V1219 Cyg - a YSO showing deep fades

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Summary

Within a search for outbursts among variable stars of Orion type by comparing DSS and DSSII images, V1219 Cyg was identified as potential candidate. While modeling its SED, the 2MASS magnitudes turned out to be too faint by about 3 mag. The NIR fluxes derived from the UKIDSS images are consistent with SED models, and confirm that the object was ***much dimmer*** during the 2MASS observations. Thus, instead of hinting at an outburst, the initial find points to a ***previous*** fading during the DSS epoch. We characterize this interesting YSO using new observations performed with the Tautenburg 2-m telescope as well as a wealth of archival data.

V1219 Cyg – current knowledge

The object was announced as Sonneberg variable star No. 10 077 [1], situated in a dark cloud close to ν Cyg. Irregular brightness variations of ~1mag were reported which are still present as confirmed by the Optical Monitoring Camera (OMC) of the INTEGRAL satellite (Fig. 1) [2].

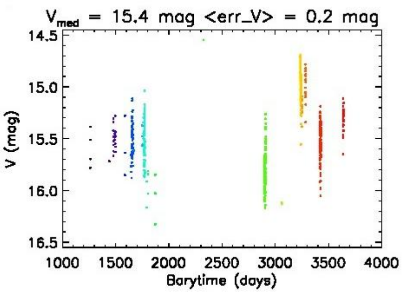

Fig.1 - OMC light curve

The presence of Hα emission [3] led to the detection of V1219 Cyg by IPAHS [4]. Subsequent works considered it to be a candidate symbiotic star [5] or a young planetary nebula [6]. The latter paper pointed at Hα reflection nebulosity around the star. The object was covered by our narrow-band survey for Herbig-Haro (HH) objects performed with the Tautenburg Schmidt telescope. Our imaging in 2005 revealed a candidate bipolar HH flow, and more possible HHOs across the parent dark cloud TGU H497 P7 [7]. V1219 Cyg was studied in more detail after we identified it as outburst candidate among stars of Orion-variable type. The comparison between DSS and DSSII (Fig. 3) showed a brightening of ~3.5 mag in R based on USNO-B1 magnitudes.

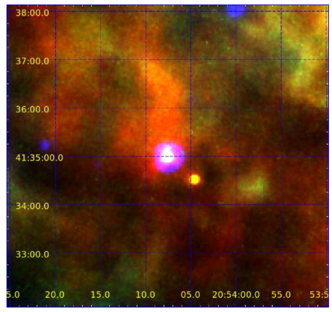

Fig.2 Color image based on WISE (12μm) and Herschel-PACS frames (100, 160μm).

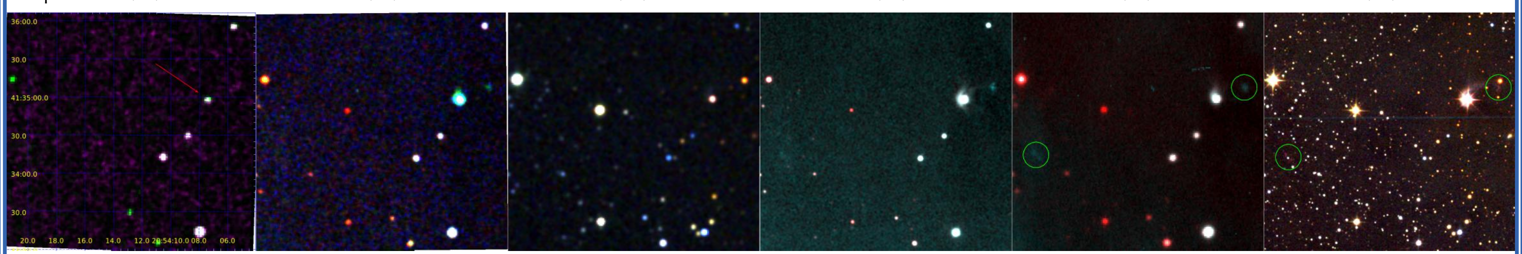

Fig.3 -temporal sequence, from left to right: DSS (arrow points to object), DSSII, 2MASS, SDSS, Tautenburg Schmidt (Herbig-Haro objects encircled), UKIDSS (circles comprise H_2 emission)

Properties of the young star from SED fitting

In order to derive quantities of the YSO its SED was established, and analyzed using the Robitaille web fitter [8]. To our surprise the fit failed because of deviating 2MASS fluxes (Fig. 4). Obviously, the object experienced another deep fade during the 2MASS epoch. NIR fluxes for the bright state were derived from UKIDSS, taking non-linearity due to saturation into account. The ten best models suggest a stellar mass of 1.5...3.5$M_\odot$ and an age of 10^6..10^7yr. All are pure disk models, typical for Class II sources, with inclinations ≤75°. The direct view onto the star is also indicated by the absence of SiO absorption. The distance amounts to 500...700pc. The period of a circular orbit within 15...20AU matches the epoch difference of 44yr between the two dim states.

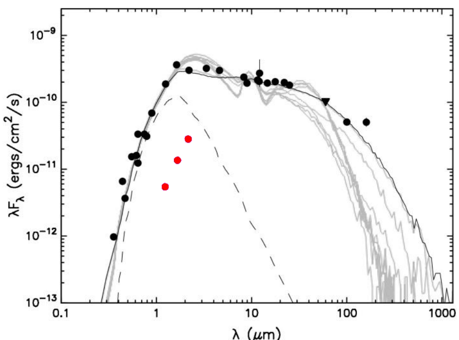

Fig. 4 -SED fits. The lines display the ten best models with the top one in black. Red dots denote 2MASS fluxes.

Spectroscopy of the YSO and the HH flow

Optical spectra of the YSO and the HHOs (Figs. 5, 6) were obtained using the Nasmyth spectrograph attached to the 2-m TLS telescope. The stellar spectrum resembles that of a classical T Tauri star, with Hα, CaII, HeI, OI, and Paschen emission lines superimposed on a veiling red continuum. The Paschen jump at 820nm is visible as well. The spectra of the HH candidates confirm their shock-excited nature. Their radial velocities provide information on the orientation of the outflow axis. The faint HHO to the east is red-shifted by v_{LSR}≈90km/s while the bright knot to the west has a blueshift of −80km/s. Notably, the HHOs also emit in H_2 as seen in the UKIDSS K image.

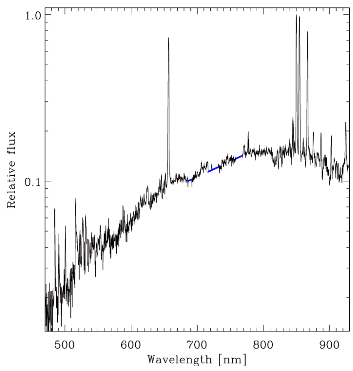

Fig. 5 – Optical spectrum of the YSO. Telluric absorption is marked in blue.

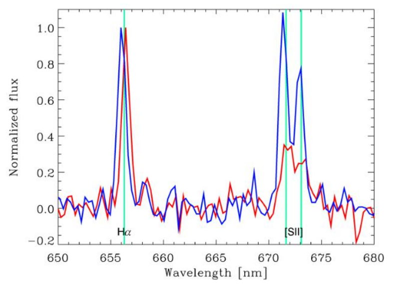

Fig. 6 – Section of the HHO spectra covering Hα and [SII]. Color indicates the velocity shift.

Discussion & conclusions

The JHK magnitude differences between 2MASS and UKIDSS amount to 3.9, 3.5, and 2.8mag, respectively. Thus, the fading is not caused by a solid body or gray grains. Both the SED analysis as well as the HHO kinematics suggest that the disk is seen ≈10° off from edge-on. Since the SED models imply an angle of ≈6° subtended by the disk, considerable variations of the scale height have to exist which cause the irregular variations, and the deep fade in particular. It seems tempting to employ a dense eddy or even proto-planetary body to explain the latter. Recent monitoring efforts provide crucial insights into the bursting and fading mechanisms of young stars [9]. V1219 Cyg is a particularly interesting case which warrants further scrutinizing.

References

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