On Main Sequence Distances and the Local Distance Scale

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ABSTRACT. We analyze a deep CMD for the LMC cluster NGC1831, based on CTIO PFCCD frames. More than 4 magnitudes of main sequence (MS) are evident, as well as a prominent clump, and a few possible giant branch stars. We fit the MS to a series of models and Galactic clusters,and derive a distance of 18.3±0.1 and an age of 0.5±0.1 Gyr, for an abundance of about 2/3 solar ([Fe/H]∼–0.23), based on the VandenBerg models (Vandenberg and Poll 1989). A fit to the empirical Pleiades MS, assuming an intrisic modulus of 5.6, gives a LMC modulus of 18.25-18.35, after an adjustment for the relative abundance difference of –0.2.

We can also fit the cluster with convective overshoot models (Chiosi et al., 1988). Using solar abundances, we find an age of 0.8 Gyr with $(m\text{-}M)_o$ = 18.20–18.30. The main effect of the overshoot models is to increase the derived age, not to change the distance.

A more serious problem arises when we attempt to determine the distance using the Revised Yale Isochrones (Green *et. al* , 1987; hereafter RYI). We derive a distance of $(m\text{-}M)_o$ =18.4–18.6 for different abundances. A systematic difference between the VdB and RYI distance scale exists for Galactic clusters also, including the Hyades and Pleiades. We determine a distance modulus to the Pleiades of 5.75-5.8 based on RYI models, 0.15 to 0.20 longer than the VdB and Poll distance. High quality CMDs and abundance determinations can produce MS distances with internal accuracies of about 5%, when a specific set of models or zeropoints is assumed. The differences shown above, however, indicate that systematic errors at the 10% level still exist.

The true distance to the Pleiades is not known with high precision of course, and the RYI distance may be the proper one (we are not implying they are wrong). We do note however that the standard *Cepheid scale and the RYI scale differ by about 0.2mag*, with the Yale scale longer, and care should be used when comparing various local distances, because of often unstated assumptions on the true zeropoint. For example, some distances are still based on a Hyades modulus of 3.03 (Tammann 1987). Some recent Cepheid–based moduli imply an extremely bright absolute magnitude for RR Lyrae stars (*e.g.*, Sandage and Carlson (1983) use an apparent LMC modulus of 19.0, which would yield $M_v(RR) = 0.2$).

Despite recent claims in the literature that the local distance scale is known to ∼5% (Tonry 1991), we find that the zeropoints of all the local distances are uncertain by 10% or more (as discussed by Feast 1991).

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