THE HYADES CLUSTER - SOLAR METALLICITY?

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Some simple comparisons have been made between models of main sequence (MS) stars and the Hyades main sequence with the aim of investigating the effects of *small* changes in the stellar opacities, the zero point of the temperature scale and the assumed distance modulus for Hyades cluster have on the inferred metallicity of the Hyades. Three grids of MS models were constructed using the Cox and Stewart (1970a,b) opacities. Furthermore, taking a rather conservative view with regard to future changes in opacity compilations, another grid was constructed with opacities 20% higher than the Cox-Stewart opacities. Following the procedure outlined by Gough and Weiss (1976), the mixing length required for constructing a solar model was found to be 1.36. Because recent photometric and spectroscopic work (Barry *et al.* 1978; Hardorp 1978) suggests that the sun may be redder than traditionally believed, i.e., $(B-V)_{\odot}$ = 0.66-0.67 instead of 0.63 mag, two temperature scales have been used to transform the MS models to the CM diagram.

Table 1

Assumed Modulus	Opacities*	Temp. Scale Zero Point $(B-V_o)$	Metallicity: Hyades/Sun
3.25	κ(cs)	0.63	2.1
3.30	κ(cs)	0.63	2.4
3.25	κ(cs)	0.67	1.1
3.25	1.2κ(cs)	0.63	1.6
3.25	1.2κ(cs)	0.67	0.8
3.30	1.2κ(cs)	0.63	1.8
3.30	1.2κ(cs)	0.67	1.1

*κ(cs) = Cox-Stewart opacities

James E. Hesser (ed.), Star Clusters, 119–120.

Shifts in the theoretical main sequences were found to obey the following relations: $\Delta M_V = -0.84\Delta\log Z + 3.63\Delta Y$ or $\Delta(B-V) = 0.14\Delta\log Z - 0.60\Delta Y$. The results of using these relations in comparing the theoretical main sequences with the Hyades main sequence are given in Table 1.

The use of the Cox-Stewart opacities and the traditional zero point for the temperature scale results in a "high" inferred metallicity for the Hyades while larger opacities and a redder temperature scale result in solar-like metallicites. A change of 0.05 mag in the assumed distance modulus has a rather small influence on the inferred metallicity. Furthermore, it turns out that a decrease of $\sim$0.02 mag in the temperature zero point is equivalent to an opacity increase of 20%.

Although a 20% increase in interior opacities is probably a reasonable forecast (see Flower 1978), there may be some hesitancy in accepting a large shift in the temperature scale. For instance, if one compares the "reddened" Sun with MS stars whose temperatures have been determined via detailed spectroscopic analyses (Perrin *et al.* 1977) and whose colors are accurately known (Nicolet 1978), one finds that the Sun is 0.05 mag redder than the mean temperature scale defined by some 40 stars. The temperature and colors of these MS stars are, of course, independent of the solar values. Furthermore, although searchers for the solar analog have assumed zero reddening for the Hyades cluster, Taylor (1978) presents evidence for a minimum of $\sim$0.02 mag reddening in the direction of the Hyades cluster.

If one is to venture a conclusion amid all the uncertainties associated with evolutionary models, opacities, etc., it would be that the evolutionary models used in this study support a Hyades metallicity that may be as high as 1.5 times solar but is probably closer to solar.

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