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PHOTOMETRIC BEHAVIOUR OF Be STARS IN THE LIGHT OF RECENT ACTIVITY OF EW Lac

EW Lac (HD 217050, HR 8731, MWC 394) is a well-known shell and Be star observed now for almost 100 years. The spectrum of the star was variable until the end of the World War I. Emission and shell features appeared and disappeared several times.However, from 1926 to the end of 1977 the star was quite inactive. It exhibited a well-developed shell spectrum and double emission components of hydrogen and strongest metallic lines, with the V/R ratio always close to unity. Hydrogen shell lines are resolvable up to H42 on our 4.2 Å/mm spectrograms taken in 1973.

During the whole stable period, only mild velocity variations of the shell lines were observed - radial velocity being always in the range from -10 to -30 km/s. A detailed study of these variations (based on some 200 Ondřejov and Okayama coudé spectrograms of 1965 - 1978) is now being prepared in collaboration of Drs. Hirata and Kogure from Japan and Harmanec, Koubský, Krpata and Ždárský from Czechoslovakia.

The photometric variability of EW Lac was discovered by Walker (1953) who found cyclic variations of the V magnitude with characteristic duration of about 0.8 days and with variable amplitude. Lester (1975) detected a 0.7-day quasi-periodicity in his 1972 four-colour measurements of the star. As far as we know, any systematic study of the photometric behaviour of EW Lac on longer time scale has not been published so far.

In 1978, the shell of EW Lac has become active again. We have found a strong Balmer progression on a spectrogram taken in July 7.9, 1978, and the V/R ratio of the Hβ emission much larger than 1 on another spectrogram taken on December 5.9, 1978 (see Hadrava et al., 1978).

The purpose of this note is to present UBV photometric measurements of the star obtained during 1972 - 1978 at the Hvar Observatory, and to show that the activity of the shell was accompanied by a large change especially in the U-B index of the object. We measured the star differentially (relative to 4 Lac and 5 Lac) - always in the July - September period in the years 1972, 1974, 1975, 1976, 1977 and 1978. The measurements were carefully transformed to the international UBV system assuming Johnson's et al., (1966) values V = 4.58, B-V =+0.09, U-B =-0.34 for 4 Lac. For 5 And, we used the values V = $5^{m}.688$, B-V =$+0^{m}.433$, U-B =$+0^{m}.013$, which we derived differentially relative to 4 Lac. No measurable variations of either 4 Lac or 5 And were detected.

Our series of measurements during individual nights cover usually less than 0.2 days and do not indicate variations larger than $0^{m}.05$. Consequently, we used nightly mean UBV values to construct the U-B versus B-V diagram shown in Fig.1. Different ob-

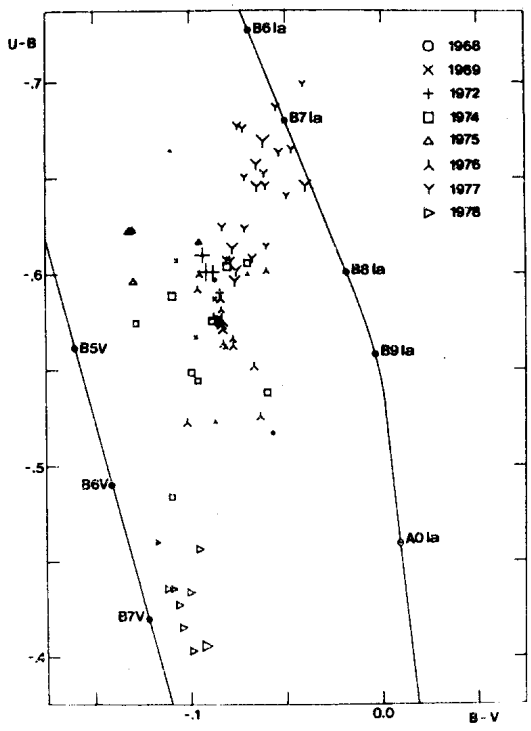

Figure 1

serving seasons are denoted by different symbols. The 1968-1969 measurements are from Haupt and Schroll (1974), corrected to our values for 5 And. Position of unreddened main sequence and Ia supergiants is also shown in Fig.1. Grouping of the points of individual seasons is clearly visible, which lends support to our conclusion that the long-term variations are much larger than the variations occurring on shorter time-scales (unless the variations are strictly periodic with a period very close to one day, which is improbable).
Similar behaviour is known also for 88 Her (Harmanec et al.,1978), BU Tau (Sharov and Lyuty, 1976), π Aqr (Nordh and Olofsson, 1977) and for some other Be stars.

Thus, we cannot agree with a recent conclusion by Percy (1979) that "it is becoming increasingly evident that the major light variations of Be stars occur on a time scale of hours rather than a time scale of days or weeks as previously believed...". In all cases known to us, the long-term light and colour variations of Be stars, occurring on a time scale of years, are the most pronounced ones. It seems that these variations and the long-term spectral variations of Be stars (appearance and disappearance of emission and shell lines) are closely connected and are therefore consequences of the same physical cause. In this sense these variable Be stars could be understood as very mild examples of reccurrent novae.

On the other hand, it is apparent from Fig.1 that also variations occurring on shorter time scales do exist and the questions such as: which is the relation between these and long-term variations or which is the relation between Be stars and β Cep variables are very exciting. What is urgently needed in this connection are longer systematic series of photoelectric observations of Be stars, which are almost lacking so far. We appeal to all photometrists securing the data for Be stars to use always differential photometry and to transform their data to international systems. Otherwise, very important information is lost.

Finally, we want to remark that the large change of EW Lac, which occurred during 1978, can be formally interpreted as if the object had changed its luminosity class from Ia to V without

changing the spectral type B7. It will be interesting to see whether this is a pure coincidence or whether this finding has some connection with the observed changes in the spectrum.

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References:

Hadrava, P., Harmanec, P., Koubský, P., Krpata, J., Žďárský, F., (1978) IAU Circular No. 3317
Harmanec, P., Horn,J., Koubský, P., Kříž, S., Žďárský, F., Popoušek, J., Doazan, V., Bourdonneau, B.,Baldinelli,L., Ghedini, S., Pavlovski, K.,(1978) Bull.Astr.Inst.Czech. 29, 278
Johnson, H.L.,Mitchell, R.I., Iriarte, B.,Wiśniewski, W.Z.(1966) Comm. Lunar Planet.Lab. 4, 99
Lester, D.F. (1975) Publ.Soc.Pacific 87, 177
Nordh, H.L. and Olofsson, S.G.(1977) Astron.Astrophys.56, 117
Percy, J.R. (1979), I.B.V.S. No. 1530
Sharov, A.S., Lyuty, V.M. (1976) in "Be and Shell Stars" (ed. by A. Slettebak),Proc.IAU Symp.No.70,D.Reidel,Dordrecht Holland, p. 105
Walker, M.F., (1953), Astrophys.J. 118, 481