"TWO NEW STATES" OF VV PUPPIS

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VV Puppis, a dwarf-nova binary with a 100 min period (Herbig 1960) was observed on two occasions. On 2nd February 1979, VV Puppis was in a faint inactive state. On the other hand it was bright and active on 14th June 1979. Spectral and polarimetry observations were made on both these occasions using IDS (modified as polarimeter) at the f/15 Cassegrain focus of the 4 meter Anglo-Australian Telescope. Spectral range covered was from 3600 Å to 7000 Å with a resolution of 10 Å. The star and sky apertures both were of size 3 x 4 sec of arc and 40 sec apart.

On 2nd February 1979, 12 scans of VV Puppis were obtained. Integration time for each scan was 8 min. A visual mag V corresponding to each scan was computed by integrating the flux between $\lambda5000$ to $\lambda6000$ and plotted against the phase of VV Puppis in Figure 1. The light curve of VV Puppis reached a minimum of 17.7 mag and remained at this minimum for ~60 min. The rise to maximum was slow and was followed by a rapid drop to minimum (~17.7 mag). The sharp eclipse ingress occurred at about 0.15 phase in terms of Walker's ephemeris and is in agreement with other observers (Warner and Nather 1972, Liebert and Stockman 1979). Thus on 2nd February 1979 VV Puppis was in a normal faint inactive state.

Spectral energy distribution for the bright phase (observations from 1148 to 1158 UT) as well as the faint phase (1227 to 1310 UT) are displayed in Figure 2. The faint phase spectrum shows a flat energy distribution with emission lines of neutral hydrogen.
In contrast, the bright phase spectrum is much redder and emission lines are weak. More importantly the bright-phase continuum is dominated by broad absorption features covering the spectral regions $\lambda\lambda4100$-4600, 4600-5400 and 5400-6200. Further the faint phase spectrum shows little circular polarization while the bright phase spectrum shows +5% circular polarization.

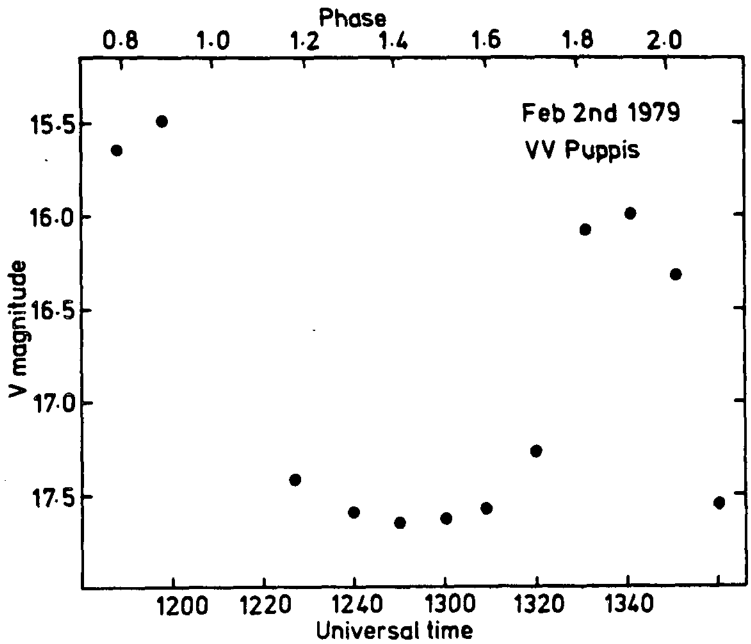

Figure 1. Light curve of VV Puppis observed during 2nd February 1979. V magnitude, obtained by integrating the flux between λ5000 to λ6000, in the IDS scans is plotted against phase given in terms of Walker's ephemeris. The time resolution of each scan is eight minutes.

The broad absorption features seen only in the spectra of bright phases are very likely associated with the gas at the base of the accretion column near the active magnetic pole of the white dwarf. From the brightness temperature consideration alone a Zeeman interpretation due to hydrogen with fields greater than 10^8G appears unlikely. An attractive possibility is that these absorption features seen in the bright phase spectra are cyclotron absorption harmonics arising from the accretion column. In that case, the features can be identified with the 6th (5800Å) 7th (4977Å) and 8th (4380Å) harmonics at a magnetic field of 3.08×10^7 G. The high circular polarization of the continuum observed at this phase supports this interpretation. The temperature of the radiating column derived by assuming that the features are broadened by the relativistic Doppler effect is 10^8 K . (Bekefi 1965). This is consistent with shock temperature expected for accretion to the white dwarf (Fabian *et al.* 1976). If this interpretation of the absorption features in the spectrum of the bright phase is correct, this would be the first time the field strength in the vicinity of a magnetic white dwarf has been determined *by other than* Zeeman spectroscopy. A detailed model is given in Wickramasinghe and Visvanathan (1979, in press).

On June 14th 1979, we found VV Puppis in a very active state with $V \simeq 13.90$. The spectrum obtained at 0826 UT is displayed in Figure 3. Strong emission lines of neutral hydrogen and helium (λ4471, λ5876) singly ionized helium (λ4686, λ5411, λ4541) and doubly ionized carbon and nitrogen (λ4647) dominate the visible spectrum. Flux ratio for Hα to Hβ, Hβ to Hγ,HeI λ4471 to λ5876 are 0.7, 1.1, and 1.1 respectively. These ratios are less compared to recombination ratios and indicate a high electron density of ~ 10^{14}

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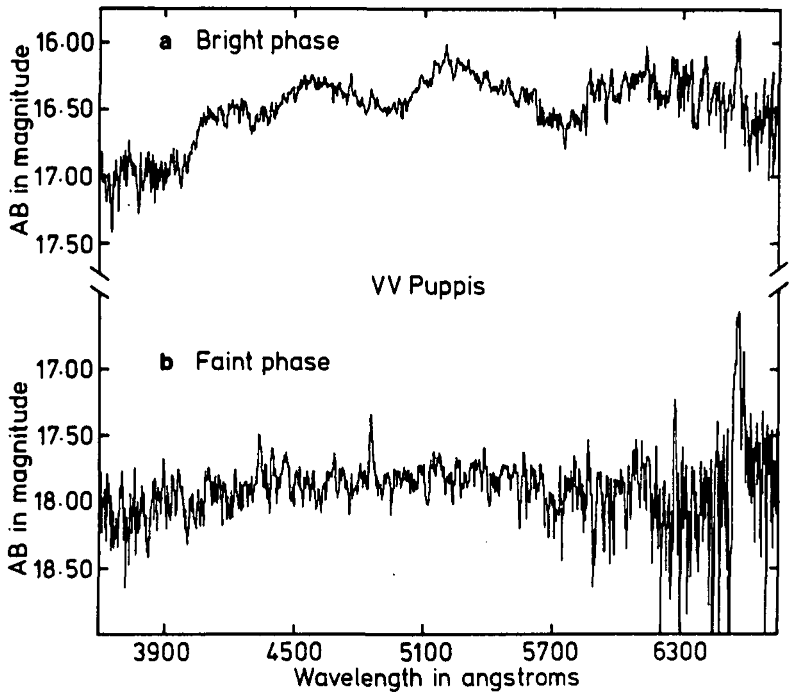

Figure 2. Absolute energy distribution of VV Puppis at 10 Å resolution on 2nd February 1979 for the bright (1148 UT to 1158 UT) and faint (1227 UT to 1310 UT) phases.

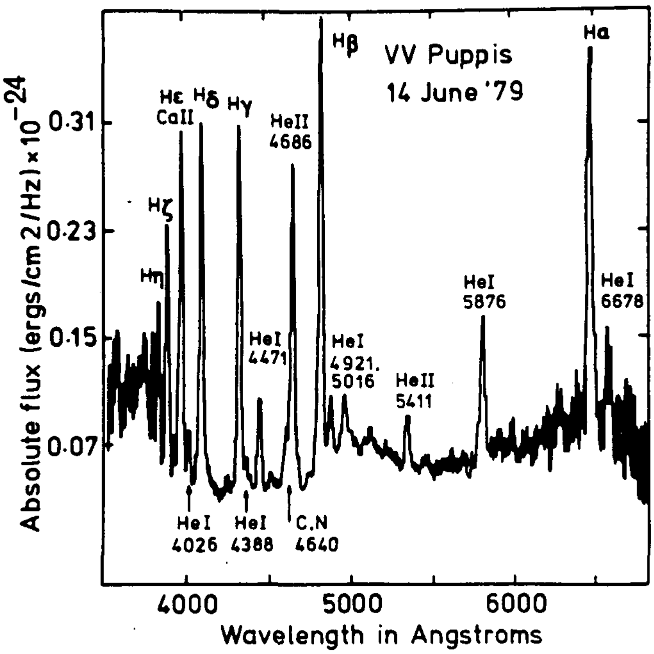

Figure 3. Absolute energy distribution of VV Puppis at 10 Å resolution on 14th June 1979.

electrons cm^{-3} and collisional excitation in the line emission region (Adams and Petrosian 1974). However, this region is optically thin to the higher excitation lines. VV Puppis has not been observed before spectroscopically in this very active phase. The spectrum at this phase strongly resembles that of AM Herculis (Stockman *et al.* 1977) and identifies VV Puppis as an AM Herculis type system. As X-rays have been observed in AM Herculis during its active phase (Hearn and Richardson 1977) we believe that VV Puppis may be detected as an X-ray source during states of enhanced activity.

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