

How luminous is HD 80077?

Abstract

The B2 supergiant HD80077 seems to have a luminosity exceeding the maximum luminosity for its temperature suggested by the Humphreys-Davidson limit. However, its stability does not suggest that a return to the right of this limit is imminent. Therefore we investigated whether this star is less luminous than assumed until now. We could not find proof of this.

Introduction

The B2 Ia+ star HD80077 has been discovered as an extreme supergiant. If it is a member of the cluster Pismis 11, which seems to be the case, its luminosity would place it in the HR diagram above the HD limit. According to current ideas it must be extremely unstable so that it will shed off its atmosphere and return to the hotter parts of the HR diagram. It does not show any signs of this instability.

Stellar parameters:

Spectral type:	B2
yields T_{eff}	17000 K
V:	7.65 ^m
E(B-V):	1.54
d:	3.2 kpc
M_{bol} :	-11
$\log L/L_{\odot}$:	6.3 \pm 0.5
$\log R/R_{\odot}$:	2.21 \pm 0.25
$\log g_{\text{Newton}}$:	1.7 \pm 0.5

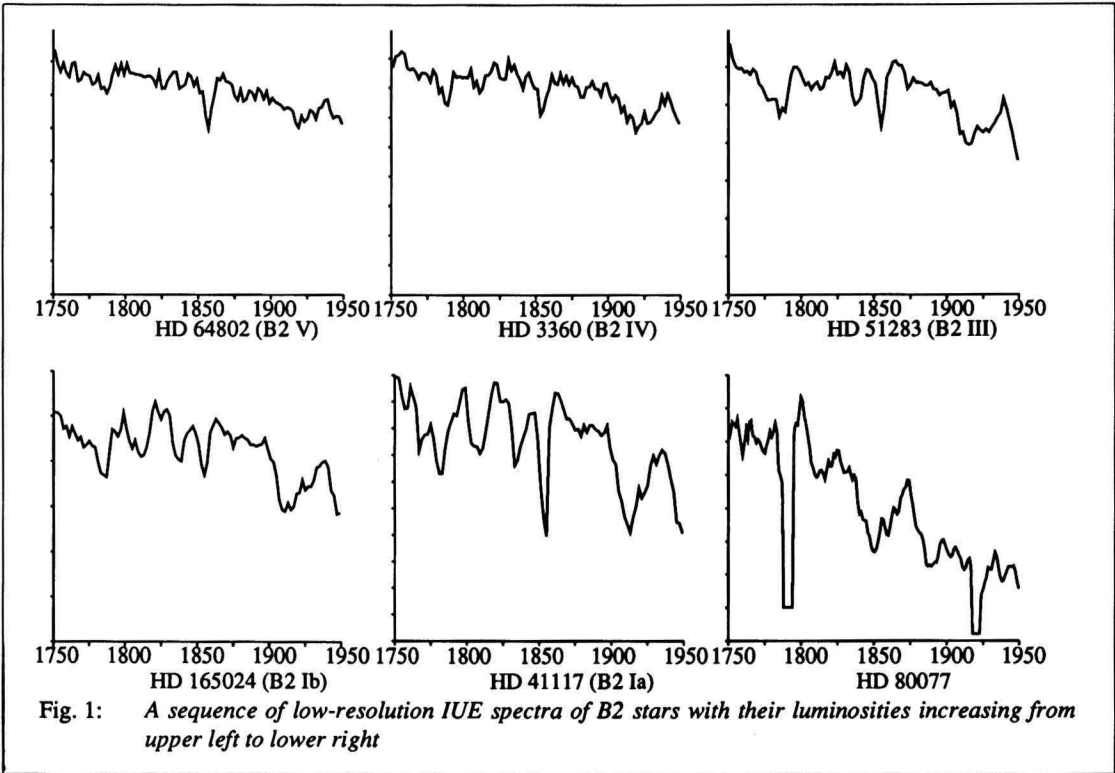


Fig. 1: A sequence of low-resolution IUE spectra of B2 stars with their luminosities increasing from upper left to lower right

Signs of (in)stability:

Mass loss rate: $5 \cdot 10^{-6} M_{\odot}/\text{yr}$, relatively small
 $\Delta V < 0.02$
(in 10 years of measurements).
P Cygni profiles only in $H\alpha$ and $H\beta$
Mass loss flux: $3 \cdot 10^{-5} \text{ g/cm}^2/\text{s}$
(cf. P Cygni: $4 \cdot 10^{-4} \text{ g/cm}^2/\text{s}$)
Very stable when compared to its neighbours in the HR diagram, the LBV' s!

The UV spectrum

Fig. 1 shows a sequence of IUE spectra of different stars, with increasing luminosity. It is clear that the "strength" of the line complexes increases with increasing luminosity, with HD80077 having the strongest absorption in this area. This indicates that the luminosity must greatly exceed that of the most luminous star in the sample, χ^2 Ori.

The visual spectrum.

Besides the Balmer lines, visible up to H_{23} , the He lines also give an indication of the extreme luminosity of this star: Fig. 2 shows the gravity dependence of these lines, calculated in non-LTE.

The equivalent widths of these lines in the spectrum of HD80077 indicate a much lower surface gravity than $\log g=2.5$.

Conclusions

All evidence suggests an extreme luminosity for HD80077, which is in contrast with its stability.

References:

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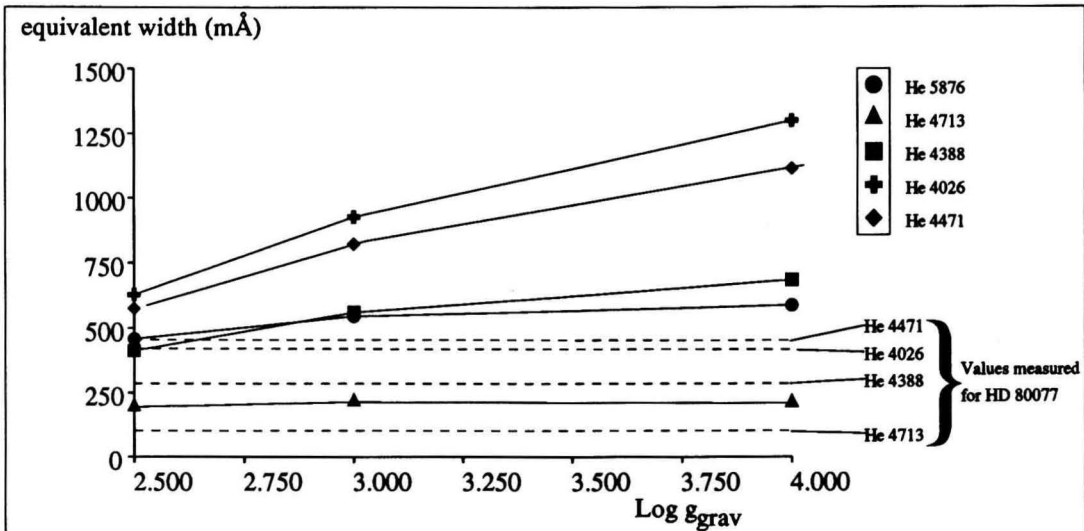


Fig. 2 The equivalent widths of Helium lines as a function for $\log g_{\text{grav}}$ calculated in non-LTE for $T_{\text{eff}} = 17500 \text{ K}$. The dotted lines are the equivalent widths of He lines in the spectrum of HD 80077.