

## NEW AGES FOR OLD CLUSTERS

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A major result of the Hipparcos mission is the availability of accurate parallaxes for a much-increased sample of nearby subdwarfs. On the basis of those data, both Reid (1997-R97) and Gratton et al (1997-G97) have used main-sequence fitting techniques to obtain new estimates of globular cluster distances, deriving significantly larger moduli (by 0.15 to 0.3 mag) for extreme, metal-poor clusters such as M92 and M15. These re-calibrations are not solely the result of the revised parallax data - both D'Antona, Caloi & Mazzitelli (1997 - DCM) and Reid show that similar results can be derived from pre-Hipparcos subdwarf data if the calibrations are not tied exclusively to HD 103095. The longer distance scale leads to a brighter inferred turnoff, and, combined with the latest models (DCM), ages of only 11 to 13 Gyrs - substantially younger than the  $16 \pm 2$  Gyrs proposed by Bolte & Hogan (1992).

Recently, Pont et al (1997) have suggested that these revised distances reflect systematic bias in the calibration, notably underestimation of subdwarf abundances. Their distance modulus for M92 ( $(m-M)_0 = 14.68$ ) is closer to the Bolte/Hogan value (14.65 mag) than those derived by G97 (14.82 mag) or Reid (14.93 mag). While we believe that Pont et al overestimate the bias, particularly where high-resolution spectroscopic analyses are concerned (G97, Reid, preprint), there is no question that significant uncertainties remain in the cluster distance calibration. Colours, rather than luminosities, are particularly vulnerable, and a mismatch of 0.01 in (B-V) translates to  $\delta(m - M)_0 \sim 0.05$  mag. Amongst the problems are:

- 1) regardless of the random uncertainties in [Fe/H] for subdwarfs, there are systematic differences of up to 0.3 dex between different calibrations (Reid, preprint);
- 2) the  $\delta(B - V)$  correction required to adjust subdwarfs to a mono-metallicity scale is poorly-defined empirically;
- 3) interstellar reddenings remain uncertain for many subdwarfs and clusters;
- 4) discrepancies of up to 0.04 mag exist in the colours adopted for individual subdwarfs, and most stars have only BV photometry;
- 5) there are systematic differences in the  $(M_V, (B-V))$  isochrones predicted by the DCM and Vandenberg models - in shape as well as zeropoint. These discrepancies are often ignored.

Overall, the main legacy of Hipparcos should be a better appreciation of the true level of uncertainty in main-sequence fitting. There are over 200 HIP stars with parallaxes measured to  $\frac{\sigma_\pi}{\pi} < 15\%$ , and falling below the 47 Tuc main-sequence. Accurate photometry and high-resolution spectroscopy of those stars will go a long way toward setting cluster distances on a firmer footing.

### References

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