SPECTROPHOTOMETRY OF NOVA VULPECULAE 1984 # 1

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ABSTRACT

The spectrophotometric observations of the nova Vulpeculae, 1984, # 1 obtained at the Kavalur observatory in September 84 have been reported. Various emissions have been identified and compared with other novae. The nova appears to be in the early decline phase and falls into the category of slow novae.

Key words: Spectrophotometry, nova Vul 1984 # 1

1. INTRODUCTION

The nova Vulpeculae 1984 (#1) was discovered as a 9.2 mag object by Wakuda (Ref. 1) on July 27.711. It brightened further and reached a magnitude of 6.6 on August 2 and 6.3 on August 4. The rate of decline was very slow and there were large amplitude light fluctuations. The nova was available as an 8-8.5 mag object during September, October and November 1984. We made some spectrophotometric observations which are reported here.

2. OBSERVATIONS

The spectrophotometric observations were done by the automated spectrum scanner (Ref. 2) at the 102 cm telescope of Kavalur Observatory. The visible region was covered in two parts (4000-6000A and 5800-7800A). The exit slit was 20A 3rd September 1984 and on 19th and 20th September, it was 40A. A refrigerated EMI 9658 R was used as the detector. These scans have been standardised to the calibration of Hayes and Latham using selected standards stars.

3. RESULTS

The scans are rich in emission lines as is the case generally with novae. The scans of 19th and 20th September look smoothened out because of the larger exit slit employed. The various emission lines were identified with the help of spectra obtained close to these dates of observations. These spectra are being analysed in detail by another group (Ref. 3). The possible emissions, including the blends are indicated in the figure. The line blends of $H\delta$ and $H\gamma$ with other FeII lines are quite conspicuous. The 4640 complex has not yet reached enough strength to be easily detectable. The FeII (42) lines at 4924A and 5018A appear in all the scans although the former is sometimes lost in the red wing of $H\beta$. The other possible emissions include NII, NI, OI and CaII. The presence of SII(2) lines in the λ 6400A region can be confirmed only by spectra of better dispersions. The CaII 2 appears conspicuously in the scan of 3rd September 1984.

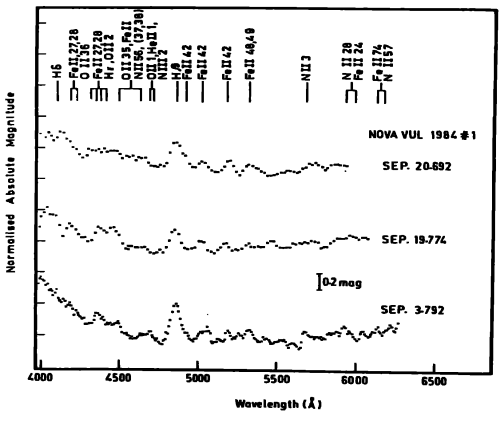

Figure 1. The scans of nova Vulpeculae 1984 in the blue region. The various emissions are indicated with the multiplet numbers.

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These scans have not been corrected for interstellar reddening, which possibly explains the excess flux towards the red regions in the continuum itself.

4. DISCUSSION

There are two striking features in these scans (1) the absence of strong absorption edges (2) the absence of forbidden and higher excitation lines.

The violet absorptions can be seen at this dispersion only if they are very strong (if the nova is in the Orion phase, see e.g. Ref. 4). The spectra taken on 5/6 September 1984 (Ref. 3) show absorptions for Hδ and Hγ and not conspicuously for Hβ. This absence thus probably implies that the nova has not yet entered the Orion phase. The absence of forbidden lines and higher excitation lines also probably indicates this. The HeII line of 4686A, HeI lines at 5876, 5411, 4471A etc. which generally appear in other novae are not noticeable in these scans. Even if they are present, they are very weak. Similarly other higher excitation lines like NIII, OII etc. which start appearing at the onset of transition and become stronger later, also are not very strong here. Hence, it is possible that this nova at the time of our observations had not been reached the transition stage. Thus these scans show the early decline phase of the nova.

The light curve can now be looked at carefully for locating the onset of transition stage. Figure 3 shows the light curve. (two other novae DK Lac and DN Gem also are shown.) A decrease of 2.5 mag in 100 days classifies it to the category of the slow novae. From the CaII K line measures Duerbeck et al. (Ref. 5) found that the distance is 1.2 kpc and they estimated the absolute magnitude as -5.5 which is fainter than the mean value of slow novae. We estimated the fluxes Hβ and Hα and corrected

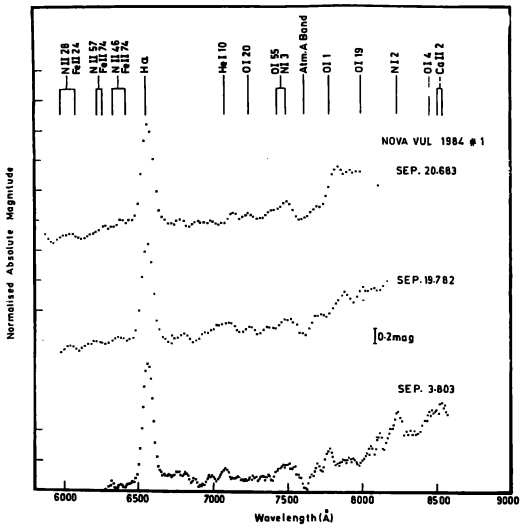

Figure 2. The scans of nova Vulpeculae 1984 in the red region. Possible emissions are indicated with multiplet numbers.

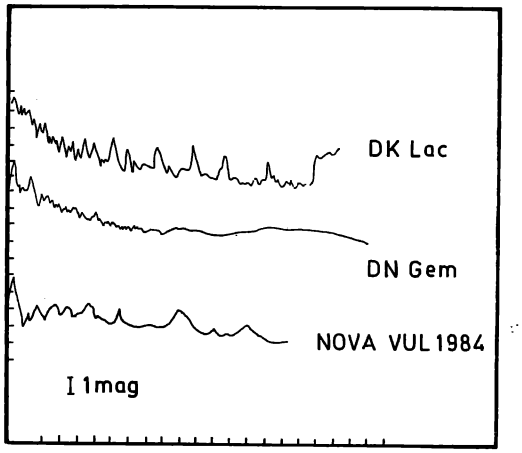

Figure 3. The light curve of nova Vulpeculae 1984 constructed from IAU Circulars and compared with light curves of other novae. The abcissa is graduated in units of 10 days and the ordinate in one magnitude steps.

it for reddening using their value of A(v) (1.4 mag) and these values also are slightly smaller compared to other novae.

The large amplitude variations in the light were seen in other novae like DK Lac, DN Gem, V603 Aql, T Aur and DQ Her (Ref. 6). The figure 3 shows only two of these novae. We see that although they show similar variations in light, DK Lac and DN Gem had a decline rate much greater than this nova i.e. they were faster. RR Pic also showed such rapid variations. Thus the present classification into the category of slow nova will have to be revised after watching the development into further stages.

DQ Her showed similar variations but the transition stage was very fast. Such quick transitions were also seen in the nova Ser 1970 (FH Ser). In this case this quick transition was associated with the appearance of IR excess.

Thus the nova Vul 1984 (#1) is interesting. The large amplitude light variations, which are usually attributed to recurring mass transfers, are seen for a longer duration, in this case. Being a slow nova this is an important case for studying the dust shell evolution. The fainter absolute magnitude and smaller values of fluxes also pose problem of classification.

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Table 1.

Fluxes of Hβ and Hα in ergs/cm^2/sec

Date	Hβ flux	Hα flux
Sep 3.792	1.70×10^{-11}	7.11×10^{-9}
19.774	2.19×10^{-11}	7.49×10^{-9}
20.692	1.68×10^{-11}	6.72×10^{-9}

6. REFERENCES

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