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V 1057 Cyg

Some preliminary spectroscopic information is now available for the remarkable object V1057 Cygni = LkH α -190. Prior to 1969, the star was known only as one of the faint, slightly variable ($m_{pg} = 15.5 - 16.5$) T Tauri stars associated with the North America Nebula, NGC 7000 (Herbig, Ap.J. 128, 259, 1958). G. Welin discovered recently (Astr. and Ap., in press; private communication) that in late 1969 the star had brightened to about $m_{pg} = 10$. It is still near that brightness. 120-inch coude spectrograms obtained in March and April 1971 show an absorption spectrum near type A1, clearly more luminous than class V. The H α line is rather strongly in emission, with a P Cyg-type absorption component displaced about 420 km/sec to shortward. There is a similarly-shifted component shortward of the K line of Ca II, but without accompanying emission. H α and the infrared Ca II triplet are the only emission lines detected. A very interesting feature of the absorption spectrum is a rather strong Li I λ 6707 line, whose presence at type A1 implies a high total lithium abundance.

The only observation of the pre-outburst spectrum of V1057 Cyg is apparently the low-dispersion Lick plate of 1957 Aug. 3, which showed an advanced T Tauri-type emission spectrum, with no detectable absorption lines. If the type then had been K0, an increase in the surface brightness resulting from the change in the spectral type to A1 would account for an increase in brightness by a factor 30 at 4200 A. Since the observed rise of approximately 5.5 mag. corresponds to a factor of about 150, a radius increase of only a factor 2.2 could account for the remainder. If the original radius had been about $2 \odot$, then in the rise time of about 250 days (Wenzel, Mitt. Ver. Sterne, in press; private communication), the photosphere would have had to expand at a mean velocity of only about 0.1 km/sec. This is much less than the atmospheric ejection velocity of about 420 km/sec suggested by the P Cyg structure.

The absorption-line velocity of V1057 Cyg is now about -60 km/sec, clearly different from the mean velocity of the H II region NGC 7000, which has been measured by Courtes, Cruvellier, and Georgelin (J.d'Obs. 49, 329, 1966) as about -15 km/sec, and by Miller (Ap.J. 151, 473, 1968) as -19 ± 4 km/sec. The large apparent negative shift of the

star could be due to radial motion in its atmosphere, but if so, the magnitude of the velocity is again much greater than expected.

Welin also discovered that V1057 Cyg now appears attached to a bright filament of nebulosity that was not present before the outburst. This nebulosity is well seen on recent 120-inch direct plates, and resembles a broken ring about 50" x 90". The star is involved closely in still brighter nebulosity, and is displaced from the center toward the southwest edge of the ring. Presumably this ring, whose appearance is rather like that of a cavity illuminated from within, represents dust near the star that has just recently been lit up as a result of brightening. At a distance of 500 parsecs, a light signal would expand in the plane of the sky at the rate of 1" in 1.9 days. The portion of the ring most distant from V1057 Cyg is about 65" east of the star, and thus its illumination would be delayed by at least 190 days. This is compatible with the observed time of the brightening of the star and the subsequent date of detection of the nebulosity by Welin. It will be interesting to see if still more distant reflection nebulosity appears as the light signal continues to propagate outward.

The outburst of V1057 Cyg is highly reminiscent of the brightening of FU Orionis in 1939 (Herbig, Vistas in Astr., 8, 109, 1966), even to details such as the sudden appearance of a reflection nebula and to the high abundance of lithium. If the two events represent the same basic phenomenon, then V1057 Cyg has established a very important point that could not be settled in the case of FU Ori for lack of a pre-outburst spectrogram. That is, the fact that the spectrum of V1057 Cyg changed fundamentally from minimum to maximum light proves that an intrinsic change in the star took place, and that the explanation is not that it was simply unveiled by the dissipation of a circumstellar dust cloud.

We are very much indebted to Mr. Gunnar Welin for informing us in advance of publication of his very important observations of V1057 Cyg and to Dr. W. Wenzel for information on the light curve.

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