SHORT TERM PHOTOMETRIC AND SPECTROSCOPIC VARIABILITY OF A SAMPLE OF Be STARS.

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1 INTRODUCTION

Previous studies of variable Be stars show that the short-term variability is a common, but not well understood phenomena. From a list of 'candidates' given by Alvarez (1980) and Schuster & Alvarez (1983) under a cooperative program between France and México, we choose some interesting Be objects to study their behaviour both in spectroscopy and photometry. We are reporting some preliminary results of our observations.

2 OBSERVATIONS

LQ And (HD 224559): m_v=6.54, B4 V_{en} is an interesting object that shows a photometric periodicity of 0.31 d.(Percy, 1983) or a double wave with a 0.62 d. periodicity (Harmanec, 1984) and a small amplitude of 30-40 m.mag. From Hubert-Delplace & Hubert (1979), we know that this star has shown permanent emission with a slow variation in the Balmer lines and Fe II lines. Sareyan et al.(1986) found that the 0.31 d. period is present in our H_α observations obtained on September-October 1983 at the San Pedro Mártir observatory. Their results give a 2K amplitude of 10-12 km s^{-1} on a broad emission line showing a V sin i$\cong$330 km s^{-1} from Ballereau et al.(1986). Harmanec (1984) gives a value of 250-300 km s^{-1} from his study. Our results give a ratio 2K/Δm between 250 and 400, that is within the range of the βCMa variables. Our 13-color photometry of this star show a variation of $\cong$ 100 m.mag in the '58' magnitude, that is consistent with the maximum variation found at different epochs of the differential photometry. From these studies it is not possible yet to invoke the pulsation hypothesis or the rotation of a spotted star, as being the cause of the observed variations. A simultaneous photometric and spectroscopic study is under way to elucidate some of the new questions posed to understand the observed phenomena.

BW Vul (HD 199140): m_v=6.56, B2 III is a classical βCMa star with a well-known period of 0.20103 d. and a large variation in amplitude ΔV$\cong$0.24 mag. Although this interesting object IS NOT an emission star, Odgers (1955) reports "at the phase of maximum star, H_α and H_β appear to be weakened, as though partially filled in by emission". Barry et al. (1985, 1986) and Alvarez & Michel (1986) found that this star shows a double maximum on its light curves, detectable at longer wavelengths than 5800 A and very clear at the IR. The first maximum is coincident with the 'stillstand' observed at shorter wavelengths and it occurs at the moment of maximum RV (that is at the time of minimum radius under the pulsation hypothesis). The second maximum of the light curve coincides very well with the observed discontinuity on the RV curve where the radial velocity abruptly changes from +100 km s^{-1} to -40 km s^{-1}. During the maximum phase

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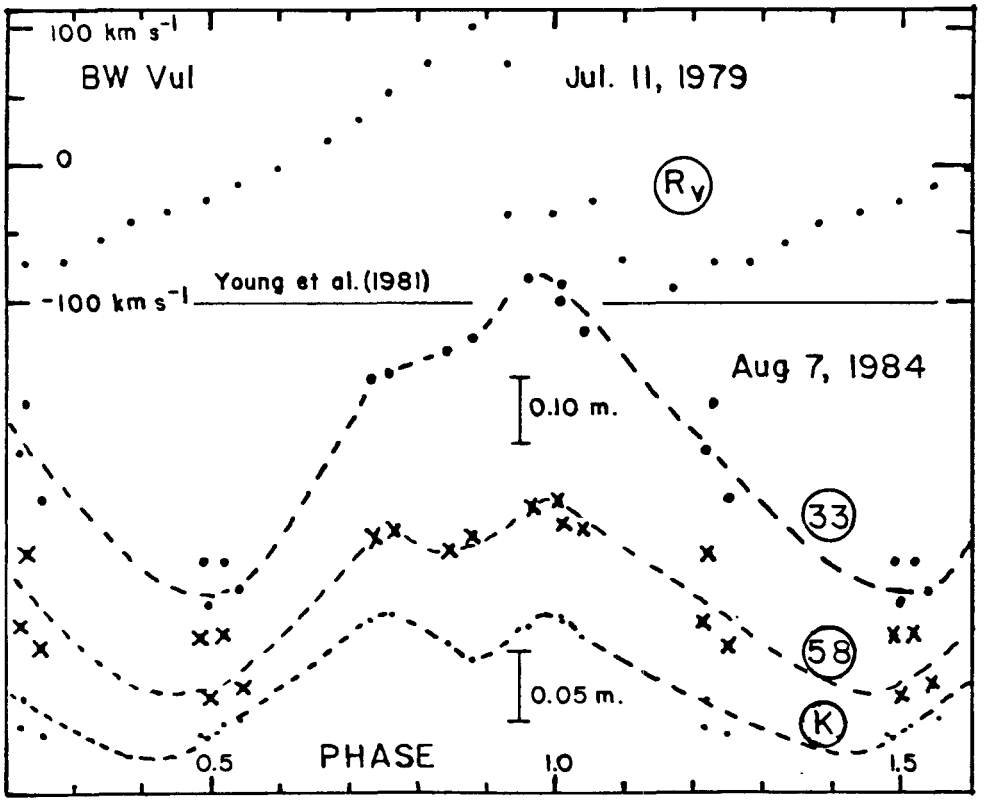

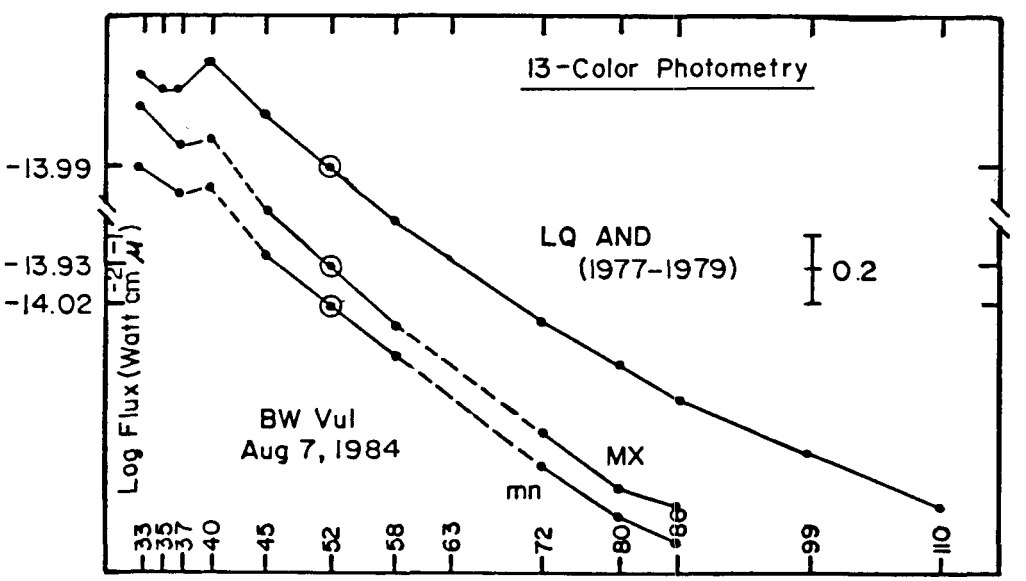

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of the star, the 13-color photometry resembles a B2 III star, while at the minimum of the light curve, Alvarez and Michel (1986) report an important deficiency at UV wavelengths and a relatively large red excess. These two effects are common signature of envelopes around B stars. These observations suggest the idea of a radial pulsation that accumulates energy while the star contracts, liberates it suddenly and due to its small value of V sin i=26 km s^{-1}, gravity dominates and the ejected 'envelope' falls back again into the atmosphere.

3 SUGGESTION

On any color-color diagram, we found that many B stars are mixed together with B_e, βCMa, etc. and there are several observational features that do not allow to differentiate between all these 'species'. There is plenty of evidence that suggest that most B_e stars vary and at certain times, they resemble 'normal' stars (without emission). Is the B_e phenomena only a stage of the life of a B star?. Is the short-term variability a common feature of the B and B_e stars? To answer some of these questions, we believe that it is necessary to continue the detailed study of these stars with new ideas and techniques. Simultaneous observations are very important and of course, the theoretical models must be revised to include the newer observational facts.

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DISCUSSION FOLLOWING ALVAREZ

Furenlid:

Pulsation in B stars appears not to contribute much to ejection of circumstellar material. Recent VLA observations by Hollis and Furenlid of BW Vul show no trace of circumstellar gas, even though BW Vul has one of the largest velocity amplitudes of the hot pulsating stars.

Alvarez:

I would like to believe that the formation of an extended atmosphere is the result of the combination of a mechanism that ejects matter into the upper parts of the atmosphere, plus high rotational velocity that helps to keep the extended atmosphere around the star. Since vsini is around 26 kms^{-1} for BW Vul, I do not expect the ejected "blob" to remain around the star. It will fall back with very high velocity as you have shown recently.

Peters:

In view of the observed long-termed and short-termed results in the light from Be stars, I would like to comment that it is important that you continue your 13-color observations. You have the ability to detect changes in the flux distribution, which might be caused by variations in the star's surface temperature. Have you searched for such variations in temperature? Any comments on μ Cen?

Alvarez:

Yes, we are continuing with our program on 13-color photometry of B and Be stars. We are looking at the "long time" and "short period" variability on a list of around 100 bright stars. Recently, we are doing simultaneous spectroscopic and photometric measurements and in some cases, we cover the observations on a longitude basis, working with our colleagues from France and Spain.

Yes, we are comparing flux distributions at different epochs in order to see the temperature variations. For example, for BW Vul that we are reporting, we can see a clear temperature change of the order of 2000 K between the maxima and minima of the light curve.

I will look on our recorder for some observations that we might have of μ Cen.

In the near future we will extend our observing program on fainter stars with new detection and larger telescopes we are developing at our observatory.

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