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PHOTOMETRIC HISTORY OF SOME LBV CANDIDATES OF M 33

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RESUMEN

Presentamos la historia fotométrica de algunas estrellas candidatas a LBV en M 33. La búsqueda fué hecha en la colección de placas del Observatorio Astronómico Nacional de Bulgaria. Se encontró que 1 de los 6 objetos estudiados muestra variaciones fotométricas consistentes con LBV. Este comportamiento, junto con el espectro de Corral (1996), hace de esta estrella una nueva LBV de M 33.

ABSTRACT

We present the photometric history of some luminous blue variable candidate stars of M 33. The search was made with the plates collection of the Bulgarian National Astronomical Observatory. We found that 1, of 6 objects studied, showed photometric variations consistent with the LBV phase. These new data, together with the LBV type spectrum of the object shown in Corral (1996), make this star a new LBV of M 33.

Key Words: **STARS:EVOLUTION — STARS: MASS LOSS — STARS: MASSIVE — STARS: SPECTRAL TYPES**

Luminous Blue Variables (LBV) form a group of non-explosive stars that show extreme changes in brightness, spectral type and colour. They have eruptive outburst in irregular time-scales and are so luminous that is posible to recognize objects of this type in the Galaxy and in nearby galaxies as well. Conti (1984) coined the term LBV to cover a collection of variables stars known as S Dor variables, P Cygni-like stars and the Hubble-Sandage variables in M 31 and M 33. An extensive review of this type of stars and of some of the individual LBVs can be found in Humphreys & Davidson (1994).

LBV have shown three types of variations: microvariation of less than some tenths of magnitude in time-scales of weeks to months, of the type also showed by some normal luminous supergiants; moderate variation or eruptions during which the brightness can increase in 1 or 2 magnitudes for years or decades, defining the characteristic of the class; and giant eruptions, where the brightness increases by more than 3 magnitudes, which may last decades and release as much energy as a supernovae but, obviously, on a much larger time-scale.

It is possible that some LBV may spent several years without showing an outburst. P-Cygni has not shown any variation of this type since the outburst of 1600 (Lammers & de Groot 1992). So, is the spectral resemblance enough to classify a star as LBV? No, according to Conti (1997), because there are another stars in the same region of the HR diagram that share some of the characteristics of LBVs but are not classified as LBV (e.g., B[e] or Ofpe/WN11 stars). It must *walk, look and quack like a duck*, because if it *honks* it is a *goose*.

The Hubble-Sandage (Hubble & Sandage 1953) variables in M 31 and in M 33 were found in a photometric search of variables on plates from the Mount Wilson telescope covering observations between 1920 and 1953. As it has been shown that some LBV can last for a very long time in quiescent phase, it is possible that some true LBV stars did not show up in the original Hubble-Sandage search.

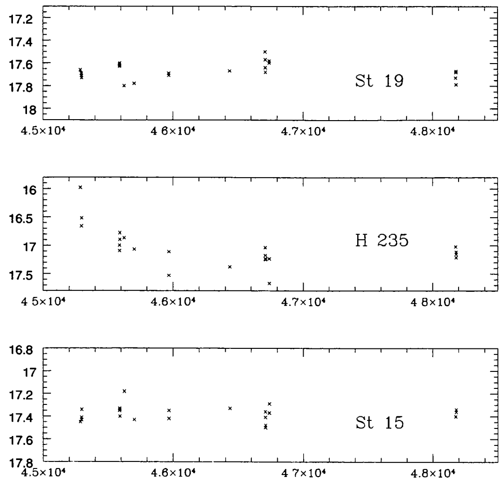

Fig. 1. Light curve of the LBV candidate H 235. Standard stars are from Sandage & Johnson (1974).

We looked for the recent photometric history of some of the LBV candidates of M 33 in the plate collection of the Bulgarian National Astronomical Observatory. These plates were taken with the 2 m RCC Rozhen telescope. There are 24 B-plates of 30×30 cm (103aO, IIaO and ORWO ZU 21 emulsions plus GG 2385 glass filter) with images of M 33. The plates were taken between November 1982 and October 1990, the area covered was 1×1 deg, with the whole image of M 33 fitting in each plate. The crowding and variable background make iris-photometry not reliable, so measurements have been made with a MF-4 densitometer using a constant diaphragm. At least four sky estimates were made around each object and the average value was used. The calibration curves were made using stars of the photometric sequence of Sandage & Johnson (1974). In Figure 1 we present the light curve of H 235 and the measurements of two standard stars, St. 15 and St. 19. It can be seen that the star looks like it was caught recovering from an outburst.

This star was classified as a LBV candidate by Spiller (1992), giving from observations made in 1990 $V=$ 16.75 mag; later, Willis et al. (1992) reported a Of/WN type spectrum and gave $V=$ 17.5 mag. Smith et al. (1995) estimated $V=$ 17.7 from their spectrophotometry. In their opinion, H 235 shares the evolutionary status of R 84 (in LMC) which, according to Crowther et al. (1995), is either a dormant LBV or a phase inmediately after this stage. When we take all these data in account with the light curve presented, it is possible to assume that H 235 has presented an outburst, which together with the typical LBV spectrum make certain its characterization as a new LBV in M 33. H 235 could show further outbursts in the future, and it should be frecuently monitored in order to observe the early phases of the eruption.

REFERENCES

Conti, P. S. 1984, Tests of stellar evolution theory, ed. A. Maeder and A. Renzin1, (Dordrecht:Reidel), p. 233.
Conti, P. S. 1997, ASP Conf Ser 120, 387
Corral, L. J. 1996, AJ 112, 1450
Crowther, P. A., Hillier, D. G., Smith, L. G. 1995, A&A 293, 172
Hubble, E., & Sandage, A. 1953, ApJ 118, 353
Humphreys, R., & Davidson, K. 1994, PASP 106, 1025
Lamers, H. J. G. L. M., & de Groot, M. J. H. 1992, A&A, 257, 153
Sandage, A., Johnson, H. 1974, ApJ, 191, 63
Smith, L. J., Crowther, P. A., Willis, A. J. 1995, A&A 302, 830
Spiller, F. 1992, Ph. D. thesis, Heidelbeg University
Willis, A. J., Schild, H., Smith, L. J. 1992, A&A 261, 419

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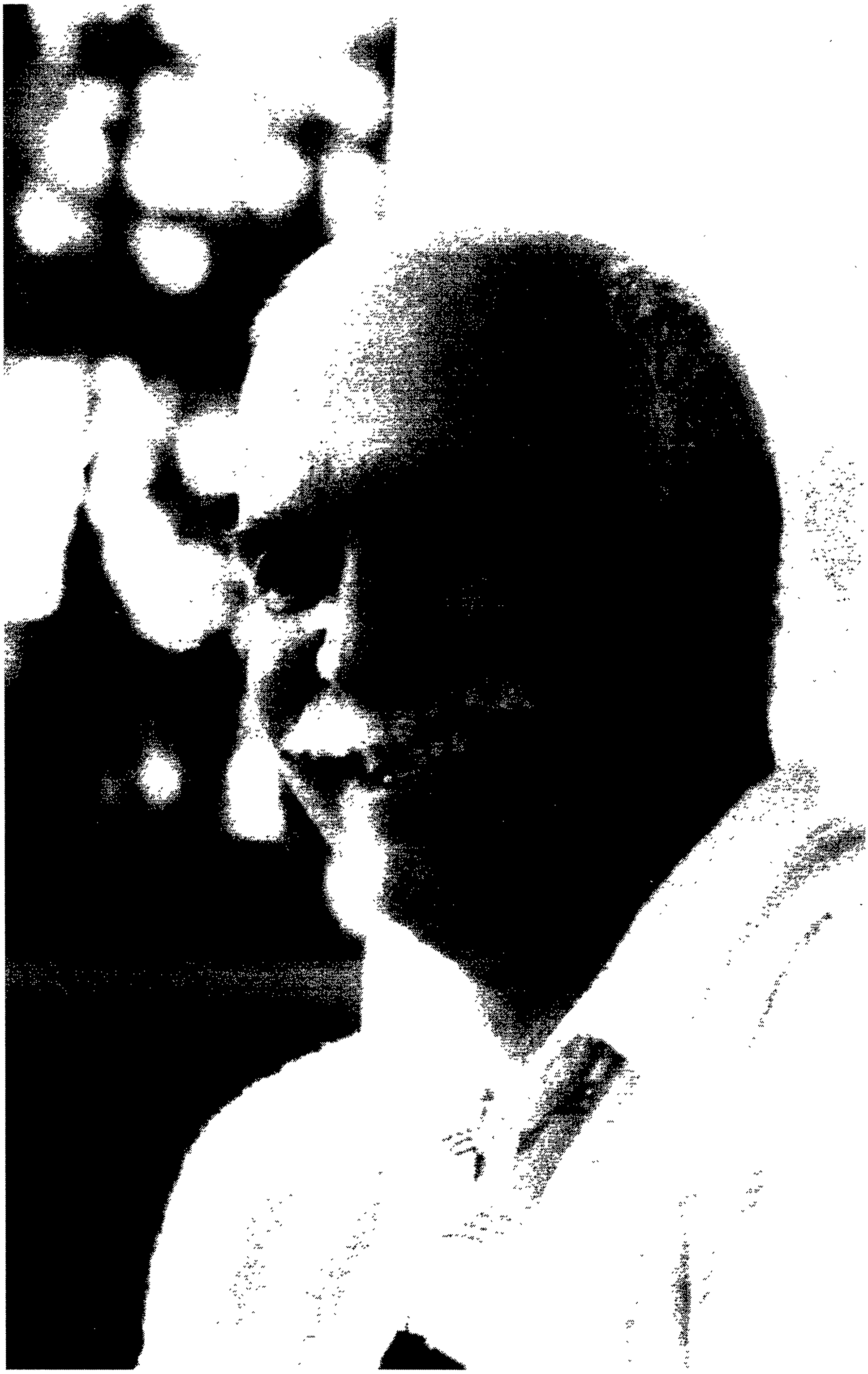
Stellar Ejecta and its Interaction with the Environment



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