INTRODUCTORY REPORT ON V1016 CYGNI

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The formation of a new planetary nebula should be a rare event, and the case of V1016 Cyg may represent such an example. This is the reason of the considerable interest of the astronomers in this star since the discovery of its outburst in 1965. The light history of this star has been described in detail by several authors (e.g. Ciatti et al. 1971, FitzGerald 1971, etc.), and can be divided into three distinct phases:

1. The preoutburst phase (before 1964): the B-magnitude of V1016 Cyg has been probably always fainter than 15^m. In particular, during 1948-1963 it was close to 15.0-15.6 mag (FitzGerald et al. 1966). On a 1947 objective prism plate it was classified as a late M type star (FitzGerald et al. 1966),but this is the only reported observation of a late type spectrum in this star before outburst. A strong H_α emission was first detected by Merrill and Burwell (1950) who denoted the star MH_α 326-116.

2. The phase of increasing luminosity (about 1963 to 1968): In 1963-64 the star underwent a large increase in its luminosity. This outburst was discovered in 1965 (FitzGerald et al. 1966) when the pre-outburst M-type spectrum was already disappeared, and an emission line spectrum and a hot continuum had appeared (FitzGerald et al., O'Dell 1967). According to Mammano and Ciatti (1975) and to Andrillat (this conference figure 2), TiO and VO bands are still detectable in the near infrared. Between 1965 and 1968 the mean ionization energy of the emission lines increased continuously, as shown by the successive appearence of lines of higher and higher ionization energies (see e.g. FitzGerald and Pilawaki 1974). The spectral and light evolution of V1016 Cyg during this phase clearly resembles that of a very slow nova and of other symbiotic stars like RR Tel (Thackeray 1977). But the lack of the spectral coverage for the earliest phases of the outburst prevents us to go further into this comparison.

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3. A quasi stationary phase was reached after 1968 with no large luminosity changes, and small spectral variations mostly characterized by the further increase of the ionization range and the appearence of higher ionization stages (e.g. Ciatti et al. 1971, 1978). At high resolution the emission lines show a considerable structure: the strongets lines were characterized by two components separated by about 70 km s^{-1} and by a broad weaker blue shifted component (FitzGerald 1973).

V1016 Cyg is particularly interesting outside the optical spectrum. In the infrared, a large excess due to dust emission was found by Knake (1972) and Swings and Allen (1972). Baratta et al. (1974) from a study of the energy distribution and light curve of the star concluded that the dust envelope was present before the outburst. The IR spectrum probably originates from a nebula with at least two dust components with temperatures of $\sim$ 250 and 1000°K (Seaquist and Gregory 1973, Kwok 1976). Harvey (1974) discovered that the IR flux of V1016 Cyg is variable on time scales of the order of 450 days, quite appropriate for a Mira variable. No more recent systematic photometric observation in the IR has been so far published to confirm, or disprove, the periodicity of these variations.

Strong radio emission from the star was discovered by Purton et al. (1973) and confirmed by successive observations (see Kwok, this conference). Historically, this was the first astrophysical object where the slope of the radio spectrum ($S_{\nu} \propto \nu^{0.6}$) suggested emission from an optically thick nebula with a density gradient of the type $N_e \propto r^{-2}$ as in the case of continuous mass outflow from the central star (Seaquist and Gregory 1973; see also Panagia and Felli 1975). According to Ahern et al. (1977) this outflow started $\sim$ 600 years before the optical "outburst". When the mass loss ceased, the radiation from a remnant hot core of the star started to ionize the nebula producing the observed emission line spectrum and the visual brightening.

The ultraviolet spectrum of V1016 Cyg was extensively studied by Nussbaumer and Schild (1981) on the basis of low and high resolution IUE spectra. The low resolution, de-reddened UV spectrum of the star is shown in figure 1. Nussbaumer and Schild, to interpret the UV spectrum, developed a model of single star, with $T_* \simeq$ 160000°K and $R_* \simeq 0.06\ R_\odot$, surrounded by a high density planetary shell with a mass of $\sim 2.8\ 10^{-4}\ M_\odot$, an electron density of $3\ 10^6 cm^{-3}$ and T_{el}= 27000 to 8000°K from the inner to the outer boundary. The interstellar extinction was estimated from different arguments to be $E(B-V) \simeq 0.28$.

X-ray emission from V1016 Cyg has been detected by Allen (1981 and this conference) with the Einstein satellite and has been interpreted as

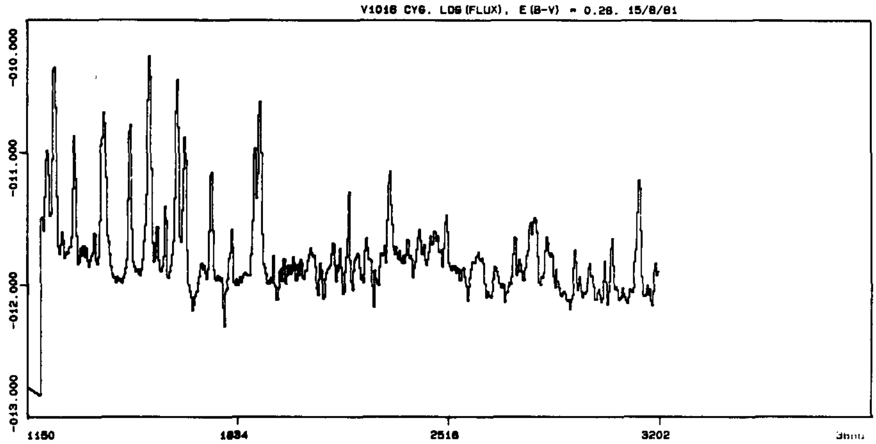

Figure 1. The low resolution IUE spectrum (1200–3200 A) of V1016 Cyg.

an evidence for thermonuclear events on a white dwarf accreting from an M companion. Certainly, further X-ray observations spanned on a long time scale with the EXOSAT satellite will give a better insight on the origin of the X-ray emission and its relation with the other phenomena, like the mass outflow (and radio emission), the IR variations, etc.

Conclusions. Single star models of V1016 Cyg have been proposed by several investigators (Baratta et al. 1974, FitzGerald and Houk 1970, Kwok 1977, Ahern et al. 1977 etc.). Mammano and Ciatti (1975) suggested a binary model consisting of an M giant and a hot star ionizing the surrounding gaseous shell. The arguments in favour of this model are the presence of TiO and VO absorption bands (that in the single-star hypothesis are supposed to be formed in high density inhomogeneities of the expanding shell) and the IR variability, which suggests the continued presence of a late type (Mira variable) star.

We think that the problem of the nature of this star is still open. Certainly V1016 Cyg is a very interesting astrophysical object in all spectral ranges, and it would certainly require further studies in the future expecially with space experiments.

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