THE EARLY OUTBURST SPECTRA OF NOVA V1500 CYGNI

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Nova Cygni 1975 (V1500 Cyg) was outstanding in several respects. It was the most luminous galactic nova ever observed, had the largest outburst amplitude, and had the fastest evolution with time.

The spectra, with dispersion 28 A/mm and in spectral range λλ3560-5055 A, were obtained with the CCS spectrograph on 90 cm reflector at Toruń Observatory by the research group supervised by prof. A. Woszczyk. The CCS spectrograph was equipped with the 3.5 arcsec aperture Richardson's image slicer and stars with known spectral energy distributions were observed on each night, so we were able to derive absolute energy distributions for the V1500 Cyg spectra. The calibration of the energy scale was performed by comparing synthetic B magnitudes calculated from our spectra with numerous published B photometry of the nova. The first spectra were obtained about 3^h later than spectra reported by Boyarchuk (1977) and about 6^h earlier than spectra discussed by Duerbeck and Wolf (1977); thus they are among the earliest spectra of the nova available. Simultaneously, the spectra correspond to the earliest state of spectral evolution of a nova ouburst yet observed. The pre-maximum spectral evolution of Nova V1500 Cyg is extremely fast. The spectra (Figures 1 and 2) secured on JD 2442654 are characterized by a very strong continuum and broad blueshifted absorption lines of OII, NII and CII of unusual strengths, as well as the Balmer series and HeI. The Balmer absorption lines are very weak on the first set of spectra and then grow stronger with time. The energy distribution of the first spectrum (JD 2442654.41) roughly resembles that of a B2-B3 supergiant; about 5 hours later (JD 2442654.61) the continuum can be compared with that of B8-B9 supergiant, although some excess flux in the UV region is present. Very large equivalent widths of the OII, NII and CII absorption lines in comparison to those observed in normal supergiants suggest gross overabundances of carbon, nitrogen and oxygen relative to cosmic values during the early phase of the nova outburst. The radial expansion velocity of the nova envelope derived from the HI Balmer absorption lines grew from about -1250 km/s to about -1350 km/s during the first

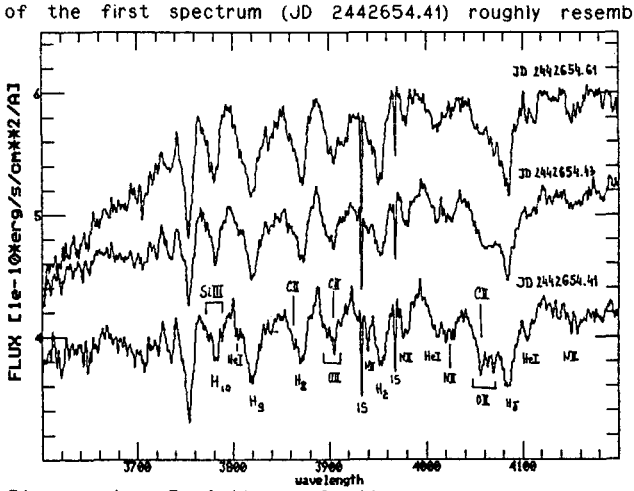

Figure 1. Evolution of the pre-maximum absorption spectrum. The flux scale of the first spectrum (bottom) has been displaced by -10^{-10} erg cm^{-2} s^{-1} A^{-1} for better presentation.

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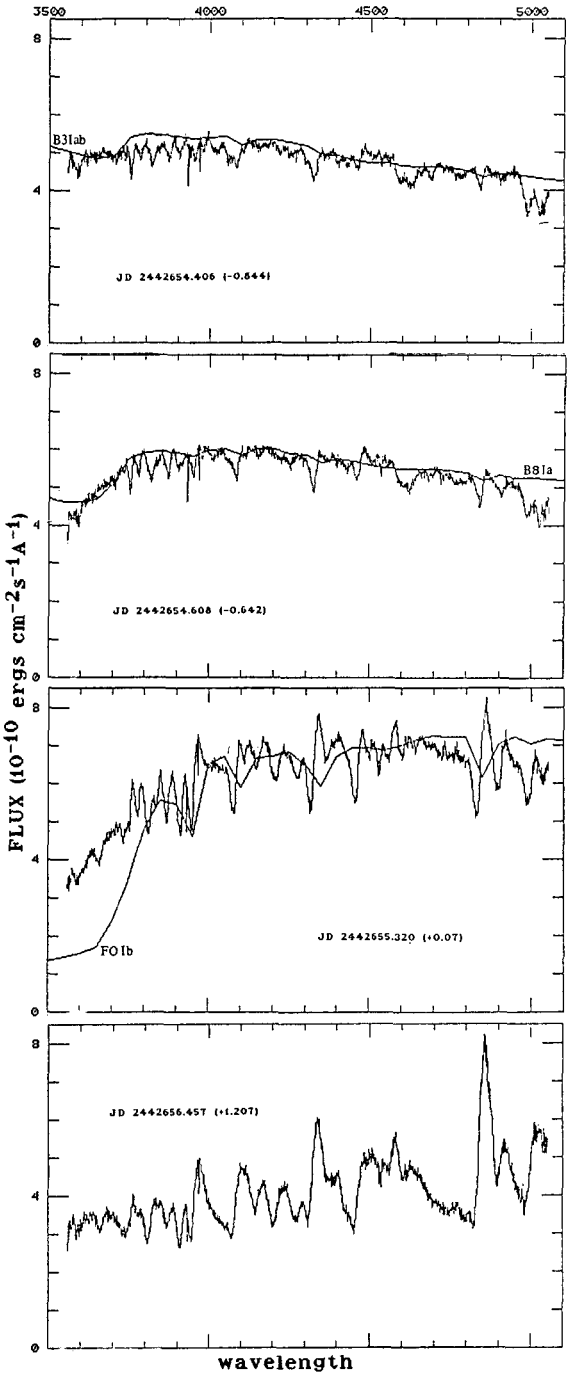

Figure 2. Absolutely calibrated spectra taken around maximum – in brackets phases (in days) relative the maximum of B magnitude. Energy distributions in the supergiants spectra are from Sviderskene (1988) with E_{B-V}=0.5.

night (JD 2442654). The expansion velocities derived from the absorption lines of HeI, CII, OII and NII were systematically lower by 100÷150 km/s relative to those obtained for the Balmer lines during the period when they were visible.

The continuum energy distribution and the absorption line spectrum around maximum (JD 2442655.30-55.60) is roughly similar to that of an F0 supergiant, although the flux blueward of the Balmer jump is contaminated by HI continuous emission (Figure 2). The spectra obtained the day after maximum (JD 2442656.30-56.61) are dominated by numerous broad P-Cygni type emission lines from the Balmer series, HeI and FeII, and it is impossible to discern any photospheric-type spectrum.

The absolutely calibrated pre-maximum spectra of V1500 Cyg presented here can be used for constructing realistic models of the nova envelope during the early stages of the nova outburst.

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