THE IMPACT OF HIPPARCOS ON THE OLD PROBLEM OF THE HELIUM CONTENT OF THE HYADES

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ABSTRACT

In the following we shall only summarize our contribution to the detailed study of the atmospheres of 40 Hyades dwarfs during this symposium. A very basic paper entitled: 'The Hyades: distance, structure, dynamics, and age' has just been accepted by *Astronomy & Astrophysics* (Perryman et al 1997, in press). A more specialized paper (Cayrel de Strobel et al., in preparation), containing the observational high resolution, high S/N spectroscopic data for the 40 Hyades stars presented in Venice, plus a few new objects, including the binary stars for which the mass of the components have been determined, will be submitted for publication in *Astronomy & Astrophysics* very soon.

It will show how the recent refinements in the computation of model atmosphere analyses and stellar structure models combined with the newly arrived Hipparcos data are productive in new results. Among them, a very interesting one is the determination of the helium abundance in the Hyades. The results presented here rely on the 20 single Hyades members remaining after all spectroscopic binaries, or newly-suspected binaries by Hipparcos, have been removed from the list of 40.

The only way to reach the helium abundance in stars later than B ($T_{\rm eff} \leq 12000K$) is indirect. In the Hyades, the turn-off is in the A-type, and an indirect method has to be used. It consists in comparing the observational ($\log T_{\rm eff}$, $M_{\rm bol}$) diagram, representing the observational unevolved main sequence of the Hyades, with a grid of theoretical zero-age-main-sequences (ZAMS).

In our case this grid is derived from internal structure models, computed with different Helium and metal abundances and with the best up-to-date input physics (see Lebreton et al., this volume). Lebreton has determined the mixing length parameter, $\alpha = \ell/H_p$ (ℓ being the mixing length and H_p the scale height), by the condition that the solar evolutionary track reproduces the present Sun after 4.5 Gyr. This parameter value has been applied to the Hyades. Then the theoretical ZAMS depends upon two free parameters: the metallicity Z and the He content Y (Z and Y are given in mass fraction).

The metallicity and the effective temperature of the analysed stars are known from spectroscopic analyses, so that Y remains the only free parameter available to fit the observational ZAMS. We are now able to deduce the helium abundance of the cluster using our grid of theoretical ZAMS's.

We find that the data of the observational Hyades ZAMS constrain Y to the value:

$$Y_{\rm Hyades} = 0.26 \pm 0.02$$

with no significant departure from the solar value:

$$Y_{\rm Sun} = 0.266 \pm 0.01$$

in spite of the metallicity higher than solar:

$$[{\rm Fe/H}]_{\rm Sun}^{\rm Hyades} = +0.14 \pm 0.05 \text{ dex}$$

Figure 1 represents the positions in the ($\log T_{\rm eff}$, $M_{\rm bol}$) diagram of the considered 20 single and unevolved Hyades dwarfs as a function of different assumed distance moduli proposed by three authors before the availability of the Hipparcos data. Here we see that, before Hipparcos, the position of the observational main sequence of the Hyades was too uncertain for allowing a statement about their He-content.

In Figure 2 the observational positions based on the Hipparcos parallaxes and two theoretical ZAMS's are merged together into a composite HR diagram. It shows that the Hyades ZAMS ($Y = 0.26$, $Z = 0.024$) is shifted by 0.16 mag with respect to the solar composition ZAMS ($Y = 0.266$, $Z = 0.0175$).

In conclusion, Hipparcos clearly shows that the higher metallicity of the Hyades is not accompanied by a parallel increase in helium content. This suggests that the metal enrichment of the Hyades mother cloud might have been caused by a local supernova event.

Key words: Hyades; HR diagram; effective temperature; Metal and Helium abundances.

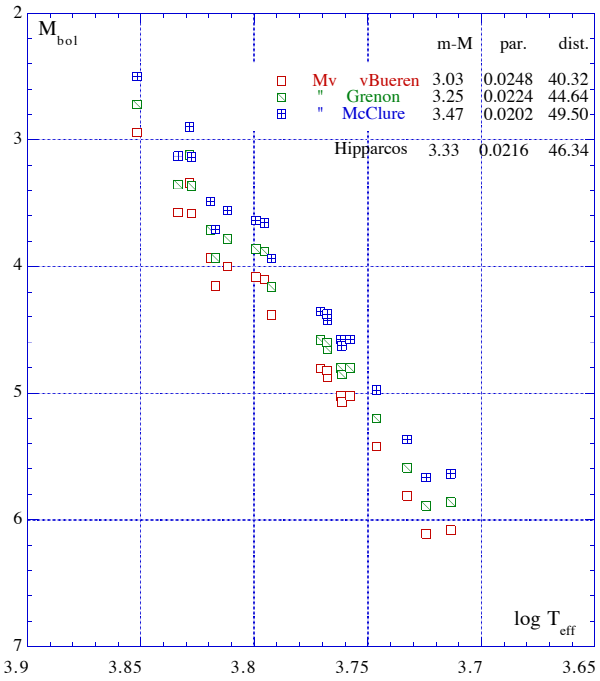

Figure 1. log ($T_{\rm eff}$, $M_{\rm bol}$) diagram for the 20 single unevolved Hyades stars previously subjected to detailed spectroscopic analysis, for 3 different values of the distance modulus of the cluster.

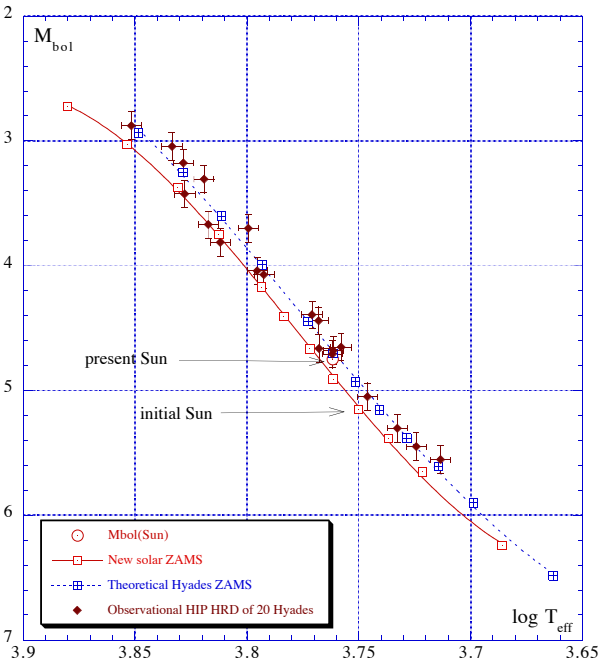

Figure 2. Observational (log $T_{\rm eff}$, $M_{\rm bol}$) diagram of the same 20 Hyades dwarfs, with the newly-calculated solar and Hyades ZAMS sequences.