COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 714

Konkoly Observatory
Budapest
1972 September 12

THE R-I COLOR OF V 1057 CYGNI BEFORE THE OUTBURST, AND ITS BRIGHTNESS AND SPECTRAL CHANGES

As announced in my "Preliminary Note on V 1057 Cygni and Some Other Similar Objects" (Haro 1971), we have at the Tonantzintla Observatory two direct plates obtained in succession the night of November 24, 1965, in red and near infrared emulsions (Eastman Kodak 103aE and IN plates behind Wratten filters No. 29 and No. 89b, respectively), centered approximately near V 1057 Cyg.

At my request, Dr. T.A. Lee kindly obtained the B, V, R and I photoelectric magnitudes of the Be star Lk Hα 192 that is located very near V 1057 Cyg and in the same obscured area. The results from two independent measures of Lk Hα 192, made on June 15 and 16, 1972 by Dr. Lee, are as follows:

B = 15.62, V = 14.33, R = 12.99, I = 11.4

Altough the lower precision in the I magnitude quoted above was emphasized in Dr. Lee's private communication, we can be rather confident in the approximate value of R-I=+1.5 for Lk Hα 192, which obviously indicated a very high reddening for a Be type star.

This particular photometry and Andrews' (1970) red photographic photometry in Orion allowed me to determine the R and I magnitudes of V 1057 Cyg as it was on November 24, 1965. A simple inspection of the Tonantzintla plate collection on Cygnus evidences that the blue photographic magnitude of V 1057 Cyg was before the outburst systematically at least half a magnitude fainter than Lk Hα 192 and that the R-I color

undoubtedly was larger for the first star than for the second. Below are the quantitative R and I values derived for V 1057 Cyg and its R-I color:

$$R = 12.7, \quad I = 10.9, \quad R-I = +1.8$$

According to Rieke, Lee and Coyne (1972), the R and I magnitudes of V 1057 Cyg on the 12th of March, 1971 were:

$$R = 8.13, \quad I = 6.92$$

As it can readily be noticed, the R-I color of V 1057 Cyg was conspicously larger before the outburst than after it. Obviously, I made a mistake in my Preliminary Note (IBVS No. 565) when stating that the near infrared color of V 1057 Cyg was larger after than before the "slow flare-up".

Several astronomers have suggested that there was not an intrinsic change in the luminosity and spectral type of V 1057 Cyg, and that the clearing of a dense inner shell or circumstellar envelope has been responsible both for the optical variation and dissipation of the veiling that masked the real spectral type of this particular star which was of an early type before the outburst.

Now we can present some additional arguments in favor of our original ideas of an intrinsical change in the star itself: a) Although the near infrared color was larger before than after the outburst and this can be taken, at least partially, as a consequence of a clearing or dissipation of a dust shell, it can also be interpreted as caused by the real transit of an advanced T Tauri star of G-K spectral type that has passed through a severe change in temperature and spectrum. If that is the case, the high value of R-I =+1.8 before the outburst can mainly be taken as the sum of the intrinsic "normal color" of a late type star plus the color excess due to "normal" interstellar extinction. The high value of the R-I color of the Be star Lk Hα 192 supports, in part, this last consideration;

b) After the outburst of V 1057 Cygni, the first one to obtain its spectrum in September 1970 was G. Welin (1971; and a private communication including the tracing of his objective prism spectrum), who classified it as approximately of B3 type; later on, Herbig and Harlan (1971) gave type A1 of luminosity class brighter than V, and in May 1971 Haro classified it as A1-2 of luminosity class III-IV. According to a private communication to Rieke et al. (1972), Herbig found that in June and July 1971 the star had a spectral type near A7III. In several of our Tonantzintla objective prism plates obtained in July 1972 the star appeared, because of the strength of the CaII K line, as A8-F0. I have learned through a private communication by Dr. Lee, that recently Herbig classified this star as an early F type. According to the above information it seems that V 1057 Cyg, which before 1969 was classified as an advanced T Tauri type star of approximately K spectral type, after the "slow flare-up" showed an early spectral type (B3) and two years later had evolved up to an early F type;

c) the continuous photographic monitoring at the Tonantzintla Observatory of V 1057 Cyg in the U, B, R and I colors shows that up to August, 1972 the star has slowly declined in brightness. Dr. Lee, quite independently, has also observed this and he informed us that in June of this year the V magnitude was 9.76 as compared to 9.34 in March, 1971. He also writes "It is interesting that the colors of Lk H_α 192 and V 1057 Cyg (present) are very similar. We haven't seen any change in V 1057 Cyg at 2.2 μ or longer wave lengths.

Based on the above information we cannot avoid concluding:

1) That an intrinsic change has been and is taking place in V 1057 Cyg and, therefore, it is not a matter of a clearing or dissipation of a circumstellar shell.

2) The intrinsic process taking place in V 1057 Cygni is entirely similar to the one in FU Ori.

3) Contrary to what Herbig supposed (1966) the FU Ori type objects are not the antecedent of the T Tauri stage but, in certain cases, a later step in which the original mass of the previous T Tauri objects must play a fundamental role.

I would like to express my gratitude to Dr. Thomas A. Lee for his valuable cooperation and permission to quote his observations.

August 25, 1972

G. HARO
Instituto Nacional de Astrofísica,
Optica y Electrónica
Tonantzintla, Mexico

References:

1 Andrews, A.D. 1970. Bol. Obs. Ton. y Tac., 5, 195.
2 Haro, G. 1971. IBVS No. 565 (IAU Comm. 27).
3 Herbig, G.H. and Harlan, E.A. 1971, IBVS No. 543 (IAU Comm. 27).
4 Herbig, G.H. 1966, Vistas in Astronomy, Vol. 8, p. 109. Pergamon Press.
5 Rieke, G., Lee, T., and Coyne, G. 1972. Pub.A.S.P. 84, 37.
6 Welin, G. 1971, Astron. and Astrophys. 12, 312.