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PRELIMINARY NOTE ON V 1057 CYGNI AND SOME OTHER SIMILAR OBJECTS

The remarkable object V 1057 Cygni = LkHα190, known to be a small amplitude variable (15.5 - 13.5), was found by G.Welin (1) to show in late 1969 a long-term flare-up of about 6 photographic magnitudes. At the time of writing this note the star still is at a maximum brightness of about 10th photographic magnitude. Previously this star was recognized by Herbig (2) at minimum light as an advanced T Tauri type star but the absorption line spectral type was not given. In August 1950 the first Schmidt camera objective prism plate containing this object was taken at the Tonantzintla Observatory, using a 103aE emulsion and a Wratten filter No.29. The Hα emission line was moderately strong and it was then marked as one of the Hα emission stars associated with the North America Nebula. Several red spectral plates were taken in 1950 and 1951, and the red continuum (from λ5900 up to Hα) did not show the characteristics of an M type star. In our collection of direct blue plates taken from 1943 through 1965, the star showed small light variations but it never appeared as bright or brighter than the neighboring Be star LkHα 192. 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) showed that the R-I color of V 1057 Cygni was larger by about 0.4 magnitudes than the R-I color of the K0 Type star LkHα 188. Based on our small dispersion spectral red plates, the B-R and the R-I colors, the comparison with the red spectra and colors of the two K0 stars LkHα 188 and LkHα 191, and the Be type star LkHα 192 plus Herbig's original spectroscopic observation of LkHα 190, we are led to believe that this star probably was of spectral type later than K0 bat earlier than M0.

Slit spectrograms obtained by Mr.Rafael Costero during the last part of May, 1971, with our spectrograph attached to the Tonantzintla 1 meter telescope and with a dispersion of 125 A/mm, revealed that V 1057 Cygni has a spectral type A 1-2 of luminosity class III-IV at maximum with Hα in emission. This last spectroscopic observation almost coincides with Herbig's results (3).

Although we have been unable to measure quantitatively the R-I colors of the star at minimum and maximum, it seems that the infrared color is larger now than when the star was at minimum. At the present time, V 1057 Cygni has a V-I color excess of the order of 2.5 magnitudes. The quantitative values of the near infrared colors at minimum and maximum will be given later.

What I wish to emphasize in this note is that the brightening-up of FU Orionis and V 1057 Cygni represents entirely the same kind of phenomenon that makes some advanced T Tauri type stars evolve rapidly in an identical way as these two stars have evolved. There is a significant number of objects in the sky that most probably have passed through this kind of rapid evolution. Besides FU Orionis and LkHα 190, good examples of this kind of objects are: MWC 1080, LkHα 233, Z CMa, LkHα 208, RR Tau, AB Aurigae, BD +61°154, LkHα 198, V 380 Ori and possibly some of the additional objects contained in Herbig's paper (Ap.J.Supplement, Vol.4, p.337, 1960), as well as many others satisfying the conditions which are enumerated below.

In my working hypothesis I have chosen the stars that meet the following conditions, slightly modifying and extending the ones established by Herbig in the above mentioned article: i) the spectra are peculiar (absorption features due to a weak overlying shell and/or emission lines and line structure of the P Cygni type), of types F5 or earlier and with emission lines; ii) the stars lie in a remarkably obscure area; iii) the stars illuminate bright nebulosities in their immediate vicinity and in many instances (especially the ones that I have mentioned before) a bright, well defined and curved filament starts out from the stars like a tail or a jet; iv) the infrared excesses, particularly in micron wave lengths, are conspicuously larger than the corresponding to the spectral class observed photographically.

At the present time the similarities of FU Orionis and LkHα 190 with the other objects listed above are really amazing and, as stated, I am convinced that such objects have evolved in a similar way. Most probably they have rapidly evolved from an advanced T Tauri stage into a long-term flare, just as the case of FU Orionis and the new Cygnus star. Of course, in my working hypothesis I do not assume that all the young and advanced T Tauri type stars have evolved so rapidly or would do so. It appears almost certain that the great majority of the T Tauri stars evolve in a more gentle manner, in a succession of rather short-time flares and by ejecting mass through different processes.

In the past I have stressed - based on results obtained especially in Orion and in the Pleiades - a) that the

different photometric and spectroscopic features observed in the "fast" and "slow" flare stars can be due to the fact that the phenomenon which produces the outburst takes place at different layers or depths of a given star, and b) that the younger the stellar aggregate and therefore the younger the flare stars involved, the more propitious the internal physical conditions of a late type star will be in order to give place to a "slow" and more permanent outburst. Thus, for instance, in extreme cases the appearance in one Herbig-Haro object of the two emission nebulous nuclei discovered by Herbig may be a sample of such a long-term outburst at the source where the ionizing radiation originates - or perhaps, more significantly, the other very conspicuous case represented by FU Ori, to which we can now add V 1057 Cygni. From these last two rapidly evolved stars we can make a preliminary guess that within 1 kpc from the Sun one would expect at least 4 or 5 similar rapidly evolving advanced T Tauri stars per century like V 1057 Cygni. A more extended and comprehensive study on the subject will be published later.

I would like to thank Dr. N.J.Woolf for informing me, in advance of publication, about the infrared observations of FU Orionis and LkHα 190 made by Martin Cohen and by him.

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