

Cepheid Distance to M33 Based on HST Observations

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We have determined the distance to M33 using single epoch I-band observations of Cepheids based on HST/WFPC2 images of five fields in M33. One of the local group galaxies, M33, was not included in HST H₀ Key Project because it is too huge to observe the Cepheids in it, and the ground-based observations of Cepheids in M33 undergo severe crowding problems. We have estimated the distance to M33 using combination of the HST single epoch I-band photometry and the periods determined from the ground-based observations (DIRECT) for 21 Cepheids with $\log P > 0.8$ in the sample of 32 Cepheids. We derive a distance modulus of $(m-M)_0 = 24.52 \pm 0.14(\text{random}) \pm 0.13(\text{systematic})$ for a calibration of $M_I = -2.962 \log P - 1.942$ and an adopted total reddening of M33, $E(B-V) = 0.20 \pm 0.04$ ($E(V-I) = 0.27 \pm 0.05$) given by Freedman et al. (2001), the reddening to the LMC, $E(B-V) = 0.10$, and the distance to the LMC, $(m-M)_0 = 18.50$. If the total reddening to M33 of $E(B-V) = 0.10 \pm 0.09$ given by Freedman et al. (1991) is used, the Cepheid distance modulus based on the I-band photometry will be increased by 0.20. Metallicity effect on the Cepheid distance to M33 is estimated to be small, $\delta(m-M)_Z = 0.01$ to 0.06, which leads to $(m-M)_0 = 24.53$ to 24.58 after this metallicity effect correction. Using the Wesenheit W_I , an extinction-free parameter, we derive a similar value, $(m-M)_0 = 24.52 \pm 0.15(\text{random}) \pm 0.11(\text{systematic})$. These results are in reasonable agreement with those based on the ground-based multi-epoch BVRI observations of brighter Cepheids in M33, and are ~ 0.3 smaller than those using the tip of the red giant branch and the red clump methods based on the HST/WFPC2 images (Kim et al., 2001, AJ, in press). This difference is considered partially due to the uncertainty in the estimation of the total reddening for Cepheids in M33. Searching for the Cepheids and determining the periods of the Cepheids using small size ground-based telescopes, and obtaining I-band photometry of them at a single epoch using HST would be a good strategy for determining the distance to nearby galaxies.