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ULTRAVIOLET SPECTRAL EVOLUTION OF V1974 Cyg USING IUE LOW RESOLUTION SPECTRA

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We investigated the spectral evolution of some normalized UV emission lines through different stages of the outburst of the classical nova V1974 Cyg using International Ultraviolet Explorer (IUE) low resolution short wavelength spectra. The emission line fluxes were calculated and used to estimate the ultraviolet luminosity of the emitting region, and the latter is used to determine the average mass accretion rate during the post-nova phase. We found an average value of the ultraviolet continuum luminosity $L_{cont} \sim 4.6 \pm 0.4 \times 10^{35}$ *erg* s^{-1} *and the average mass accretion rate* $\dot{M}_{acc} \sim 6.6 \pm 0.6 \times 10^{-10}$ $M_{\odot}$ yr^{-1}. *We used the fitted continuum luminosity to estimate the temperature of the central white dwarf, and we found an average value of* $\sim 3 \times 10^{5}$ *K. The spectral behavior is attributed to the variation in the opacity, temperature, and density of the ejecta during the different phases of the outburst. Our results are consistent with the theoretical ONe classical nova models.*

Keywords: *novae: cataclysmic variables - stars: Individual (V1974 Cyg) - ultraviolet: stars - white dwarfs*

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1. Introduction

Cataclysmic variables (CVs) are semidetached binary stars where a white dwarf accretes matter from a late type main sequence star via Roche lobe overflow through the inner Lagrangian point. Due to the high angular momentum of the falling gas stream, matter does not fall directly on the star and forms an accretion disk.

Classical novae are a class of cataclysmic variables where only one outburst has been observed. During this outburst the magnitude difference is between 6 and 19 mags from the prenova state. It is widely accepted that this outburst is a result of thermonuclear runaway of the matter accreted on the surface of the white dwarf [1].

It has been proposed that most of the mass of the envelope accreted on the surface of the white dwarf is ejected in the form of optically thick wind (see, e.g., [2,3]). The time required for a nova to decline 3 magnitudes below its visual maximum (t_3) is used to classify novae into different speed classes.

The study of the outburst of classical novae is very important in astrophysics since it provides us with an opportunity to understand the evolution of close binary systems, the nature of white dwarfs, thermonuclear runaway processes, and the hydrodynamics of the explosion.

The outburst of a classical nova can be divided into different stages. After the explosion, the "fireball phase" starts where the shock resulting from the explosion heats the ejecta which is expanding freely and cooling. During this phase the opacity is high in both line and continuum. The second stage is the iron curtain, where the cooling of the ejecta leads to the recombination of the iron peak elements leading to the screening of other lines in the spectrum. The third stage is "lifting the iron curtain," which is characterized by the retreat of the pseudo-photosphere leading to the enhancement of ionization and the disappearance of ultraviolet absorption lines. The opacity of the ejecta then decreases and semi-forbidden lines start to appear, marking the "transition stage." The nebular phase is characterized by the appearance of strong forbidden lines in emission. Then the spectrum enters the post-nova stage [4-7].

A wide range of intercombination, resonance, and forbidden lines for many elements can be found in the ultraviolet spectra of novae; some of these lines are characteristic of some of the different stages of the outburst. The study of these line provides us with an opportunity to understand the physical conditions of the ejecta and determine the elemental abundances accurately [8].

The outburst of V1974 Cyg (Nova Cygni 1992) was discovered on Feb 19th 1992 by Collins et al. [9] at a visual magnitude of 6.8 mag. It reached a maximum visual magnitude of 4.4 mag 3 days later. Its visual magnitude declined by 3 magnitudes 42 days after the maximum, making it a fast nova [10]. It is a wellstudied classical nova with multiple observations in different bands. There are some estimates of the V1974 Cyg distance. In our investigation we adopt a value of 1.8 ± 0.1 kpc, which is consistent with the distance determined from the MMRD relations and expansion parallax method [11-13]. We adopt an E(B-V) value of 0.35 mag [14].

In this paper, we present IUE low resolution ultraviolet spectra for V1974 Cyg. In Section 2 we present the spectra and data reduction. Main results are presented in Section 3. We discuss these results in Section 4. Section 5 contains the conclusions.