An Adjustment to Cepheid Distances Calculated Using Model Atmospheres

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Hindsley and Bell (1989, Ap. J., 341, 1004) determined distances for 23 Cepheids using the surface brightness method. The color $V - I_C$ on the Cousins system or $V - R_J$ on the Johnson system was used to measure visual surface brightness. Combined with the observed visual magnitudes, angular diameters were then calculated. Comparison of angular diameters with radius differences in linear units, obtained by integrating the radial velocity curve, yielded each Cepheid's distance.

Hindsley and Bell calibrated the relationship between color and surface brightness using model atmospheres. The zero point of the relationship was found using observations of Vega and an appropriate model. More recently the spectral scans of Gunn and Strycker (1983, Ap. J. Suppl., 52, 121) and the Cousins filter response curves of Hindsley and Bell were used to calculate colors and these were compared to the corresponding observed colors. It was found that the colors produced from the Gunn and Strycker data were redder than the observed colors. A transformation equation of the form

$$C_{OBS} = constant \times C_{SYN} \tag{1}$$

with C_{OBS} being the observed colour and C_{SYN} that calculated from the Gunn and Strycker data, was found to be sufficient. For the Cousins colour $V - R_C$, the constant was 0.977, while for the colour $V - I_C$ the constant was 0.966. Note that no offset is needed. When the synthetic colours $V - I_C$ and $V - R_J$ were thus corrected and the analysis repeated for twelve stars,the resulting period-luminosity relationship was:

$$< M_V >= (-3.24 \pm 0.43)(logP - 0.8) - (3.82 \pm 0.44) \tag{2}$$

This zero point is 0.21 magnitudes fainter than the previous result, but more in agreement with the value of −3.75 found by Barnes, Gieren, and Moffett 1990 (in Confrontation Between Stellar Pulsation and Evolution, ed. C. Cacciari and G. Clementini, Astr. Soc. Pac. Conf. Series, 11, 221). Absolute magnitudes derived using the Johnson system colour $V - R_J$ in the analysis are about 0.25–0.5 mag brighter than absolute magnitudes obtained using the colour $V - I_C$ on the Cousins system. This is due to the well-known difficulty with the Johnson R filter response curve. Further work is needed to resolve this problem. It is expected that the final result will be a zero point very close to that obtained using only $V - I_C$ observations, −3.60.

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