(\log P - 1)(\pm 0.011) - 5.60(\pm 0.003)$	$M_H = -2.92(\log P - 1)(\pm 0.014) - 5.60(\pm 0.004)$
$M_K = -2.97(\log P - 1)(\pm 0.011) - 5.65(\pm 0.003)$	$M_K = -2.97(\log P - 1)(\pm 0.014) - 5.65(\pm 0.004)$

VIJK Leavitt Law calibrated with (V-J) based wesenheit yields the distances to LMC and SMC as 18.378 ± 0.114 and 19.070 ± 0.032, respectively.