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VRI PHOTOMETRIC OBSERVATIONS OF V1647 Ori (IRAS 05436-0007)

SEMKOV, E. H.

Institute of Astronomy, Bulgarian Academy of Sciences, 72, Tsarigradsko Shose blvd., BG-1784 Sofia, Bulgaria, e-mail: esemkov@astro.bas.bg

Recently McNeil (2004) discovered a new reflection nebula located in the Orion L1630 molecular cloud and associated with the IRAS point source (05436-0007). The nebula is not seen on the POSS plates and an eruptive object like FUor or EXor (Reipurth and Aspin 2004) illuminates it. According to Samus (2004) the designation V1647 Ori has been given to the variable star associated with IRAS 05436-0007. Briceño et al. (2004) suggest that the outburst begun at some time between 2003 October 28 and November 15 and the point-like object illuminating the nebula rose by 5 mag in about 4 months. They found the spectrum of V1647 Ori similar to the early outburst spectrum of FUor star V1057 Cyg. Based on near-infrared spectroscopy Vacca et al. (2004) state that V1647 Ori is a low-mass late-stage Class I protostar surrounded by a circumstellar disk. Walter et al. (2004) report a general decline of brightness of V1647 Ori by $0\overset{\mathrm{m}}{.}4$ (I) in the period February 10 - May 7. The bolometric luminosity of V1647 Ori estimated by Andrews al. (2004) is 3.4 $L\odot$. Ábrahám et al. (2004) state that the IR SED of V1647 Ori resembles the SEDs of FUor objects.

In this paper we present data from VRI photometric observations of V1647 Ori in the period August 18 - October 3 immediately after the beginning of morning visibility. Our observations were made with the 1.3-m RC telescope of the Skinakas Observatory[1] of the Institute of Astronomy, University of Crete (Greece). The Photometrics CCD camera 1024×1024 pixels was used. The size of the pixel is 24 μm and the scale is $0\farcs5$/pixel. All frames were taken through a standard Johnson-Cousins set of filters. The typical FWHM during our observations with the 1.3-m telescope is $1\farcs5$. Aperture photometry was performed using DAOPHOT routines. In order to minimize the light from the surrounding nebula we used a $2\farcs5$ (5 pixel) radius aperture. The background is taken between radii 20 and 25 pixels. In the case of a $2\farcs0$ (4 pixel) radius aperture the estimated star brightness decrease by 0.04-0.05 mag.

In order to facilitate transformation from instrumental measurement to the standard system we tried to calibrate in VRI bands all bright stars in the field of view of the 1.3-m telescope ($8\farcm5 \times 8\farcm5$). Calibration was made during two clear nights August 20/21 and October 1/2. Standard stars from Landolt (1992) were used as reference. The finding chart of the comparison sequence is present in Fig. 1. Table 1 contains the photometric data for the VRI comparison sequence. The corresponding mean errors of the mean are

[1]Skinakas Observatory is a collaborative project of the University of Crete, the Foundation for Research and Technology - Hellas, and the Max-Planck-Institut für Extraterrestrische Physik.

listed too. We confirm that the two brightest stars in the field LkHα 301 and the star V of Briceño et al. (2004) are variable. From our photometric data LkHα 301 varies with amplitudes $0\overset{m}{.}55(I)$ and $0\overset{m}{.}77(V)$ and the star V varies with amplitudes $0\overset{m}{.}78(I)$ and $1\overset{m}{.}29(V)$. We suspect that the stars A and F from our list are possible variables with small amplitudes and we advise the observers to use them with discretion.

The results from our CCD photometric observations are given in Table 2. The table contains Date, the Julian Date, the V, Rc and Ic magnitudes. Fig. 2 shows the V, Rc and Ic light curves of V1647 Ori for the period of our photometric observations. It is seen from the figure that V1647 Ori varies with amplitude of $0\overset{m}{.}5$ and a very slight decrease of brightness can be observed.

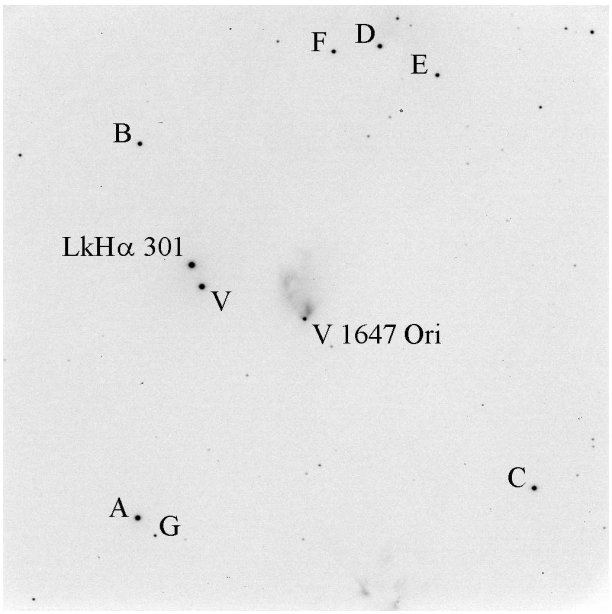

Figure 1. A finding chart of the comparison sequence in the field of V1647 Ori. The field is $8\farcm5 \times 8\farcm5$, centered on V1647 Ori. North is at the top and east to the left. The chart is a reproduction from an I CCD frame obtained with the 1.3-m RC telescope on Oct. 3, 2004. The stars are labeled from A to G in order of their V-band magnitude.

Table 1. Photometric data for VRI comparison sequence.

Star	V	σ_V	Rc	σ_R	Ic	σ_I
A	15.19	.03	14.15	.04	13.05	.05
B	15.66	.02	14.89	.03	14.23	.05
C	16.88	.03	15.45	.02	13.58	.06
D	17.85	.04	16.09	.06	14.00	.08
E	17.95	.03	16.38	.03	14.66	.02
F	18.60	.05	16.80	.03	14.64	.05
G	18.79	.04	17.90	.03	16.20	.05

There is only two papers (Briceño et al. 2004, Walter et al. 2004) containing optical photometric observations of V1647 Ori in the period of outburst. The authors use different

Table 2. Photometric observations of V1647 Ori in the period August - October 2004

Date	J.D.(245...)	Ic	Rc	V
2004 Aug 18	3235.603	14.79	16.97	18.56
2004 Aug 21	3238.601	14.70	16.83	18.33
2004 Sep 09	3257.585	14.65	16.78	–
2004 Sep 18	3266.614	14.49	16.67	18.11
2004 Sep 19	3267.616	14.47	16.71	18.10
2004 Sep 20	3268.606	14.46	16.65	18.03
2004 Sep 21	3269.556	14.61	16.81	18.28
2004 Sep 23	3271.599	14.71	16.92	18.41
2004 Sep 29	3277.508	14.81	17.02	–
2004 Sep 30	3278.502	14.77	16.96	–
2004 Oct 01	3279.510	14.75	16.87	18.42
2004 Oct 02	3280.618	14.84	16.97	18.50
2004 Oct 03	3281.611	14.90	17.06	18.58

apertures to estimate the brightness of the star, $4''.1$ in Briceño et al. (2004) and $1''.85$ in Walter et al. (2004). In the case of a larger aperture the measurements include much light from the nebulous background around the object. The comparison of our data with the data published by Walter et al. (2004) shows a general decline in brightness of about $0^{m}.9$ (I) in the period February - October 2004. We find this decline real, because the expected errors from the different aperture used are of the order of 0.05 mag. The nebula surrounding V1647 Ori is variable also (Briceño et al. 2004) and its variability affects the estimated magnitudes. Therefore, the observed outburst of V1647 Ori was continued during the whole year.

The comparison of all available photometric data suggests that the light curve of V1647 Ori in the period of outburst resemble the well-studied FUor objects. The FUor or EXor outbursts are very rare phenomena but with a great importance for the pre-main sequence evolution. We know only a few objects from both classes and every new possible FUor or EXor attracts a great interest. Both FUors and EXors are characterized by large amplitudes of outburst (4-6 mag). While the EXors spend only a few weeks or months in the maximum brightness, the outbursts of FUors extend some decades. In the present the exact classification of V1647 Ori is not possible. The evidences for a previous outburst on 1966 (Mallas and Kreimer 1978) can be explained as a recurrent EXor event. The emission line spectrum and the low luminosity of V1647 Ori also support this statement. On the other hand the long time outburst, the light curve of the object and the observed SED (Ábrahám et al. 2004) are evidences for a new FUor event.

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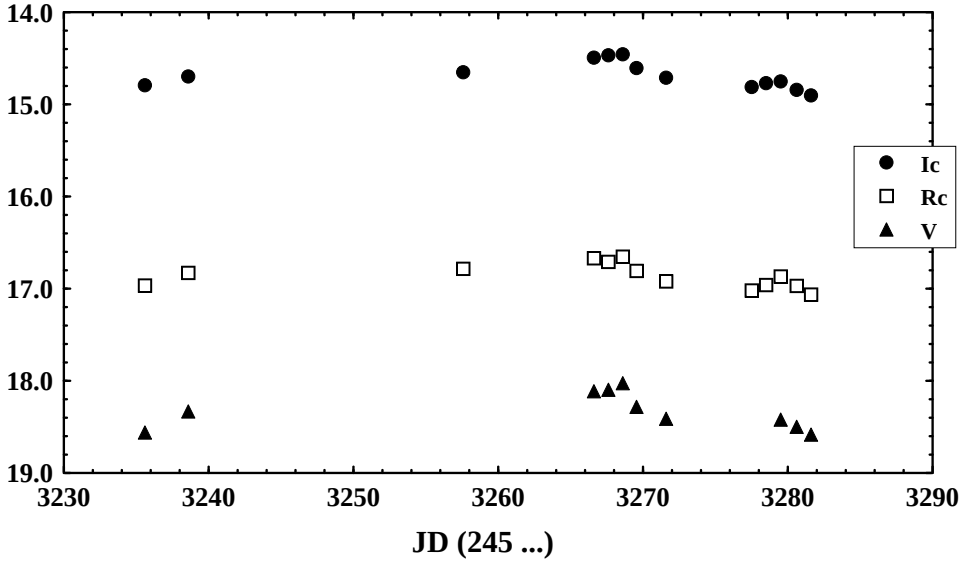

Figure 2. V, Rc and Ic light curves of V1647 Ori

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