

Seasonal light variations of the contact system V839 Oph in 2007

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Abstract

New CCD BVRI light curves of the W UMa system V839 Oph, obtained in June, July and August of 2007, are presented. The within-season changes in the light curves over monthly, weekly and even daily time-scales are presented and possible mechanisms for such variations are discussed.

1. Introduction

The V839 Oph (BD 9° 3584, HD 166231, GSC 1009:0264, $\alpha_{2000} = 18^h 09^m 21^s$, $\delta_{2000} = 9^\circ 09' 04''$, Max=8.8 mag V, Min=9.4 mag V, spec. type F7V) is an eclipsing binary system of the W UMa type. Its light variability was initially determined by Rigollet (1945). More precise light elements were later calculated by Binnendijk (1960), followed by further photoelectric measurements by Wilson & O'Toole (1965), Lafta & Grainger (1985), Niarchos (1989) and Akalin & Derman (1997). Light curve analyses were made by Niarchos (1989), Lafta & Grainger (1985), Akalin and Derman (1997) (modelling and period analysis) and Pazhouhesh, Edalati & Bagheri (2001). Rucinski & Lu (1999) first published the true mass ratio of V839 Oph based on radial velocity measurements. These measurements were combined with photometric data by Pazhouhesh & Edalati (2003), and as a result the first reliable geometric and physical parameters of the system were derived. An analysis of the O-C values by Akalin & Derman (1997) and by Wolf, Sarounova & Molik (1996) showed changes of the orbital period of V839 Oph. The most recent CCD observations and modeling of the system, based on accurate photometric and spectroscopic observations, were presented by Gazeas, Niarchos & Gradoula (2006).

2. Observations

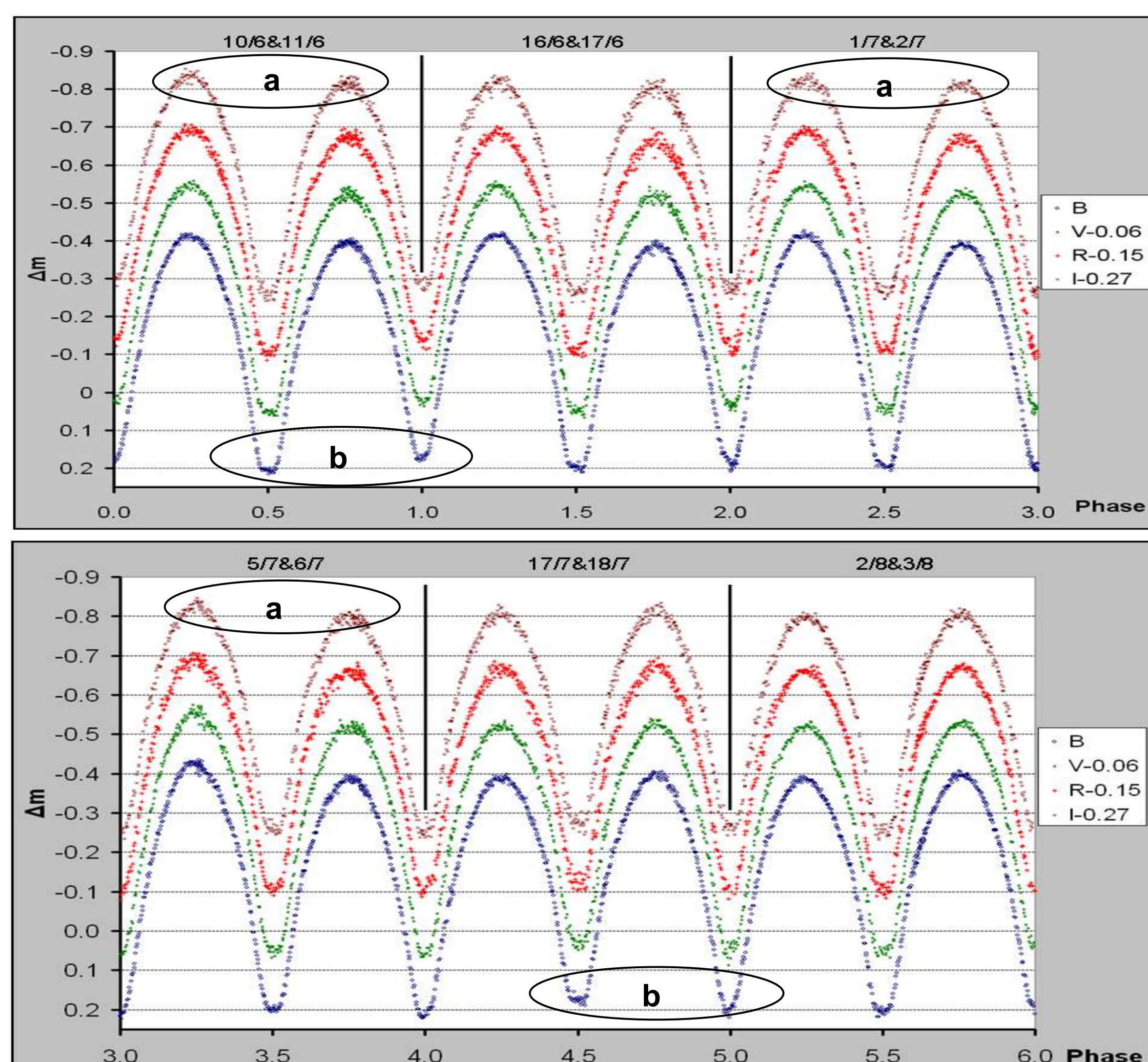
The system was observed with the 40 cm Cassegrain telescope of the Observatory of the University of Athens, equipped with the ST8XMEI CCD camera and Bessell BVRI filters. The observations were made on June 10, 11, 16, 17; July 1, 2, 5, 6, 17, 18; and August 2, 3, 2007. Differential magnitudes were obtained for the system. The standard deviation of our measurements was 0.005 mag on average in four filters. The stars GSC 1009:0464 (SAO 123174) and GSC 1009:0566 were used as comparison and check star, respectively. Ten times of minima from our observations, computed with the Kwee & van Woerden (1956) method, are given in Table 1, while the observed light curves are shown in Fig. 1.

Table 1. The times of minima from our observations (mean values in BVRI)

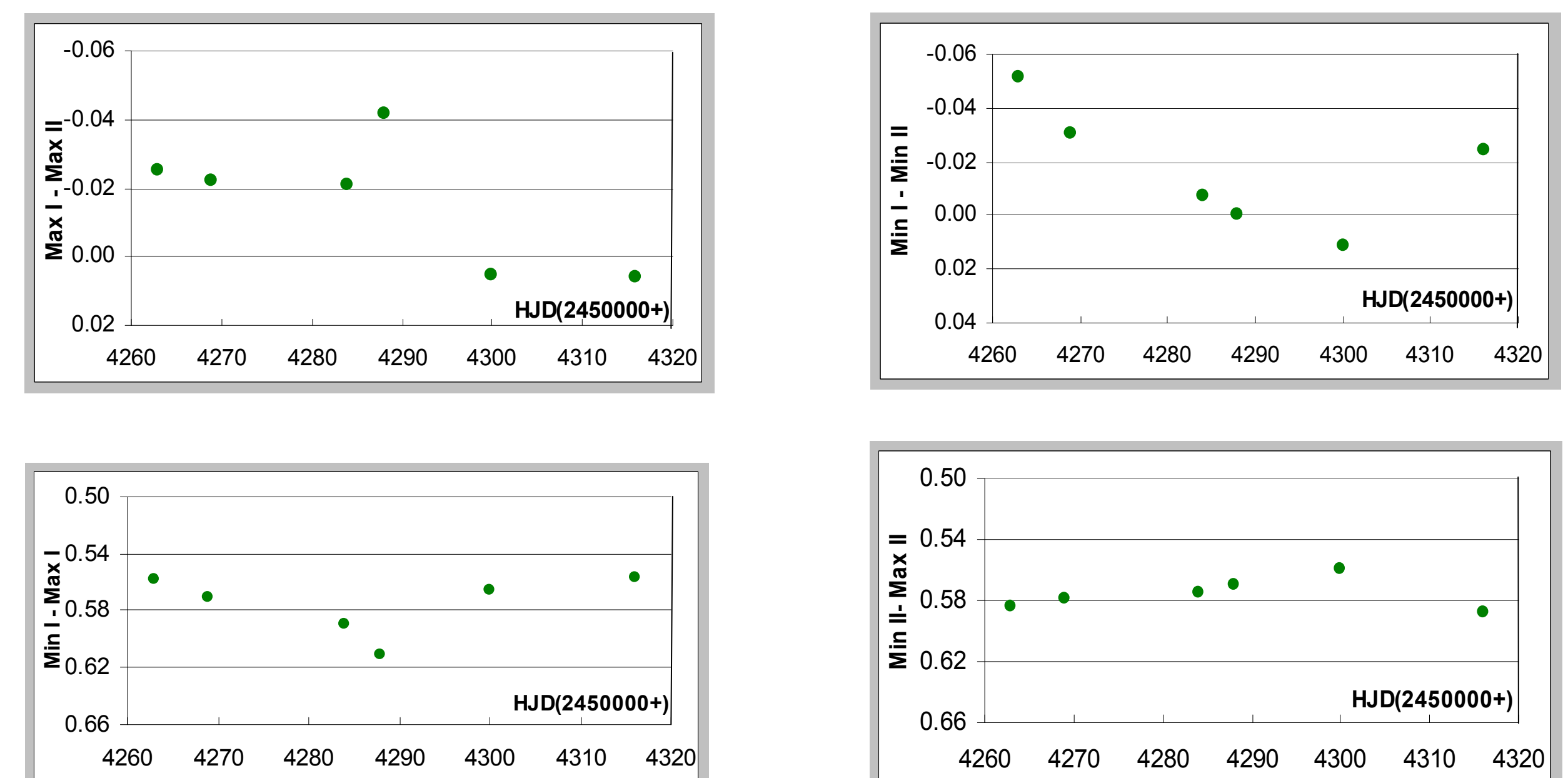
HJD	Error	Type	HJD	Error	Type
2454262.44601	0.00010	I	2454288.41924	0.00013	II
2454263.46952	0.00010	II	2454299.46193	0.00019	II
2454268.37802	0.00022	I	2454300.48374	0.00017	I
2454269.39891	0.00014	II	2454315.41286	0.00014	II
2454287.39454	0.00014	I	2454316.43549	0.00015	I

3. Light Curve Variations

The light curves obtained during the season June-August 2007 are shown in Figs. 1&2. The light variations in both the maxima and the minima are obvious and the largest differences are marked. Figs 3-6 show the variation with time of some characteristic quantities describing the shape of the light curves. The values of these quantities are given in Table 2.



Figs.1 & 2. The BVRI light curves of V839 Oph. The largest magnitude difference in maxima and minima are marked by a and b, respectively.



Figs. 3-6. Graphical representation of the variation of characteristic quantities describing the shapes of the light curves of V839 Oph in June-August 2007..

Table 2. Quantities describing the light variations of V839 Oph in V

HJD 2450000+	Max I	Max II	Max I - Max II	Min I	Min II	Min I - Min II	Min I - Max I	Min II - Max II
4263.0	-0.484	-0.459	-0.025	0.074	0.125	-0.051	0.558	0.584
4269.0	-0.481	-0.458	-0.022	0.089	0.120	-0.031	0.570	0.578
4284.0	-0.485	-0.464	-0.021	0.104	0.112	-0.008	0.589	0.576
4288.0	-0.502	-0.460	-0.042	0.110	0.110	-0.000	0.611	0.570
4300.0	-0.460	-0.465	0.005	0.106	0.095	0.011	0.566	0.560
4316.0	-0.460	-0.466	0.006	0.097	0.121	-0.024	0.557	0.587

4. Discussion and Conclusions

Multi-wavelength CCD observations of V839 Oph carried out on 12 nights in June, July and August 2007 show continuous light variations of the system. The light levels at maxima and minima as well as the depths of the minima, displayed in Figures 1 & 2, vary in a non systematic way. Variations exist in time scales of days, weeks, months and certainly of years. After excluding all possible effects of light extinction and/or the variability of the comparison star, the magnetic activity and/or temporal surface activities of the system could be the most probable reason for the observed light variations. Such an explanation, based on stellar magnetic activity has been given in the past by several investigators (Wolf, 1996, Akalin & Derman, 1997). Appreciable light variations in the two maxima (O'Connell effect) can be explained by the existence of cool and/or hot spot(s) on the surface of one or the two components of the system. Variations of smaller amplitude, occurring in phases other than quadratures and minima, are very probably due to local surface activities. Such variations are very difficult to describe by specific physical mechanisms associated with the system's general activity. Although our data are of high quality, they are not sufficient for a definite conclusion about the behaviour of long-term light variations. Nevertheless, our light curves confirm continuous variations of light levels at maxima and depths of the minima in short and longer time intervals.

Acknowledgements

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References

- Akalin A., Derman E.: 1997, *A&AS* **125**, 407.
- Binnendijk L.: 1960, *AJ* **65**, 79.
- Gazeas K. D., Niarchos P. G., Gradoula G.-P.: 2006, *Ap&SS* **304**, 125
- Kwee K. K., van Woerden H.: 1956, *Bull. Astron. Inst. of Netherlands*, **12**, 327
- Lafta S. J., Grainger J. F.: 1985, *Ap&SS* **144**, 23.
- Niarchos P. G.: 1989, *Ap&SS* **153**, 143.
- Pazhouhesh R., Edalati M. T., Bagheri M.: 2001, *IBVS* **5190**.
- Pazhouhesh R., Edalati M. T.: 2003, *IBVS* **5236**.
- Rigollet R.: 1945, *IAU Circ.*, 1013.
- Rucinski S., Lu W.: 1999, *AJ* **118**, 2451.
- Wilson R. E., O'Toole W.: 1965, *PASP* **77**, 58.
- Wolf M., Sarounova L., Molik P.: 1996, *IBVS* **4304**.