AN ABUNDANCE ANALYSIS OF FEHRENBACH'S STAR (HD 116745) IN OMEGA CENTAURI

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Abstract. HD 116745 is an eleventh magnitude early F-type giant occurring in the field of the globular cluster ω Cen. Membership in the cluster appears virtually certain since the star's radial velocity differs insignificantly from the mean cluster velocity of $+238$ km s^{-1}. HD 116745 lies nearly 4 mag. above the horizontal branch in the HR diagram and is presumably in a rapid, advanced stage of evolution. Spectrograms at 22.5 Å mm^{-1} and 155 Å mm^{-1} have been obtained by one of us (R.J.D.) at the Radcliffe Observatory in South Africa using a McGee spectracon image tube. The lower dispersion spectra have been used to measure Hγ profiles and the Balmer discontinuity, and one high dispersion film has provided the basis for a differential curve-of-growth analysis with respect to the Sun in order to determine some heavy element abundances. Physical data derived for the star are $M_v = -3.32$, $\theta_e = 0.77 \pm 0.02$, $\log g = 1.0 \pm 0.3$ and $\mathfrak{M} = 0.37\, \mathfrak{M}_\odot \pm^{0.37}_{0.18}$. Results of the curve-of-growth analysis, in which a model atmosphere was used to determine the curve appropriate to the star, yield a logarithmic iron-to-hydrogen abundance ratio with respect to the Sun of [Fe/H] $= -1.2$ with a provisional estimated uncertainty of about ± 0.2. This result is based on 28 lines of Fe I. Ti may be marginally overabundant, with a value of [Ti/Fe] $= +0.4$, based on 7 lines of Ti II. Other elements and ionization states identified are Mg I, Al I, Si I, Ca I, Sc II, V I, V II, Mn I, Sr II, Zr II (Eu II).

The small mass and possibly enhanced [Fe/H] above the mean for cluster giants (~ -1.7) are not unexpected on the basis of some current models of stars in late evolutionary stages in which most of the envelope mass might be lost, and an enhanced [Fe/H] could result from convective mixing from a region in which hydrogen burning is taking place. Such mixing might conceivably occur when the star is undergoing thermal pulses (driven by the He shell source instability), at times when the H-burning shell source periodically disappears (see, for example, the paper by Mengel at this Colloquium). However the present errors in the abundance and mass determinations are not yet small enough to rule out the possibility that HD 116745 has a mass typical of a horizontal branch star and a composition representative of an upper limit of a small range in abundance amongst the giant stars, which are known to show considerable intrinsic spread in colour in the HR diagram.

DISCUSSION

Bolton: Have you checked your equivalent width scale by taking spectra of the sun or some other star with the same equipment?

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Dickens: No but I hope to be able to check this point using spectra of the same star taken by Sargent with conventional equipment. I see no reason to expect large systematic errors with equivalent widths from a spectracon in view of results obtained by others with similar equipment at Herstmonceaux.

Jones: My narrow band photometry indicates that HD 116745, V 1, and the RR Lyraes in ω Cen all have the same abundance within a factor of two. What $E(B-V)$ and $\delta(U-B)$ at $(B-V)=1.0$ did you use in your two colour plot?

Dickens: $E(B-V)=0.11$, $\delta(U-B)=0.28$.

Van den Bergh: Is it known if this type of star occurs in any particular type of globular cluster? The reason for asking this question is that stars as bright as Fehrenbach's star could be seen on blue plates of M32 (which has a total giant population about 10^2 times larger than that of ω Cen) but are in fact absent from that Galaxy. It follows that the dwarf elliptical M32 does *not* contain a significant population component similar to ω Cen.

Dickens: There are such bright stars known in a number of globular clusters of various types but it is not yet known how many are cluster members.