COMMISSIONS 27 AND 42 OF THE IAU
INFORMATION BULLETIN ON VARIABLE STARS
Number 4273

Konkoly Observatory
Budapest
29 November 1995
HU ISSN 0374 – 0676

HD 161223 – A NEW VARIABLE IN THE FIELD OF IC 4665

At the end of June 1995 the open cluster IC 4665 was observed on seven nights with the 0.90 m telescope at Sierra Nevada observatory by means of a Strömgren six-channel simultaneous photometer. The main aim of these observations was to find γ Dor stars, a new type of long period variables located in the lower part of the Cepheid instability strip. Some of these stars have been detected before in the young open cluster NGC 2516 (Mantegazza et al., 1995) whose age is similar to IC 4665, approximately 3.6×10^7 year (Lyngå, 1981).

During this campaign about thirty stars with V<$9\overset{\mathrm{m}}{.}0$ were checked out. C1=HD 161677, C2=HD 161572 and C3=HD 161603 or Kopff (K) numbers (Kopff, 1943) K73, K58 and K64, respectively, were used as comparison stars. During these observations, the star HD 161223 (K28), with V=$7\overset{\mathrm{m}}{.}43$ (Nicolet, 1978), turned to be a new variable with a period of about 3.5 hours and amplitude of some hundredth of magnitude. This amplitude was variable from night to night. In addition, the colour indices b−y and c_1 presented also variation phased with the light curve, suggesting that this star is a new multiperiodic pulsating δ Sct star. A frequency analysis was performed on the observed *uvby* data, using the Discrete Fourier transform method, as described in López de Coca et al. (1984). As result a main period of 0.144 days was found. Figure 1 shows the observed light curve and variations in the colour indices for the night of July 2.

In order to derive its physical parameters, the photometric Strömgren indices of b−y=$0\overset{\mathrm{m}}{.}243$, m_1=$0\overset{\mathrm{m}}{.}105$, c_1=$0\overset{\mathrm{m}}{.}972$ and β=$2\overset{\mathrm{m}}{.}772$ (Hauck & Mermilliod, 1990) were used with the method described in Philip et al. (1976) using the reference lines of Philip & Egret (1980) with the appropriate corrections for gravity and metallicity (Crawford 1975, Philip et al. 1976). Thus, the following values of $0\overset{\mathrm{m}}{.}092$, $0\overset{\mathrm{m}}{.}058$ and $0\overset{\mathrm{m}}{.}225$ were obtained for the colour excess, δm_1 and δc_1, respectively. This last value of δc_1 indicates that HD 161223 is an evolved δ Sct star. With the corresponding dereddening indices of $(b-y)_0$=$0\overset{\mathrm{m}}{.}151$ and c_0=$0\overset{\mathrm{m}}{.}949$, the values for T_e=7560 K and log g=3.59 were obtained using the (log g, T_e) grids of Lester et al. (1986) for [Me/H]=0.0. Then the mass, luminosity and age of the star have been derived from the evolutionary tracks from Schaller et al. (1992) for Z=0.020. When a main sequence stage is considered, M=$2.35M_\odot$, Age=7.1×10^8 years and M_v=$0\overset{\mathrm{m}}{.}51$ were found while a mass of $2.17M_\odot$, an age of 9.4×10^8 years and M_v of $0\overset{\mathrm{m}}{.}59$ can be obtained if we place the star on post-main sequence. The position of HD 161223 in the H−R diagram can be seen in Figure 2 where are also shown the sample of δ Sct stars and the observational edges of the instability strip in the δ Sct region from Rodríguez et al. (1994). The value of Q=0.027 days for the pulsation constant was obtained, using the equation derived by Petersen & Jørgensen (1972). This value suggests that this star pulsates in the first overtone.

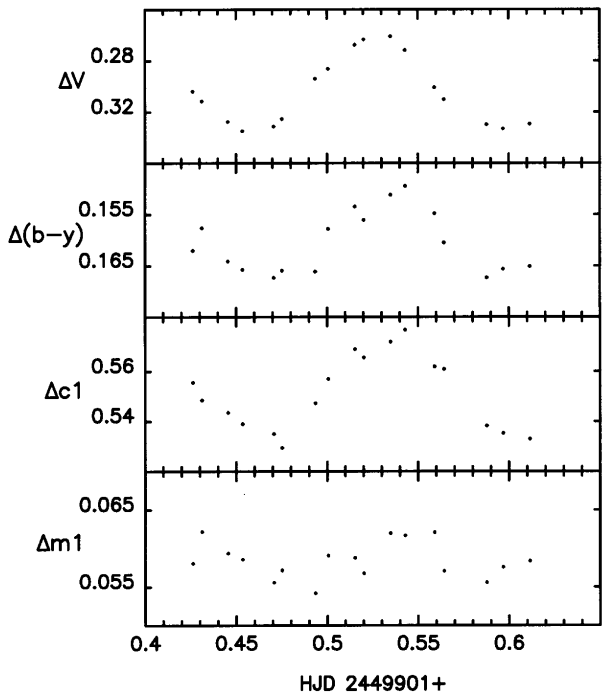

Figure 1. Differential light and colour index curves of HD 161223 with respect to C1=HD 161677 versus Heliocentric Julian Day during the night July 2^{nd}, 1995.

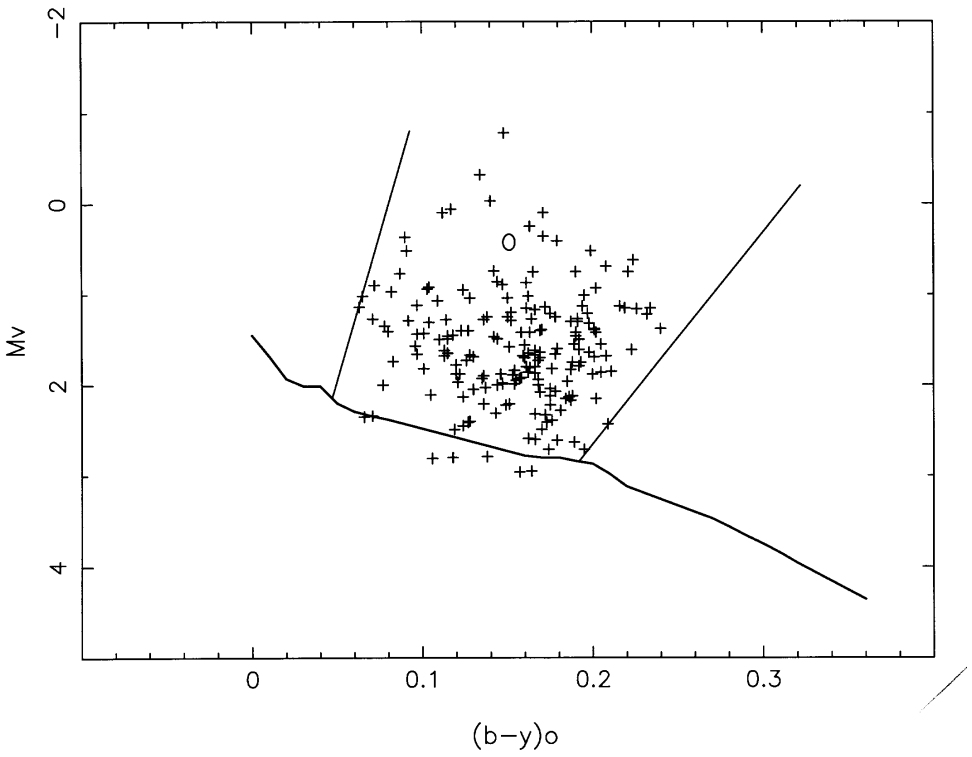

Figure 2. Position of δ Sct stars in the H−R diagram. HD 161223 is shown with the symbol O.

However, the δm_1 value obtained for this star suggests that HD 161223 is slightly deficient in metal content. In fact, using δm_1 and knowing that for this star $2^m.72<\beta<2^m.88$, the value of [Me/H]$=-0.53$ was obtained using the Smalley's (1993) calibration for metal abundances, that is, three times lower than the solar one. Furthermore, Figure 1 shows that the m_1-index varies significantly in the same sense as the light curve, indicating that the metallicity is low as compared with δ Sct stars. In fact, using the (Δm_1^*, β) grids from Rodríguez et al. (1991) for log g=3.5, $\beta=2^m.77$ and [Me/H]$=-0.5$ we find an expected m_1-index variation of about $0^m.004$ in the same sense of the light curve. This value is in very good agreement with the observed m_1 variation in Figure 1. So, taking into account these results, the real physical parameters of this star must be slightly different from the above calculated. Moreover, due to the fact that the metal content is low this star could be classified as an SX Phe star rather than a normal (Population I) δ Sct star. In this case, HD 161223 would be a field SX Phe star with the longest period known to date.

After the observations, we have revised the bibliography about the cluster IC 4665 finding that there are some reasons to consider HD 161223 (K28) as not belonging to this cluster. A study about which stars are members or nonmembers was made by Crawford & Barnes (1972). They found that this star is much less reddened and has a smaller distance modulus than the cluster average values. Moreover, the proper motion is discordant. Then, they suggest that HD 161223 does not belong to IC 4665. Furthermore, the value for the colour excess E(b$-$y)$=0^m.092$ obtained in the present work agrees well with Crawford & Barnes's (1972) results. In addition, the metal content of HD 161223 is too low as compared with that expected for the stars belonging to the cluster. In fact, the mean value of [Me/H] obtained for the members listed in the Crawford & Barnes' (1972) work is of -0.06 applying Nissen's (1988) and Smalley's (1993) calibrations for metal abundances. Finally, the age derived for HD 161223 indicates that this star is much older than the cluster.

Acknowledgements. This research was supported by the Junta de Andalucía and the Dirección General de Investigación Científica y Técnica (DGICYT) under project PB93-0134. Acknowledgements are specially made to A. López-Giménez for their help during the run of observations.

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