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Dwarf cepheid DY Pegasus—revisited

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Abstract. *UBV* broadband photoelectric photometry of dwarf cepheid DY Pegasus is presented. Using the observed light variations of this pulsating variable, mass, radius, gravity and temperature variations over a pulsational cycle have been estimated and its evolutionary nature is briefly discussed.

Key words : variable star—photometry—pulsation—dwarf cepheid

1. Introduction

DY Peg (HD 218549) is a short period pulsating star with a visual amplitude of 0.55 mag and has been classified as a member of dwarf cepheid group. But, unlike other dwarf cepheids which resemble normal pop. I stars, DY Peg is an extremely metal-poor object ($\Delta S = 6$) with a high space motion and under-luminous, something similar to other dwarf cepheid objects like SX Phe., CY Aqr. and GD 428. Pena & Peniche (1986) had reported a period of 0.07292633d for DY Peg and a period variation of $d \ln P/dt = -3.02E - 80$/yr using all earlier observations. They had estimated the $M_{(bol)}$ to lie in the range of 2.55 to 2.62 and a mass of 0.4 $M_\odot$ to 0.2 $M_\odot$ depending upon the nature of pulsation and the model adopted.

2. Observations and reduction

DY Peg was observed between 1989 and 1991 for 4 nights through *UBV* passbands using the 48-inch reflector of the Japal-Rangapur Observatory. An uncooled EMI 6256B photomultiplier was used and the output signal was recorded on a Honeywell-Brown strip-chart recorder through a DC-amplifier. *BD* +16 4878 and *BD* +16 4876 were used as comparison and check-star respectively. All observations were transformed onto the standard system through normal procedures. The adopted standard visual magnitude and colour-indices for the comparison are $V = 9.86 \pm 0.01$, $B - V = 0.60 \pm 0.02$, $U - B = 0.14 \pm 0.03$, and for the check star, $V = 11.00$, $B - V = 0.62$ and $U - B = -0.02$. The phases of the light variation were computed from the ephemeris given in the Variable Star Catalogue :

$$\text{H.J.D. (Max)} = 2444502.07044 + 0^{d}.072926297\ E.$$

Figure 1 show the light variation of DY Peg (in the sense, Var.-Comp.) through each passband. Figure 2 shows the mean V, $(B - V)$ and $(U - B)$ variations of DY Peg for all

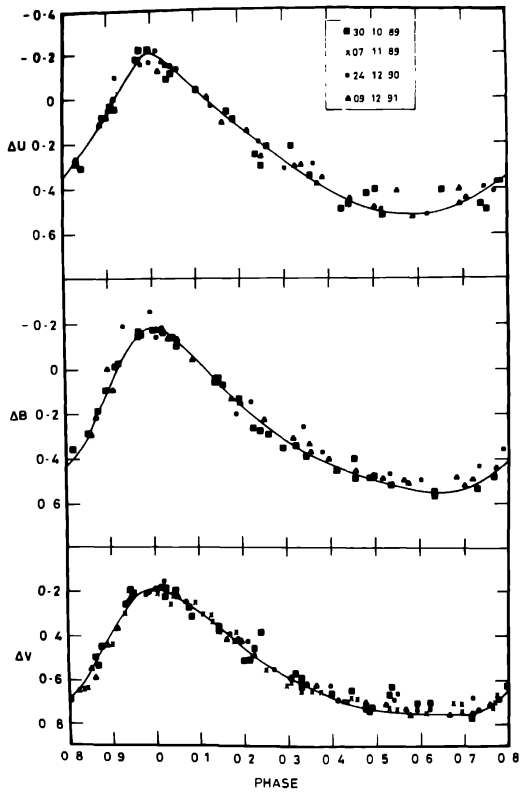

Figure 1.

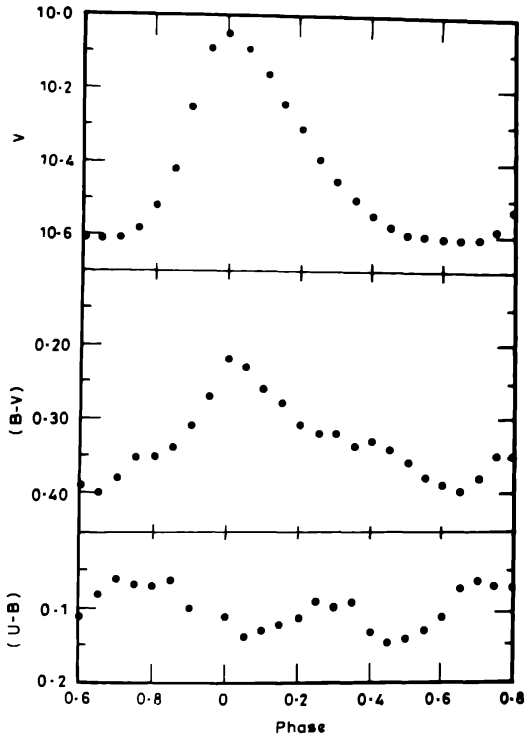

Figure 2.

observations against the phase. The observed magnitudes and colour-indices are V = 10.05 and 10.61; $(B - V)$ = 0.24 and 0.41 and $(U - B)$ = 0.14 and 0.06 at maximum and minimum light variation of DY Peg respectively. Bidelman (1947) had classified the spectral types of DY Peg at maximum and minimum as A3 and A9 respectively. From the observed maximum and minimum of $(B - V)$ index, this corresponds to a $E(B - V)$ = 0.14 and 0.12 respectively from the calibrations given by FitzGerald (1970) for main sequence stars. McNamara (1965) gave a relation $(B - V)_0 = 0.23 \log P + 0.473$ for short period, large amplitude variables and this corresponds to an intrinsic $(B - V)$ = 0.21 for the adopted period. The estimated mean $(B - V)$ index over a pulsation cycle is 0.32 mag leading to a $E(B - V)$ = 0.11. Thus, a colour excess, $E(B - V)$ = 0.11 has been adopted in the following analysis for the derivation of physical parameters.

3. Results

From the observed intrinsic $(B - V)$ = 0.13 and 0.30 at maximum and minimum of light variation, an effective temperature of 8350 K and 7200 K were obtained respectively leading to a temperature variation of (ΔT) over a pulsation cycle of the order of 1150 K.

The mean temperature over the cycle is 7775 K. Figure 3 shows the variation of intrinsic $(B - V)$ and $(U - B)$ indices over a pulsation cycle. The loop behaviour, which is normal for

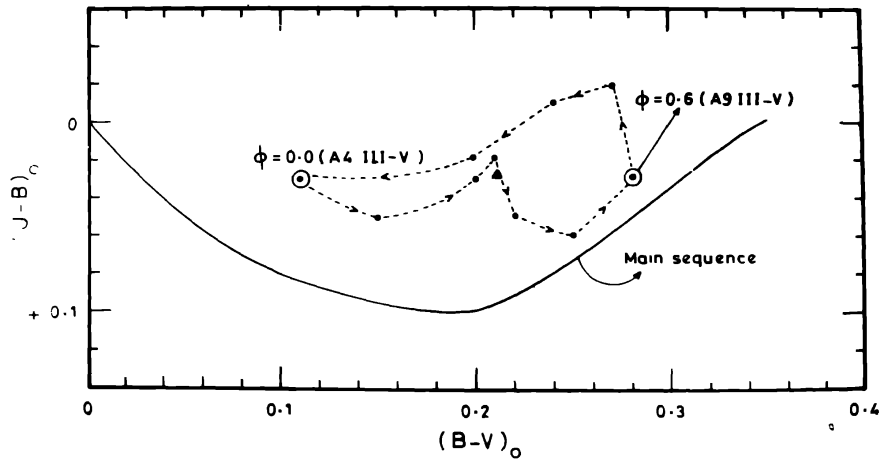

Figure 3.

this type of variables, is clearly seen. In addition, the loop lies well-above the normal main sequence relation thus, suggesting a metal-poor nature supporting earlier conclusion drawn by Preston (ΔS = 6). The spectral types derived from the observed intrinsic indices at maximum and minimum light fairly agree with that of Bidelman (1947) classification. The following physical parameters have been derived using the empirical relations given by McNamara & Feltz (1975) and compared with that of earlier derived ones (table 1).

A close look of table 1 show that the parameters <Log g>, $m/m_{\odot}$ and $M_{(bol)}$ estimated here differs from that of McNamara & Feltz, Pena & Peniche, and Burki & Meylan estimations. Further investigation is necessary to understand the state of evolution of DY Peg and similar other dwarf cepheids.

Table 1.

Parameter	Present analysis	McNamara & Feltz	Pena & Peniche	Burki & Meylan
<Temp.>	7775 ±100 K	7800 ± 100 K		7240 K
Temp. range	7200-8350 K		7400-9600 K	
$<M_v>$	2.21 ± 0.25	2.7		3.2 ± 0.5
Distance	360 pc			250 ± 50 pc
<Log g>	4.09 ± 0.2	4.0	3.60(*), 3.59(**)	
$R/R_\odot$	2.19	1.82		1.4 ± 0.4
Log Q	−1.501	−1.481		
M_v (bol.)	1.54 (±0.26)	2.1 (±0.26)	2.62(*), 2.55(**)	
Log m/L	−0.86			
$m/m_\odot$	2.14	1.24	0.23(*), 0.4(**)	

*These values were estimated with Z = 0.004 from models given by Dziembowski & Kozlowski (1974) in first order overtone.
**These values were estimated from Stellingwarf models with Z = 0.005 in second order overtone.

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