The Ages of Stars
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Towards a precise white dwarf cooling age of a globular cluster

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Abstract. The white dwarf cooling age of a globular star cluster provides a potentially precise method of determining the ages of these ancient systems. This age-dating technique should be viewed as one distinct from that of turn-off ages, with a largely different set of input physics and problems. As such the ages produced by these two methods are complimentary and we seek convergent to the same value. In addition to deep photometry and astrometry of cluster stars, precise distances to the clusters and their reddenings are required. Theoretical models of both main sequence stars and cooling white dwarfs are also needed as well as the masses of the white dwarfs and an initial-final mass relationship. In this contribution I discuss a potentially precise approach to cluster distances via a geometric technique (comparing the internal proper motion dispersion of cluster stars with their radial velocity dispersion) and spectroscopically determined masses of M4 white dwarfs at the top of the cooling sequence. These latter data extend the initial-final mass relationship down to the lowest mass stars that are currently forming white dwarfs.

Keywords. astrometry, stars: white dwarfs, Galaxy: globular clusters: individual (M 4)

Discussion

M. Liu: 1) For your proper motion measurements, do you use only the two (closely spaced) epochs from Gemini AO, or include the older CFHT archival data? 2) Given the concerns about the metallicity dependence of the initial-find mass relation, what will the fundamental limitations be in determining the ages, since the clusters used to calibrate the initial-final mass relation have different metallicities?

H. Richer: 1) The proper motions themselves are derived only from the Gemini data but the older (and much less precise) CFHT data were useful in assessing the errors in the proper motions. 2) Except for the data I just showed on M4, all the clusters used in the plot are about solar metallicity. It is interesting however, that this point for [Fe/H] near −1.3 seems to fit the same relationship quite well.

I. King: When your distance from comparing dispersions of radial velocities and proper motions is still at the 20% level of accuracy, the straightforward comparison works fine, but when you aim at higher accuracies you will need a better dynamical model, which takes into account anisotropy of dispersions and rotation.

H. Richer: I certainly agree with this. As the data improve, particularly the radial velocity dispersion which now dominates the error, a more sophisticated model will be required. We are not there yet, but soon I hope to be.

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