SPECTROPHOTOMETRIC STUDIES OF STARS AT THE TRANZITIONAL STAGE OF THEIR EVOLUTION, IN SHAMAKHY ASTROPHYSICAL OBSERVATORY

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1. Young stars with low (T Tau Type stars) and intermediate (UX Ori stars) masses

According to modern astrophysical concepts, non-stationary stars of the T Tauri type are the youngest stars in the Galaxy (their age is mainly 10^5-5.10^6 years), are in the early stages of evolution. Therefore, the study of variable stars of the T Tauri type, with the aim of discovering the mystery of the birth of stars, is one of the urgent problems of modern astrophysics.

Many works have been devoted to the study of the spectral characteristics of T Tauri stars. However, there is currently no unified model to explain the accumulated observational data. It. is mainly associated with the complexity and diversity of the very picture of variability. The relatively low apparent brightness of these stars also puts limitations on systematic spectral observations at various stages of stellar activity. In this regard, to establish the characteristic features of the emission spectrum at various stages of photometric activity (and/or at different levels of development of the emission spectrum) and to study their relationship with other characteristics of T Tauri stars, it is necessary to perform homogeneous and long-term spectral observations of these stars.

Rustamov B.N. obtained a uniform systematic series of observations of the spectra of T Tauri stars - T Tau, RY Tau and FUORs- FU Ori and V1057 Cyg, in the Cassegrain focus of the 2-m telescope of the ShAO NAS of Azerbaijan. Using a 2x2 prism spectrograph with an inverse dispersion of 94 Å/mm for Hγ and a standard diffraction spectrograph with an inverse dispersion of 75 Å/mm.

Quantitative two-dimensional spectral classification of stars is the most important method for studying the physical conditions in their atmospheres, based on spectrograms with moderate dispersion. Using this method, the equivalent line widths can be used to determine such important characteristics of the star as the spectral type and absolute magnitude.

In the work of Timoshenko L.V. [1] developed a technique: two-dimensional quantitative spectral classification of B9-F8 stars, according to spectrograms obtained with a 2-m telescope ShAO using a 2x2 prism spectrograph.

The development of a two-dimensional quantitative spectral classification of stars consists in obtaining reduction curves linking the spectral type or absolute magnitude with the equivalent width of the selected spectral lines.

B.N. Rustamov developed a technique: two-dimensional quantitative spectral classification of stars, using the same equipment, for stars of spectral class F5-K0 and luminosity classes I-V [2]. The error in determining the spectral class by this method is, on average, ±0.6 of the spectral class, and the absolute magnitude, depending on the chosen criterion, is $\pm(0.5^m$-$0.6^m)$. Subsequently, this technique was applied to a two-dimensional quantitative spectral classification of various non-stationary stars (stars of the T Tauri type, FUORs, variable young stars with non-periodic brightness decreases) [3-6].

The main results obtained from the analysis of spectral observations of T Tauri stars - T Tau, RY Tau [5,7-10]:

1. Based on a uniform, long-term (1972-1979) spectral material in the wavelength range of 3600-5000 ÅÅ, some features of the emission spectrum of the T Tau star, corresponding to different levels of development of the emission spectrum of the star, were studied. A "flash" was found in the emission lines of hydrogen and H and KCaII with a characteristic time of about 15 days. The approximately tenfold increase in the EW (equivalent width) hydrogen

lines was not accompanied by the appearance of emission in the lines of other elements. The average radial velocities along the lines of hydrogen and H and KCaII were + 60 km/s and did not show a noticeable change from night to night.

2. As a result of a comparative study of the emission and absorption of the T Tau spectra, it was found that with the enhancement of the emission in the hydrogen lines, the spectral type of the star becomes later. This observational fact indicates a correlation between the emission from the active region on the surface of the star. The 15-day quasiperiod found by us is apparently the lifetime of active formation.
3. As a result of a comparative study of the RY Tau spectra before and after the flare brightness, which occurred at the end of 1983 and at the beginning of 1984, the following features were found: after a flare with an increase in emission in Hα, the equivalent width of the Hβ absorption line decreases, Hγ and Hδ before and after the flare did not show noticeable changes. The emission in the Hα and H and KCaII lines changes synchronously. The spectral type of RY Tau did not change after the flare; before and after the outbreak, it was estimated as G0.
4. Observations carried out during the period of increased brightness of the star, in general showed the presence of all those types of H emission contours in the RY Tau spectrum, which were observed by different authors earlier, in the state of faint brightness of the star. It was concluded that the nature of the dynamic phenomena in the envelope as a whole did not change after the RY Tau flare, and the radiation flux in the Hα line increased on average.

B.N. Rustamov studied the spectral features of such unique young stars as FUORs. These objects take their name from the name of the star FU Ori, in which Herbig first discovered an unusual sharp rise in the brightness curve for 120 days at $6^m.5$. With such an amplitude, only New stars flare up, but, firstly, unlike novae, the FUORs are located in the regions of star formation and, secondly, after the outburst, the brightness level of the FUORs can remain in a bright state for a long time. To date, only a few representatives of this group and possible candidates are known.

He managed to obtain the spectra of FUOR V1057 Cyg at its lowest brightness state after the outburst, for which the exposure time in the Cassegrain focus was about 7-10 hours.

The main results obtained from the analysis of spectral observations of the FUORs stars: FU Ori and V1057 Cyg [4,6,11-13]:

1. For the first time, on the basis of a homogeneous spectral material, 2D spectral classification of FUORs: FU Ori and V1057 Cyg, in the blue region of the spectrum. Deviations in the direction of changes in the spectral type of V1057 Cyg have been found, which can be explained by fluctuations in the local temperature of the star's surface. Apparently, changes in the spectral type of FUORs do not correlate with changes in the star's brightness. The luminosity classes of the FUORs FU Ori and V1057 Cyg during the period of our spectral observations did not change within the error and were estimated as Ib-II.
2. Found a difference between spectral and photometric determinations of the absolute magnitude of V1057 Cyg. Perhaps this is due to the fact that V1057 Cyg is not a normal supergiant of the corresponding spectral type.
3. For the first time, the cover effects in the spectrum of FU Ori in the wavelength region 3900-4900 ÅÅ. A depression of the continuum in the spectrum of FU Ori was found in the wavelength range 4100-4200 Å.
4. The results of measurements of the equivalent widths of absorption lines Hβ and Hγ in the spectrum of V1057 Cyg according to spectrograms obtained in 1978-1990 showed that for the period 1978-1985 the average value of the equivalent widths of the indicated lines decreased by about two times, and for 1987-1990 showed a certain increase. Using published UBV photometry, it has been shown that since 1983 there has been a

correlation between the equivalent width Hβ and the colour index U-B, with decreasing U-B, increasing the W(Hβ) value. Based on spectral and photometric observations of 1978-1990, it is assumed that, starting from about 1984-1985. V1057 Cyg has entered a qualitatively new stage of development.

Based on the totality of these works, B.N. Rustamov in 2003 defended his Ph.D. thesis on the topic "Spectral study of T Tauri stars and FUORs" [6].

At present, under the leadership of B.N. Rustamov is engaged in the study of young stars Sabina Mammadova, Vusala Alieva, Shabnam Agaeva. Sabina Mammadova in 2018 defended her Ph.D. thesis on “Spectral and photometric features of the UX Ori-type WW Vul star” [14].

Rustamov B.N., together with colleagues, in recent years have carried out the following works: on the basis of published data of UBV photometry 1978-1998. [15,16] and from the electronic database [17], according to the average data for each season of gloss values and colour indices, the behaviour of the colours of FUOR V1057 Cyg was analysed. Anomalous behaviour of the dependence of the colour index (U-B) on the value of V was revealed [18]. As V brightness decreases, (U-B) increases, but, at certain brightness values, begins to decrease. A similar behaviour of the (U-B) versus V dependence was found for UX Orion (UXOR) stars [see eg. 19.20]. Apparently, this observational fact can be considered as an indirect argument in favour of the physical "kinship" of UXOR and FUORs. There is an assumption that UX Orion stars are evolved T Tauri stars that have passed the stage of FUOR flares [21].

The study of dynamic processes in the immediate vicinity of young stars is a great interest for understanding the physical phenomena occurring at the early stages of their evolution, since it is in these regions that planets and planetary systems are born from the primary matter of protoplanetary disks.

To study these processes at the Shamakhy Astrophysical Observatory, spectral and photometric observations of a group of young stars are carried out, selected so that it is possible to study the influence of the inclination of the circumstellar (CS) accretion disk to the line of sight on the character of spectral and photometric variability - the so-called UX Orion stars (UXORs).

UX Ori stars are unique natural laboratories for studying the interaction between a star and a circumstellar accretion disk. Due to the special orientation of the circumstellar accretion disks, the UXOR radiation passes through the circumstellar disk before the observer and is partially absorbed in it. For the purpose of establishing the physics of the phenomenon, it is highly desirable that spectral observations of these stars be accompanied by photometric observations.

One of the distinctive observational features of these stars is the non-periodic, algol-like weakening of brightness.

For the period 2006 – 2010, during 24 observation nights, the spectra of one of the remarkable representatives of UX Orion-type stars - WW Vul were obtained, in the wavelength range λλ 4700 - 6800 ÅÅ, in the Cassegrain focus of the 2-m telescope of the Shamakhy Observatory, on an echelle spectrometer using a CCD camera 580x530 pixel (with a dispersion of 10.5 Å/mm, for Hα, R = 13600) [22-24].

Based on the homogeneous spectral material, the behavior of the spectral features of a UX Ori-WW Vul star in the extreme state of its brightness was studied. During the period of our spectral observations (2006 - 2010), there was a brightness eclipse (2008 - 2010) of the star in the V band (visual) [25]. A statistical analysis of the behaviour of the intensity ratios (V/R) of the emission components of the Hα line in the WW Vul spectrum was carried out, based on 114 spectra, of which 24 were obtained by us in the period 2006-2010. [23,24,26-28], and using the published data for the period 1972-2003 obtained by different authors [20,29-33]. In the vast majority of cases, the intensity of the blue emission peak is less than the intensity of the red component (V/R <1), in many cases V/R≈1, and only in isolated cases V/R> 1 (10 profiles out of 114). This, apparently, indicates that the regime of non-stationary outflow and / or ejection of matter with variable power in the WW Vul star as a whole persists for almost 40 years and occasionally the accretion of gas from the circumstellar disk onto the star's surface is observed [14, 26-28, 36].

At four dates (July 8, 2006, August 17, 2008, June 13, 2010, and August 2, 2010), the second emission component was detected on the blue wing of the Hα line in the spectrum of WW Vul. The radial velocities of these components, measured using two spectra during the night of 07/08/2006, turned out to be equal to -280.05 km/s and -290.24 km/s, and for other dates they had the values: -256.88, -294.36, -217.5 km / s, respectively [23, 24].

2006 - 2008 (before the eclipse) the D1, D2NaI doublet line is a blend consisting of components: interstellar extinction and strongly variable, predominantly red (sometimes blue) shifted, weak absorption components of circumstellar origin. In 2010 (after the eclipse), a narrow interstellar component is clearly distinguished, and the circumstellar absorption is enhanced and is present on the blue wing of the interstellar absorption [14].

Some correspondences were found between the radial velocities of the D1, D2 NaI line and the central absorption of the Hα line, indicating that the sodium doublet line is formed in a relatively hot and dense gas, i.e., in the region of formation of the Hα line. According to the known ratio of equivalent widths [$W\lambda$ (D_2/D_1)] of the sodium doublet line, a change in the optical depth of the circumstellar medium is observed. On average, it is about unity, which indicates optically thick media at the wavelengths of the sodium resonance doublet [14].

In 2006, 2008 and 2010, during the period of our spectral observations, the λ5876 HeI helium line has an absorption profile with a complex structure and broad emissions on the blue wing of the line, and demonstrates rapid variability of both absorption and emission components. In August 2007, the line of helium λ5876 HeI is practically not visible in either emission or absorption. This, apparently, indicates that this line is formed in a limited volume and sometimes the radiation of this line is screened by the accretion disk. In August 2010, after the above-noted eclipse, both absorption and emission components increased [14].

A change in the spectral variability mode (by the lines: Hα, Hβ, D1, D2 NaI, HeI λ5876 Å) was revealed in the WW Vul spectrum in 2006 (before the eclipse) and in 2007 (the beginning of the eclipse) and 2010 (after the eclipse). On August 2, 2010, emission components were found in one spectrum on the blue wing of the Hα (second) and Hβ lines; blue-shifted absorption wind components appeared in the sodium doublet lines; in the HeI λ5876 Å line, both the absorption and emission components on the blue wing are noticeably enhanced. [14].

Apparently, in August 2006, the dominant role in the behaviour of spectral variability belongs to the rotation of the accretion disk, as in the case of a UX Orion-type star RR Tau ([34, 35]), we have a two-component Hα line profile with V/R ≅ 1. In the observation seasons 2007 - 2010. Along with the rotation of the accretion disk, an additional mechanism appears, leading to rapid changes in physical conditions in the region where these lines are formed. Such a mechanism can be the magnetic field in the accretion disk and/or on the star's surface, which determines the nature of the interaction between the star and its environment. [26-27, 36].

The results of theoretical studies on modelling physical processes occurring in young stars with small and intermediate masses indicate that the duality factor should be taken into account when interpreting observational data. In this regard, the spectral features of selected binary stars of the UX Orion type are currently being analysed on the basis of the highly dispersive spectra obtained with the 2-m ShAO telescope.

2. **Symbiotic stars: AG Dra and CH Cyg**

Symbiotic stars are spectrally resolved binaries in which one of the components is a red giant and the other is a white dwarf. At present, more than 200 symbiotic stars are known; according to some estimates, their number in the Galaxy may reach 30,000. Through the stellar wind, matter is accreted from a cold star into a hot star and an accretion disk is created around the compact star. Symbiotic stars reflect one of the stages in the evolution of binary systems.

In symbiotic stars, there are short-term glow, characteristic of cataclysmic stars, which disappear immediately after flares. If we take into account that the source of the glow is the accretion disk, then we can say that symbiotic stars play the role of a transition from a binary system to a state with an accretion disk.

In the spectra of symbiotic stars, as in the spectra of planetary nebulae, forbidden lines and Raman scattering are an evolutionary indicator between these stars and protoplanetary nebulae. Symbiotic stars represent the last stage in the evolution of binary systems. The limited number of symbiotic stars indicates the short duration of this stage. From this point of view, the study of symbiotic stars as the last stage of binary systems is of great importance.

In symbiotic systems, a directed eruption of matter (jets) occurs, typical of young stars, double X-ray stars, and the nuclei of active galaxies. Symbiotic stars are a good natural laboratory for studying these processes.

Studies of symbiotic stars at the ShAO were started by Kh. M. Mikailov, since 1983 [37-39], and since 1998 [40-51], he has been conducting regular spectral observations of symbiotic stars using modern radiation detectors - CCD matrices. Kh. Mikailov obtained a uniform systematic series of observations of the spectra of symbiotic stars: AG Dra, CH Cyg, AG Peg, etc.

The main results were obtained from the analysis of spectral (Zeiss2000) and photometric observations (Zeiss600) (1983-2008) of symbiotic stars: AG Dra, CH Cyg [37-46]:

1. As a result of observations of the star AG Dra in 1998-2001 on echelle the spectrometer at the Coude focus of a 2-meter telescope revealed changes in the radial velocities of absorption lines with a period of 756 days in the spectrum, and also refined the long period found for the radial velocities, equal to 5650 days.
2. Based on 40 spectra of the symbiotic star AG Dra obtained in 1983, the emission lines of hydrogen (Hα Hβ Hγ) and He II 4686 were investigated using the classical method on UAGS and 2x2 two prism astrospectrographs at the Cassegrain focus of a 2-meter telescope and changes in the equivalent widths of these lines were revealed. On the basis of published data in a wide spectral range, the energy distribution curve for the star AG Dra was constructed, and the Balmer decrement was determined taking into account interstellar absorption.
3. Comparison of spectral materials obtained in 1983-1987 at the classical spectrograph of the 2-meter ShAO telescope with photometric observations of the AG Dra star in a wide spectral range made it possible to propose a phenomenal model for the AG Dra system. According to this model, the symbiotic star AG Dra is a binary system consisting of a calm K3 giant and a white dwarf. Around the white dwarf, there is an accretion disk that feeds on the stellar wind of the cool star. Both components of the spectral line were observed. The likely system parameters are as follows:

$MgK = 2.8\ M_\odot$, $Ma.c = 1.0\ M_\odot$, $\dot{M} = 5\ 10^{-8}\ M_\odot/year$,
$a = 440\ R_\odot$, $Rdisk = 6\ R_\odot$, $Vorb = 30$ km/s.

4. As a result of photometric observations of the symbiotic system AG Dra in UBVR filters 1994-1995 on the ZEISS-600 ShAO telescope. In June 1994, a flare was detected on the star. The flare amplitude of the AG Dra symbiotic system in the UBVR filters reached magnitudes $2^m.9$, $2^m.2$, $1^m.4$, and $0^m.6$, respectively. The outburst grew for 18

days and for about 130 days the star was in a state of maximum activity. The next outbreak of the AG Dra system was observed in August 1995. The V-band flare amplitude was ~ 1^m magnitude. During a powerful flash, the ultraviolet radiation flux increased 15 times. Revealing the largest amplitude change in the U filter proved the connection of the AG Dra system with the hot component.

5. Analyses of spectral materials obtained in 2004-2008 on the echelle spectrometer of the 2-meter telescope ShAO for the star AG Dra in various extreme states (low activity, average activity and during an outburst) show that there is a very complex and ambiguous relationship between the star's brightness and the structure of the emission line profiles, as well as its main parameters. During a weak and powerful flash, the appearance or disappearance of certain lines is explained by a change in the ionization mode.
6. Based on spectral observations of the star CH Cyg carried out in 1998-2001, in the spectrum of the star, for the radial velocities of the Hα line components, as well as the relative intensities, periodic changes with periods of 1350 and 100 days were detected. These periods are in good agreement with the periods of brightness change obtained by other authors.
7. The appearance of elements of activity (double peak of deep central absorption of the Hα line, the appearance of the HeI and FeII lines) during a sharp increase in the brightness of the star CH Cyg.
8. In symbiotic stars, the change in radial velocities is complex character. The absorption lines characterize the main component, the cold giant, of the symbiotic system. Therefore, the study of radial velocities from absorption lines makes it possible to reveal the orbital motion in the system. Based on the literature data, as well as the data obtained from observations at the ShAO, on the basis of a 40-year period for the symbiotic star CH Cyg, a curve of the dependence of the radial velocities of absorption lines on the Julian date was constructed. Our observations made it possible to clarify the meaning of the long period and 5650^d was found for this period. In addition, a shorter period was identified, equal to 756^d. Thus, the giant star completes 756 diurnal oscillations in its 5650 diurnal orbital period. That is, approximately 7.5 fluctuations are made in one period. The radial-velocity curve of emission lines plays an important role in determining the orbital parameters and mass of the hot component of the system. In the spectrum of the symbiotic system CH Cyg, emission lines in the optical region are not always observed; they appear during the period of the star's activity and have a complex structure (for example, HeI). Relatively low ionized emission lines (lines of once ionized metals) under the action of radiation from the hot component appear in the atmosphere of the red giant, and therefore their radial velocity curves characterize not the hot component, but as absorption lines orbital motion of the cold component.
9. Radial velocity measurements from absorption lines confirm the presence of two periods ($P_1 = 5650^d$ and $P_2 = 756^d$), which indicate the triality of the Cygnus CH system. Some elements of the system's orbits are calculated. The radial velocities and other parameters of the Hα emission line indicate the presence of ~ 1350 day time changes, which were indicated by photometric measurements by Mikolaevsky et al. [52]:

Based on the totality of these works, Kh.M. Mikailov in 2010 defended his Ph.D. thesis on the topic "Creation of echelle spectrometers and spectral study of symbiotic stars" [46].

At present, under the leadership of Kh.M. Mikailov. is engaged in the study of symbiotic stars Aysel Rustamova, Arzu Orudzheva and Ruslan Mamedov.

In spectral and photometric, behaviour, quiet and active phases, as well as the revealed sets of periods for the radial velocities and brightness of the system, CH Cyg is unique and differs greatly from other classical symbiotic stars. The CH Cyg light curve changes on different time scales: from several minutes (blinking during the active phase), hundreds of days (pulsation and rotation of the M giant), and up to tens of years (orbital motion of the components in the system) [52].

Starting from about 2010, the brightness of the star in the U rays gradually and slowly increases and at the end of 2014 reaches a value of about 7^m-8^m. Along with the synchronous increase in the brightness of the star in the U and V rays, the remarkable photometric and spectral changes taking place in 2014-2015. leave no doubt about the entry of CH Cyg into the next active phase. In the active phases of the symbiotic system, a very complex kinematics develops in the circumstellar medium, as a result of the interaction between the binary system and the circumstellar matter. The variability of the regime of accretion and ejection of matter manifests itself in the form of various kinds of changes in the profiles of the Balmer lines of hydrogen.

In the active phase of a star, when a white dwarf emerges from an eclipse, it is distinguished by high activity in the form of irregular flares, accompanied by outflows of matter at a high speed; a sudden increase in the brightness of the system in a short period of time is observed - a flicker of brightness.

At 15.07.2015. in one night for 6 hours, with exposures of 20 min, 14 echelle spectra of the symbiotic star CH Cyg were obtained at the Cassegrain focus of the 2-m telescope of the Shamakhy Observatory on an echelle spectrometer using a CCD camera of 580 × 530 pixels with a dispersion of 10.5 Å/mm at Hα (spectral resolution R = 14,000) [42].

From the analysis of these spectra, we have established the following provisions [51]:

In a time interval of ~ 6 hours, from spectrum to spectrum (exposure time of each spectrum is 20 minutes), the blue emission component undergoes rapid changes. The intensity ratio of the blue (V) and red (R) components (V/R) along the profiles of the Hα and Hβ lines decreases synchronously for about 2.5 hours, and then increases for about 3 hours and reaches the previous value.

For the first time, we found that with changes in the V/R ratios of the blue emission component of the Hα and Hβ emission lines, the following occurs synchronously:

a) changes in the intensity of the HeI λ5876 line. The central intensities and equivalent widths of the HeI λ5876 line correlate with similar data on the blue emission component of the Hα lines.
b) changes in the equivalent widths of the blue emission component of the Hα and Hβ lines.
c) changes in the intensity of high-speed broad absorption components on the blue wing of the Hβ line. During observations, at the beginning for 2.5 hours, with a decrease in V/R ratios, the intensity of absorption components increases, and for the next 3 hours, with an increase in V/R ratios, the intensity of absorption components decreases.

High-speed wide absorption features with a complex structure were found in the blue wing of the Hβ emission line, with radial velocities along the absorption centers approximately: - 700 km/s; - 1250 km/s; and - 1900 km/s. Changes in the intensity of absorption components occur inversely to changes in V/R ratios.

The radial velocity of the NaI D1 absorption component approximately corresponds to the radial velocity of the blue component (~ -100 km/s), and the radial velocity of the emission component of the NaI D1 line is close to the velocities of the R component of the Hα and Hβ emission lines.

The rapid spectral changes we found in the spectrum of CH Cyg are apparently associated with scintillations in the optical brightness of the star, which is characteristic in the active phase of the system.

One of the observational manifestations of the activity of astrophysical objects with a compact companion is high-speed jet, the so-called jet (JET) ejections. These highly collimated jet ejections were found not only for relativistic (active galactic nuclei, microquasars, gamma-ray sources, radio pulsars, etc.), but also for non-relative (young stars located before MS, Herbig-Haro objects, symbiotic stars, etc.) objects. This, apparently, indicates that we are dealing with one of the universal and rather effective mechanisms of energy release of astrophysical objects -

from a protostars to black holes and quasars. Therefore, this phenomenon is considered the key to understanding the essence of the physical processes occurring in the widest class of astrophysical objects with a compact component.

Symbiotic stars are interacting binary stars in which a hot white dwarf (WD) orbits a red giant star and captures material from the wind of the red giant (RG). Because WD is compact (roughly the size of Earth, but two hundred thousand times more massive), it has a strong gravitational field and can capture more wind than would otherwise reach WD directly. As the wind accretes, material falls towards the WD, it accelerates and heats up, and energy is released. In some symbiotic binaries, accreted material can form a disk around WD.

In the case of symbiotic stars, the material for accretion onto the compact object comes from the second component, the red giant. However, not every symbiotic star is a source of jets. There are about 200 symbiotic stars known to date, only 10 stars have jet ejections. What parameters it depends on is still unknown. The speed in jets of symbiotic stars reaches several thousand km/s.

In 1990, at the time of the increase in brightness, the Bulgarian astronomer T. Tomov detected hydrogen absorption lines in the spectrum of the symbiotic star MWC 560, indicating the movement of matter at a speed of about 6000 km/s. In terms of the spectrum, these absorptions can only belong to a collimated ejection moving along the line of sight and therefore projecting onto a hotter source of the continuum, presumably a white dwarf or accretion disk, due to which the ejection manifested itself in absorption. It is an exceptional case that the orientation of the jet is exactly along the line of sight and the jet manifests itself not in emission, but in absorption of radiation.

At present, the structures of nonrelativistic Jet absorptions of the symbiotic star CH Cyg are being investigated on the basis of homogeneous highly dispersive spectra obtained with the ShAO 2-m telescope.

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