

SPECTRAL EVOLUTION OF NOVA VULPECULAE 1976

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Nova Vulpeculae 1976 was discovered by G.E.D. Alcock (1976) on October 21, 1976 as a star of visual magnitude 6.5 in position (1950): R.A.= $19^{\text{h}}27^{\text{m}}.1$; D.= $+20^{\circ}21'$.-

The visual light curve, plotted together with the color index B-V in fig.1, was obtained using the observations published in the I.A.U. Circulars. It shows a slow fall from maximum, about 2.5 magnitudes in 60 days, with characteristic fluctuations, an abrupt drop of about 3.5 magnitudes in 24 days, a slow recovery of one magnitude in 30 days, and a very gradual decline to minimum. The color index B-V remained almost constant near the mean value +1.1 during the slow early decline.

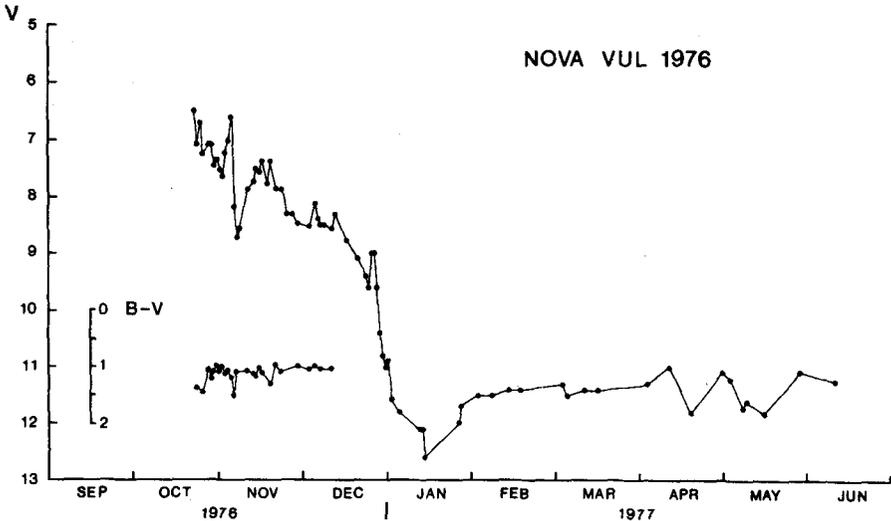


Fig.1: Visual light curve and color index B-V of Nova Vul 1976.

The first spectroscopic observations of the nova began at Asiago on October 22, when the nova was of visual magnitude 7.1. The spectrum was characterized by narrow emission lines, relatively weak over a strong continuum, flanked by a system of strong P Cyg absorptions shortward displaced, due to H, NaI, CaII, SiII, TiII, MgII and FeII. The FeII spectrum was prominent with the multiplets (49), (48), (42), (37). The mean radial velocity of the expanding layers was: $V_1 = -450 \pm 70$ km/sec.-

On October 25, when the star was of visual magnitude 7.2, the spectrum showed a strengthening and a widening of the emission lines. Two systems of absorption lines

of fairly equal intensities and partly blended with one another were measured, giving the following mean radial velocities: $V_1 = -510 \pm 40$ km/sec $V_2 = -1020 \pm 60$ km/sec. This duplicity was particularly evident in the lines of FeII 4924, 5018, 5169. The forbidden lines of [OI] at $\lambda\lambda$ 6300-6364 were weakly visible.

During the early decline the nova underwent a sudden change of brightness, with a sharp secondary maximum, $m_V = 6.6$, followed by a deep minimum, $m_V = 8.7$, attained on November 5. The spectrum secured at this latter date was characterized by the increasing strength of the emission bands of H, HeI, NII, CaII, FeII, broad and diffuse, and the weakening or disappearance of TiII emissions. The absorption components of most of the lines were no longer perceptible; to the contrary H, NaI, NII 5680 and CaII were still bordered by two systems of absorption lines of different intensity. The first, probably formed by the blend of two close systems, gives the following mean velocity:

$V_{1,2} = -750 \pm 20$ km/sec, while the second, much stronger; gives: $V_3 = -1600 \pm 30$ km/sec.-

On November 23, when the magnitude of the nova was 8.3, the spectrum showed still broad and diffuse emission bands of H, FeII, NII, HeI, CaII and NaI. The forbidden lines of [OI] at $\lambda\lambda$ 6300-6364 were stronger and a faint trace of [NII] at λ 5755 was visible. Most probably the other two forbidden lines of [NII] at $\lambda\lambda$ 6548-6583 were blended with H_{α} . Two absorption systems, associated with the Balmer lines, NII 5680, CaII and FeII (multiplet 42), were present with the following radial velocities; $V_{1,2} = -730 \pm 80$ km/sec, $V_3 = -1590 \pm 90$ km/sec, the system with the higher velocity being the strongest. All the other lines showed a diffuse absorption, due to blend of different systems.

No significant variations of the spectrum were observed on December 14 during the rapid decline of luminosity. Two systems of absorption lines were visible with the following radial velocities: $V_2 = -1100 \pm 100$ km/sec, $V_4 = -2000 \pm 100$ km/sec.

On December 30 near the deep minimum in the light curve, the spectrum showed the following striking variations:

- 1) weakening of the continuum;
- 2) disappearance of absorption features;
- 3) decreasing excitation; the strongest lines being due to: H, [NII] 5755, [OI] 6300-6364, FeII (multiplets 42,49), NII 5942, 6482, while no trace of HeI was perceptible;
- 4) saddle shaped profile of the Balmer lines and FeII at $\lambda\lambda$ 4923, 5018, 5969 with the red peak weaker than the blue. The radial velocities of the two peaks were respectively: $V_R = -360 \pm 60$ km/sec, $V_B = +380 \pm 40$ km/sec.-

After the seasonal period of invisibility, new spectroscopic data were obtained on April 25 when the nova was about 11 magnitude. The nova had entered the nebular stage. In addition to the Balmer lines, were prominent in the spectrum the nebular lines of [OIII] at $\lambda\lambda$ 4959-5007, the auroral lines of [OIII] 4363 and [NII] at λ 5755, the NIII blend at λ 4640, HeI 5875, 6678, [OI] at $\lambda\lambda$ 6300-6364; HeII at 4686, 5412 was present together with some lines of [FeVI] and [FeVII].-

A further observation in July showed a general attenuation of all the lines, the strongest ones being in order of decreasing intensity: H_{α} , [OIII] 5007, 4959, [NII] 5755, H_{β} .-

In conclusion this star has shown some remarkable similarities with nova DQ Her, particularly the presence of a deep secondary minimum accompanied by a decrease of excitation and the splitting of the lines (see C. Payne-Gaposchkin, 1957). The nova, which is now of magnitude 11.5 is still kept under observation at Asiago and further data and general discussion will be given in a successive paper.-

References:

Alcock, G.E.D.: 1976, I.A.U. 2997

Payne-Gaposchkin, C.: 1957, "The Galactic Novae", North Holland Publishing Company