HM SAGITTAE : AN ERUPTIVE VARIABLE RESEMBLING V1016 CYGNI

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SUMMARY :

We present photometric and spectroscopic observations (intermediate dispersion in the wavelength range 3700-10900 Å) of the recently discovered variable HM Sagittae (Dokuchaeva, 1976). Also pre-outburst data, indicating a red star, are used to discuss its nature and distance.

The spectral analysis reveals a gaseous envelope around the star, of excitation class 3-4 and high density ($n_e=10^6-10^7$ cm^{-3}) relative to planetary nebulae. The unusual observed properties suggest that HM Sge belongs to the same class of peculiar variables V 1016 Cyg and V 1329 Cyg. This correlation is supported by the radio and infrared data recently reported (Feldman, 1977; Davidson et al.,1977).

In view of the proposed evolutionary trend, leading this kind of objects to the formation of some planetary nebulae (Mammano and Ciatti, 1975), we remark the morphological similarities among HM Sge, the compact and dense planetaries Hb 12 and IC 4997, and the nucleus of the butterfly nebula M 2-9.

We interpret the outburst as due to the increasing temperature of a hot source, and/or emergence of its ultraviolet radiation from a previously thick shell. The nature of the hot source is revealed by the appearance in 1977 of broad emission features pertinent to a WN 6 star.

The complete details of this work will appear shortly in Astronomy and Astrophysics.

References :

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Davidson,K.,Humphreys,R.M.,Merrill,K.M. 1977, Preprint

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D I S C U S S I O N of paper by CIATTI, MAMMANO, and VITTONE:

SHERWOOD: How does the spectrum of FN Orionis compare with that of HM Sagittae (or V1016 Cygni)?

CIATTI: FN Ori may resemble HM Sge only from the photometric point of view (for its large sudden brightening) but the spectrum is completely different without high excitation emissions.

https://doi.org/10.1017/S0252921100069402 Published online by Cambridge University Press

BOYARCHUK: According to the observations which were made by Miss Beljakina at Crimean Observatory, HM Sge increases its magnitude $\Delta V \sim 0.5$ from July 15 to August 5. Thereafter HM Sge shows a flare with the amplitude $\Delta V \sim 0^m.3$ during 7 days. The light maximum was August 23.

SCHUMANN: What is the spectral range of the observations shown in your last slide?

CIATTI: I have shown spectra of V1016 Cyg obtained through an S-20 image tube, spectral range 3800 - 7600 Å. We use furthermore an S-1 intensifier for the spectral range 6300 - 10900 Å.

SHAVIV: Do you mean to say that it is a close binary that becomes a planetary nebula? There is no observation of old planetaries which are close binaries.

CIATTI: Krzeminski, Priedhorsky and Miller reported last year the discovery that UV Sge, the central star of the planetary nebula Abell 63 is an 11-1/2 hour binary. Niemela and Mendez reported this February in MNRAS that CPD-26°389, the central star of NGC 1360 is a spectroscopic binary with an $8^d.2$ period. Agnes Acker in IAU Symposium No. 76 reported three more spectroscopic binary nuclei for planetary nebulae, including FG Sge.

I would like to add that in our opinion V1016 Cyg-type objects could evolve toward some kinds of planetaries, not necessarily all of them.

FITZGERALD: Radio work reported by Ahern et al. (Astr. Astrophys. 58, 35, 1977) indicates that the nebulosity associated with V1016 Cygni has a size of 7×10^{16} cm as of 1975. From the observed expansion rate of 35 kms^{-1} it is evident that the gas surrounding the object must have been ejected considerably before (over a period of 600 yrs or more) V1016 Cygni was observed as an emission object. Consequently, it is very difficult in the binary model to understand the appearance of the hot stars, unless it itself was either hidden in the late-type stars, or obscured by a cool atmosphere itself. The former case is hard to explain physically, and the latter makes the presence of a cool star not relevant to the process causing the appearance of the emission lines, which is then interpreted as the unveiling of the hot stars by the lifting off of its atmosphere. We find the above to be fundamental objection to the binary hypothesis, and therefore advocate the single star model described in the above reference. We should note that while we can physically explain the infrared radiation through a dust grain model (Kwok, 1976), we can only qualitatively explain the IR variation with time.

CIATTI: I know your single-star model, but I think the presence of a LPV star (whose spectrum was obtained before brightening) is still required to explain the IR periodicity found by Harvey, together with some spectral features in the near IR. This late-type star is indirectly responsible for the outburst; if it has ejected for a long time the gas becomes apparent through the strong emissions.

https://doi.org/10.1017/S0252921100069402 Published online by Cambridge University Press