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VRI LIGHT CURVE OF V1647 Ori IN THE PERIOD AUGUST 2004 – NOVEMBER 2005

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The Pre-Main-Sequence (PMS) object V1647 Ori (IRAS 05436-0007) is located in the dark cloud Lynds 1630 - a region of active star formation in the Orion B complex. V1647 Ori attracted a great interest in the past two years because of the sudden outburst documented by McNeil (2004). According to Briceño et al. (2004) the outburst began in November 2003 and the stellar brightness rose by 5 mag till February-March 2004. Since March 2004 the brightness of V1647 Ori slowly goes down, resembling other young eruptive variables like FUORs or EXORs (Walter et al. 2004). In our first paper (Semkov 2004) we reported data from VRI photometric observations of V1647 Ori in the period August - October 2004 suggesting for a gradual fading of the brightness. Recently, Kóspál et al. (2005) registered a rapid photometric fading of V1647 Ori since the period October - November 2005.

In this paper we present new VRI photometric data of V1647 Ori in the period November 2004 - November 2005. Our data were obtained in two observatories with three telescopes: the 2-m Ritchey-Chretien-Coude and 50/70/172 cm Schmidt telescopes of the National Astronomical Observatory Rozhen (Bulgaria) and the 1.3-m Ritchey-Chretien telescope of the Skinakas Observatory[1] of the Institute of Astronomy, University of Crete (Greece). The technical parameters for the CCD cameras used, observational procedure and data reduction process are described in Semkov (2003). All frames were taken through a standard Johnson-Cousins set of filters. Aperture photometry was performed using DAOPHOT routines. The frames obtained with the 2-m RCC and 1.3-m RC telescopes were reduced using the same aperture of $2''.5$ radius. The frames obtained with the Schmidt telescope were reduced with a $3''.3$ radius aperture.

The standard stars used for comparison are of great importance for the correct magnitude estimation. In regions of star formation like the Orion L1630 molecular cloud a great percentage of stars can be photometric variables. In our first paper (Semkov, 2004) we presented VRI photometric data for seven stars in the vicinity of V1647 Ori suitable for comparison. Using new photometric data we try to improve the VRI magnitudes of the comparison stars. Calibrations were made with the 1.3 m RC telescope during four clear nights in August and September 2005. Standard stars from Landolt (1992) were used as a reference. Table 1 contains our corrected photometric data for the VRI comparison

[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.

sequence. The corresponding mean errors of the mean and the coordinates of the stars are listed, too. The finding chart of the comparison sequence is presented in Semkov (2004). Our new photometric data of the comparisons agree well with the published ones in Semkov (2004) and the corresponding mean errors were improved considerably. We consider the star A from our list as a small amplitude variable. On some of our frames the stellar brightness drop up to $0\overset{m}{.}2(Ic)$ from the values published in Table 1. This object was registered as a $H\alpha$ emission star (Lk$H\alpha$ 302) by Herbig & Kuhi (1963) and it is probably a PMS star (T Tauri or Herbig Ae/Be star). The star F that we mentioned as a possible variable (Semkov 2004) appears to be constant from our new data. The star B from our list is equivalent to the comparison star used by Walter et al. (2004) for differential photometry. Our VRcIc values of this star agree well with those measured by Walter et al. (2004). Some stars from our list (C, D, E and F) were also measured by Henden (2004). Comparing our magnitudes with the data reported by Henden (2004) we find a good agreement for the V and Rc values. But for Ic magnitudes there is a systematic difference of about 0.2 mag.

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. 1 shows the V, Rc and Ic light curves of V1647 Ori for the period of our photometric observations (Semkov (2004) and the present paper). Regardless of the different telescopes and CCD cameras used a continuous slight decrease of brightness ($\sim 0\overset{m}{.}9$ mag for 1 year) can be observed. Our photometric data obtained in November 2005 show a big drop of the brightness of about $1\overset{m}{.}5$ (I) that supports the rapid fading of V1647 Ori in the period October - November 2005 reported by Kóspál et al. (2005). Therefore, the observed outburst of V1647 Ori extends at least two years.

Table 1. Photometric data for VRI comparison sequence.

Star	RA (J2000)	DEC (J2000)	V	σ_V	Rc	σ_R	Ic	σ_I
A	05 46 22.43	−00 08 52.5	15.177	.091	14.168	.073	13.154	.083
B	05 46 22.50	−00 03 35.9	15.640	.028	14.875	.034	14.247	.028
C	05 46 00.30	−00 08 25.5	16.902	.018	15.452	.015	13.619	.036
D	05 46 09.03	−00 02 15.0	17.847	.033	16.074	.041	14.038	.042
E	05 46 05.84	−00 02 39.4	17.926	.019	16.386	.023	14.703	.035
F	05 46 11.62	−00 02 19.8	18.646	.042	16.881	.041	14.608	.044
G	05 46 21.41	−00 09 06.4	18.839	.033	17.830	.051	16.236	.035

There are only a few papers (Briceño et al. 2004, Walter et al. 2004, McGehee et al. 2004, Semkov 2004, Kóspál et al. 2005) containing optical photometry of V1647 Ori and the construction of its light curve is difficult at the moment. There is a sizable discrepancy in the data published by different authors produced by various methods of brightness estimation, comparison stars and photometric systems used. In the case of a larger aperture the measurements include more light from the nebulous background around the object. In spite of these discrepancies the available photometric data suggests that the light curve of V1647 Ori resembles the well-studied FUOR objects (a short time brightness increase followed by a slight decrease). The light curve of the FUOR object V1515 Cyg also shows a rapid fading in 1980 (Hartmann & Kenyon 1996), as observed on V1647 Ori by Kóspál et al. (2005).

Table 2. Photometric observations of V1647 Ori in the period November 2004 - November 2005

Date	J.D.(245...)	*Ic*	*Rc*	*V*	Tel.
2004 Nov 19	3328.502	14.68	16.76	–	Schmidt
2004 Nov 21	3330.547	14.64	16.59	–	Schmidt
2004 Dec 08	3348.360	14.92	16.97	–	Schmidt
2004 Dec 10	3350.391	14.95	17.01	–	Schmidt
2005 Feb 10	3412.370	14.86	16.79	–	Schmidt
2005 Feb 11	3413.374	14.83	16.74	–	Schmidt
2005 Mar 12	3442.286	15.27	17.32	18.86	2m RCC
2005 Apr 03	3464.245	14.86	17.04	–	Schmidt
2005 Aug 14	3596.607	15.55	17.76	–	1.3m RC
2005 Aug 27	3609.592	15.59	17.76	19.47	1.3m RC
2005 Aug 28	3610.589	15.40	17.49	19.03	1.3m RC
2005 Aug 29	3611.587	15.64	17.76	19.35	1.3m RC
2005 Sep 03	3616.603	15.50	17.63	19.31	1.3m RC
2005 Sep 10	3623.604	15.77	–	19.31	1.3m RC
2005 Sep 11	3624.603	15.87	17.94	19.60	1.3m RC
2005 Sep 15	3628.581	15.88	18.02	19.57	1.3m RC
2005 Sep 19	3632.568	15.73	17.97	–	1.3m RC
2005 Sep 20	3633.585	15.86	18.04	19.70	1.3m RC
2005 Sep 25	3638.578	15.89	18.09	–	1.3m RC
2005 Oct 03	3646.580	15.82	17.94	19.48	1.3m RC
2005 Nov 03	3678.442	17.29	19.43	>21.0	2m RCC
2005 Nov 26	3701.349	17.43	–	–	Schmidt

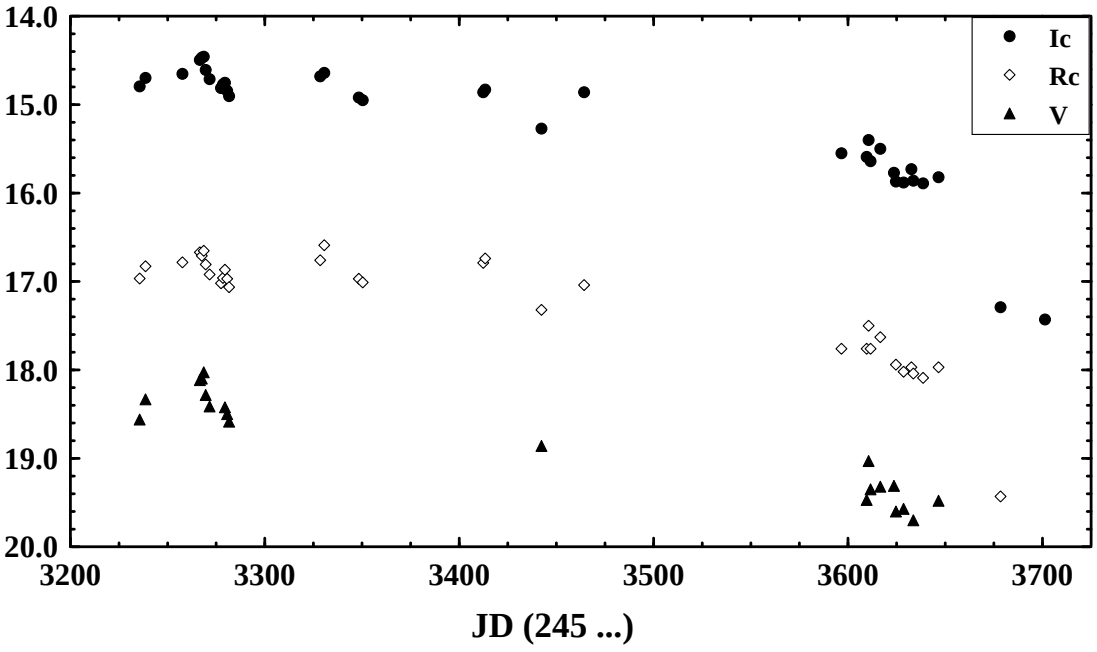

Figure 1. *V*, *Rc* and *Ic* light curves of V1647 Ori

The type of the observed outburst of V1647 Ori (FUOR or EXOR) is still undefined. The prototypes of FUORs and EXORs seem to be T Tauri stars with massive circumstellar disks. In both cases the observed outburst is explained by increased accretion from the circumstellar disk. While the EXORs spend only a few weeks or months in the maximum brightness, the outbursts of FUORs extend to some decades (Herbig 1989). This is only an empirical difference and the presence of an intermediate type (1-2 years long outburst) can be expected.

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