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SV 39: a strange variable star in the field of the Local Group galaxy IC 1613

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Abstract. We discuss the characteristics of the peculiar variable star SV39 which lies in the field of the Local Group galaxy IC 1613. From the available photometric and spectroscopic data we get the prelimiary conclusion the we are in presence of the apparent blending of a W Vir star belonging to the Halo of our Galaxy and of a long period variable red supergiant belonging to IC1613. If this interpretation is correct, the W Vir star would be the most remote known star in our Galaxy being at a distance of at least 115 kpc.

Key words. Pulsating Variables – Local Group Galaxies – Galactic Halo –

1. Introduction

Sandage (1971) discovered the variable star SV39, $\alpha(2000)=1^h05^m02^s.1$, $\delta(2000)=2^o10'24''$, in the field of IC 1613 (Fig. 1). The photographic B observations, with an average apparent magnitude of $B = 19.2$, showed a light curve with the shape of an inverted β Lyr eclipsing variable with a period of 28.72 days. Sandage included it among the possible Cepheids, but in the subsequent works (see e.g. Madore & Freedman, 1991) it was never used for deriving the PL relation of Cepheids. Hutchinson (1973) re-examined these observations and suggested it could be a W Vir star located very far in the halo of our Galaxy. Van den Bergh (2000) suggested that it could be an isolated star in the intergalactic space. Hutchinson noted

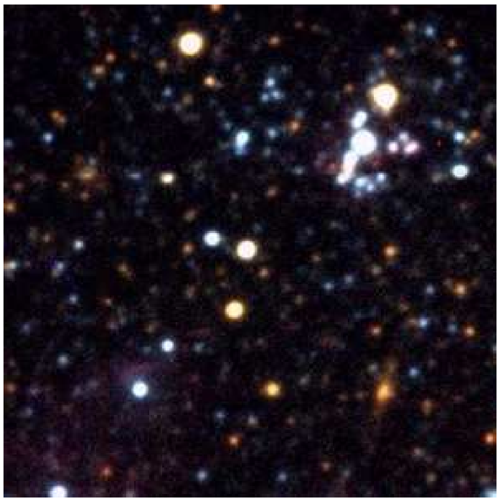

Fig. 1. Field in IC1613 centred on SV39.The bright star at the upper left corner is the long period Cepheid SV22. Several HII regions belonging to IC1613 are present in this field.

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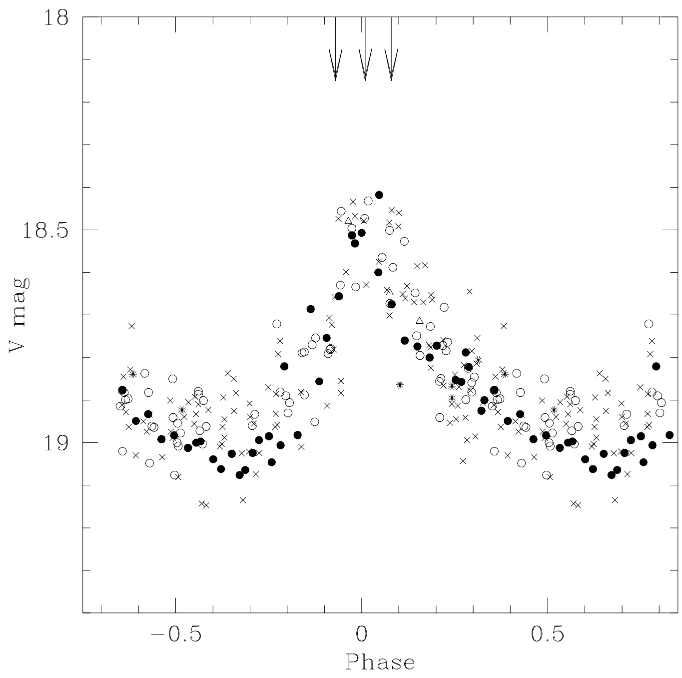

Fig. 2. Shape of the light variation of SV39 obtained by phasing all the available photometric data with the short period of 14.341d, after the subtraction of the long period variations (1118d).

also a long term variability of about 1000 d. Antonello et al. (1999) surveyed IC 1613 looking for Cepheids, and added further data points to the time series of SV39. The data, taken in unfiltered light, seemed to confirm that this is not a classical pulsating star; however its real nature remained unclear. The new observations indicated a long P of 1123^d and as regards the shorter one it was not possible to select unambiguously between 28.699^d and half this value, 14.350^d. New V and I observations were obtained in the context of the OGLE project (Udalski et al. 2001), but these data alone, due to their short baseline, were insufficient to clarify the matter. In 1999 some spectra were taken at ESO-LaSilla; they showed (Mantegazza et al. 2002) very strong emissions in the Balmer lines and, at the phase of maximum light, the presence of a broad emission feature at 6684 Å, which tentatively was attributed to HeI.

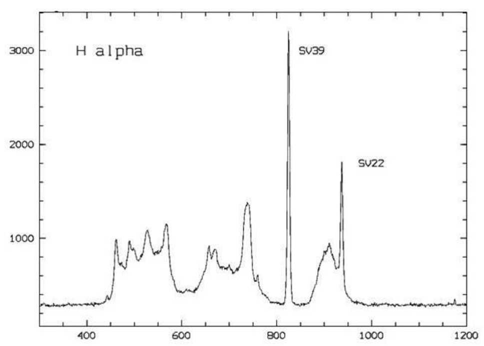

Fig. 3. Profile across the slit of the field around SV39 at the $H\alpha$ wavelength. It is apparent that SV39 lies in a zone not polluted by HII region emission. The star SV22 is the brigthest Cepheid in IC1613.

Mantegazza et al. (2002) analyzed also all the availbale photometry and concluded

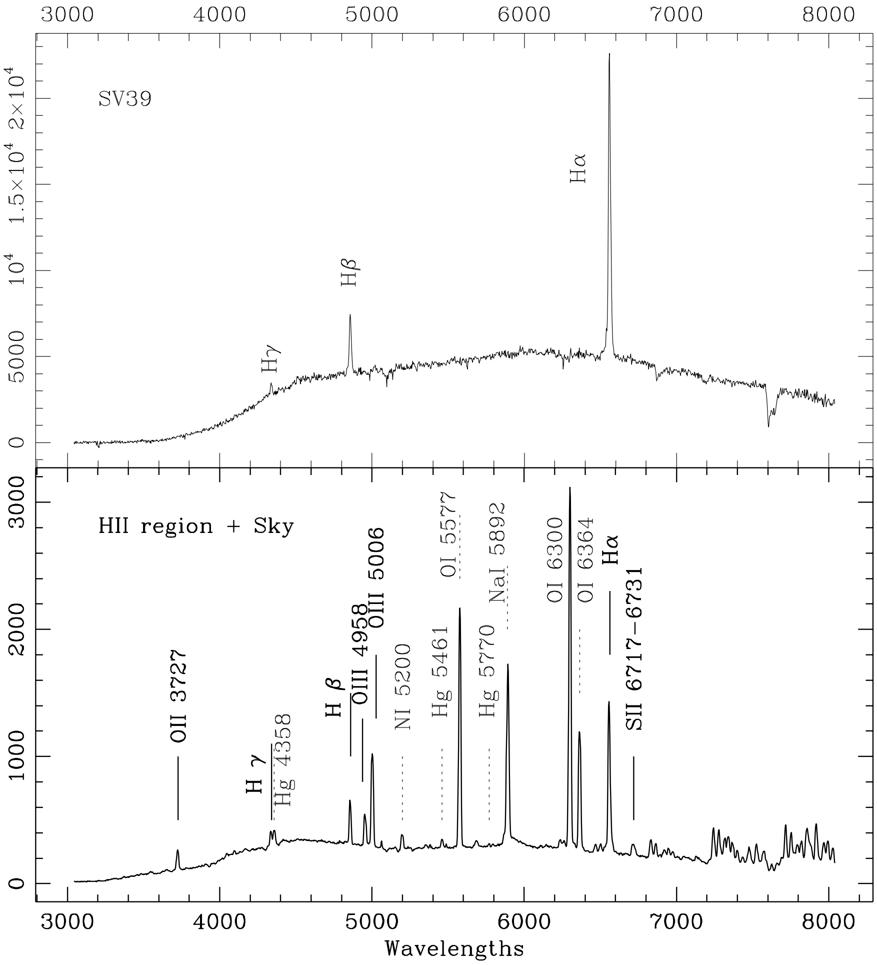

Fig. 4. Upper panel: Spectrum of SV39. Lower panel: spectrum of the strongest nearby HII region. Both HII emission lines (solid segments) and sky emission (dashed segments) are labelled.

that the observed light curve results from the superimposition of two periodic terms of 14.341^d and 1118^d respectively. The former one (Fig. 2) has the typical shape of the light curve of a pulsating variable. The discussion of all the available data (lightcurve, colour indices, spectroscopic data) led to the preliminary conclusion that the observed star could result from the apparent blending of a W Vir pulsating star, belonging to the Halo of our Galaxy and of a long period variable red supergiant belonging to IC1613. Mantegazza et al. (2002) discussed also other possible hypotheses.

2. TNG spectra

In order to strengthen these conclusions we planned further spectroscopic observations of this object. We were able in particular to get two low resolution spectra ($R \sim 400$) at TNG with DOLORES on December 2002. Because the star is located on the sky close to some

HII regions of IC1613, in order to verify that Balmer emissions in the stellar spectrum are not affected by them, we rotated the slit to include three HII regions in the spectrum. As shown in Fig. 3, which is a slice along the slit at the $H\alpha$ wavelength, our object lies in a zone free from the contamination of the HII regions.

The resulting spectrum is shown in Fig. 4, upper panel, while for comparison (lower panel) we show also the spectrum of the strongest HII region, with the identifications both of the HII emission lines and the sky emission lines. The latter were used as a reference for measuring radial velocities. From these measurements we estimate that the stellar Balmer emissions are red-shifted with respect to the HII region emissions by about 73 ± 12km/s, therefore its membership to IC1613 is unlikely. The intensities of Balmer emissions in SV39 spectrum are very similar to those in the spectra obtained with the Danish telescope at ESO-La Silla, which were observed approximately at the same phase of the short photometric period. This fact seems to indicate the periodicity also of the spectroscopic behaviour. The emission at 6684 Å, seen in the 3.6m telescope (ESO-LaSilla) spectra, which were observed at a slightly later phase, is not present. Apart from Balmer emission lines, No absoption lines, apart from telluric lines, are detectable in the stellar spectrum, even if its S/N ratio is about 60.

3. Conclusions

The TNG spectra, therefore, tend to support the model devised by Mantegazza et al. (2002). The presence of an isolated W Vir star at a distance of at least 115 Kpc should raise discussion to the open question of the true extent of the galactic halo. If true, this would be the farthest known star of our galaxy; known halo field stars and globular clusters are closer than about 100 kpc (e.g. Morrison et al. 2001). Therefore it should be very important to definitively settle the question on the nature of SV39. In order to do this, some spectra, at higher resolution of the present ones, should be taken for confirming the reality of the presence of HeI emissions, and for deriving accurate radial velocities, which could definitively exclude the membership to IC1613. The spectra should be taken both at phases in which the emission lines are present in W Vir stars (the ascending branch of the ligth curve) and at phases of minimum light, where the emission lines should be absent.

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