Long term optical photometric monitoring of η Carinæ

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Abstract

We present here the results of our optical monitoring program of the Luminous Blue Variable η Carinæ. We began this program to register the "eclipse-like" event, which ocurred in 2003.5. We have continued the monitoring of this object, aiming to complete the orbital period of 5.5 years of the proposed binary. Our observations consist of differential CCD photometry in the Johnson-Cousins optical bands $BVRI$, using the 0.8-m Reflector telescope at La Plata Observatory, Argentina. The light curves in the four bands, show a similar behavior. Fluctuations were present in every band and their amplitudes were not greater than 0.1 mag. η Car has slowly brightened reaching $V \sim 4.65$ during 2006.

Image 1. Colour composite image of η Car's field. Three of our images taken with the B, V and R filters were combined to compose this image. The "Homunculus" is clearly seen. Besides η Car, the objects in the field, used as comparison and check stars of the differential photometry, are identified:
1- η Carinæ
2- HDE 303308 (Tr16-7)
3- CPD-59 2628 (Tr16-1)
4- CPD-59 2627 (Tr16-3)

Observations

CCD images were obtained with the Photometrics STAR I direct camera attached to the 0.8-m Reflector Telescope at La Plata Observatory. The camera has a 384 x 576 pixel, Thomson TH7883PS coated CCD detector with 23 μm pixel size. This configuration results in 1'54" x 2'50" field images. A set of $BVRI$ passband filters, as those specificated by Bessell (1990), was used.

The photometry was performed since January 2003 up to date, except during the observing seasonal gaps during September and October every year. Some of these data have been published in Fernández Lajús et al. (2003, 2004, 2005). A new set of 3700 images has been obtained between 2005, November 16 and 2006, August 29, totalizing 11000 images since the beginning of the campaign in 2003.

The data reduction process and aperture photometry were performed using a script developed under IRAF. The differential magnitude of η Car is determined employing HDE 303308 ($V = 8.15$) as a comparison star. The aperture radius selected for η Car, of about 22", includes the whole surrounding nebula ("Homúnculus"). For measuring the other three brightest stars in the frames, which are used as comparison and check stars, we considered smaller aperture radii ($\sim 15''$). The zero points of the relative photometry correspond to the $UBVRI$ (Johnson) photometric magnitudes of HDE 303308 derived by Feinstein, Marraco and Muzzio (1973). The typical errors of the differential photometry are $\epsilon_B = 0.008$, $\epsilon_V = 0.005$, $\epsilon_R = 0.007$ and $\epsilon_I = 0.01$ mag.

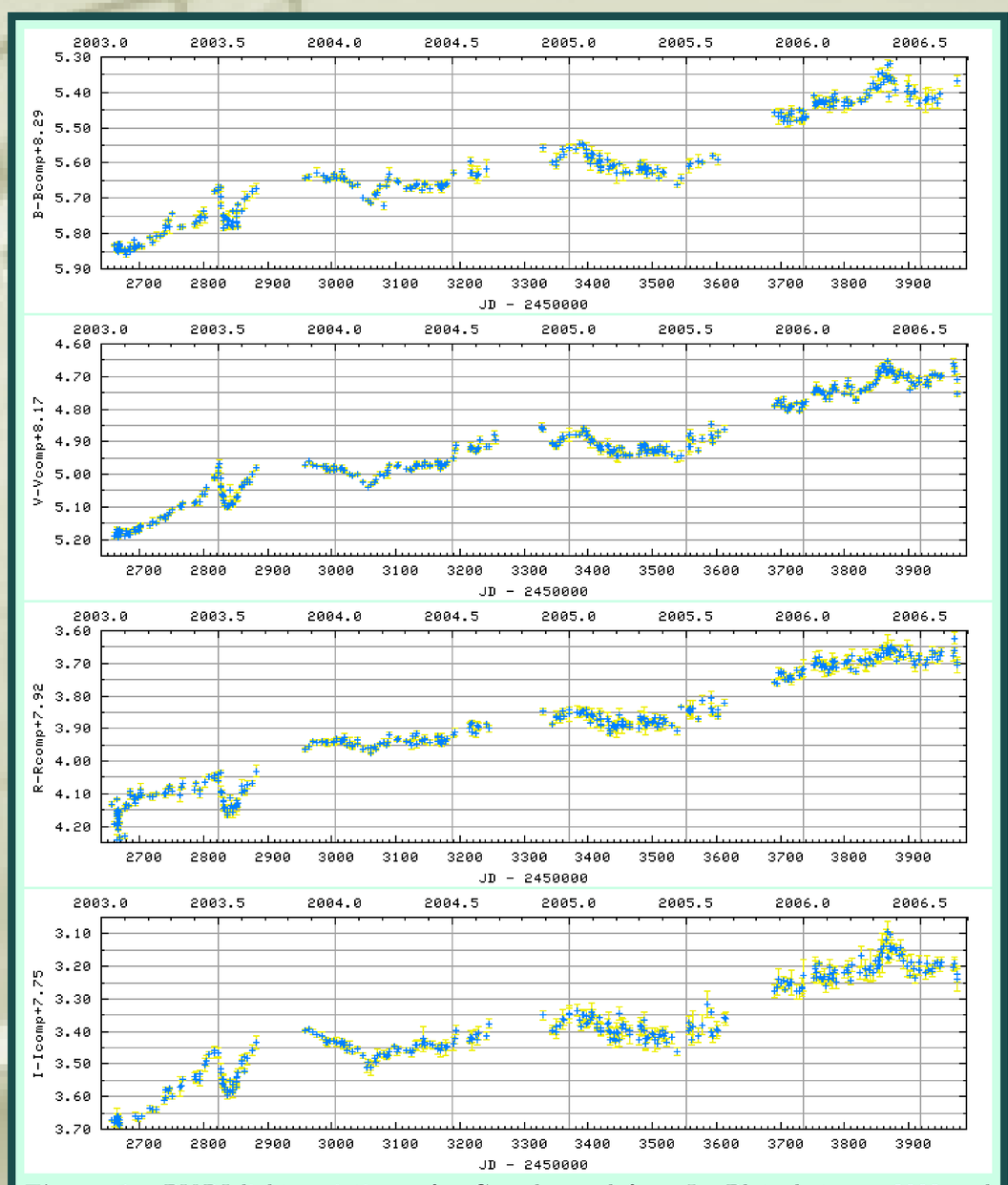

Figure 1. $BVRI$ light variations of η Car observed from La Plata between 2003 and 2006.

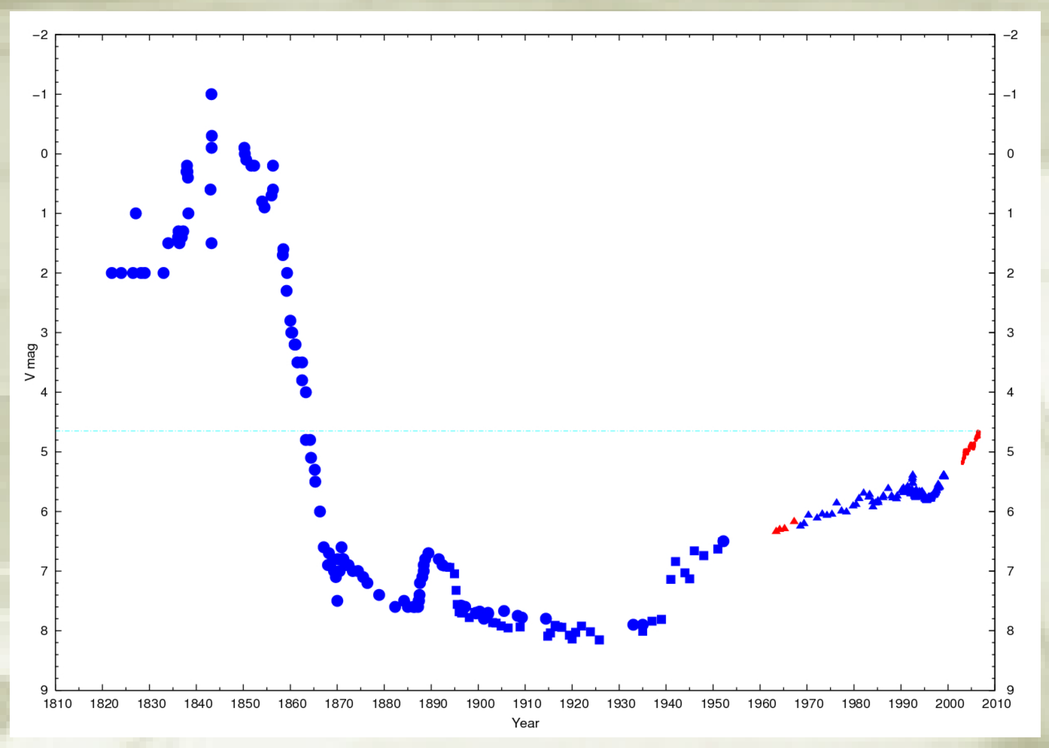

Figure 2. Optical light curve of η Car during the period 1820 - 2006 according to the papers of Innes (1903), Hoffleit (1933), Vaucouleurs & Eggen (1952), O'Connell (1956), Feinstein (1967), Feinstein & Marraco (1974), Sterken et al. (1996), Sterken et al. (1999), van Genderen et al. (2003), Fernández Lajús et al. (2003, 2004, 2005) and this work. The red points are observations carried out at La Plata Observatory (Feinstein (1967) and Fig. 1V of the present work).

Results

Figure 1 shows the light variations of η Car in the B, V, R and I bandpasses observed from La Plata since the beginning of our campaign in 2003. The gaps in the light curves correspond to the intervals in which η Car was not observable, separating the 2003, 2004, 2005 and 2006 monitoring periods. As it can be seen from the plots, during the 2006 observing season, the brightness of η Car and its nebula continued with the increasing tendency that it has shown since the campaign started. The rate of the brightness rise is about 0.13 mag/yr, which has remained close to this value for the last 8 years.

The 2006 data show that η Car has always been brighter than $V = 4.8$. The maximum visual magnitude that the object attained in this period is $V = 4.65$. The maximum is well-marked in the B, V and I band light curves (Fig. 1), whereas in the R band it is not well defined. At the end of the observing season, η Car reached again the maximum brightness ($V = 4.65$), after which a quick drop of ~ 0.1 *mag* was observed. This last event is not well documented due to the lack of visibility of the object.

Thus, until now, we have monitored more than a half of the 5.54 years orbital period of the binary system which η Car is supposed to be (Damineli et al. 2000; Corcoran, 2005).

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References

- Bessell M., 1990, PASP, 102 1181.
- Corcoran M. F., 2005, ApJ, 129, 2018.
- Damineli A., Kaufer A., Wolf B., Stahl O., Lopes D., de Araújo F., 2000, ApJ, 528, L101.
- Feinstein A. 1967, Observatory 87, 287.
- Feinstein A., Marraco H., & Muzzio J.C., 1973, A&AS, 12, 331.
- Feinstein A. & Marraco H.G. 1974, A&A, 30, 271.
- Fernández Lajús E., Gamen R., Schwartz M., Salerno N., Llinares C.; Fariña C., Amorín R., Niemela V., 2003, IBVS, 5477, 1.
- Fernández Lajús E., Fariña C., Gamen R., LLinares C., Salerno N., Schwartz M., Simontacchi L., Torres A., Niemela V., 2004, Boletín de la Asoc. Arg. de Astr., 47, 144.
- Fernández Lajús E., Schwartz M., Torres A., Salerno N., Fariña C., LLinares C., Simontacchi L., Gamen R., Niemela V., 2005, Boletín de la Asoc. Arg. de Astr., 48, 158.
- van Genderen A.M., Sterken C. & Allen W.A., 2003, A&A, 405, 1057.
- Hoffleit D., 1933, Harvard Bull. 893, 11.
- Innes R.T.A., 1903, Cape Annals, 9, 75B.
- O'Connell D.J.K., 1956, Vistas Astron. 2, 1165.
- Sterken C., de Groot M.J.H., & van Genderen A.M., 1996, A&AS, 116, 9.
- Sterken C., Freyhammer L.M., Arentoft T., van Genderen A.M., 1999, A&A, 346, L33.
- Vaucouleurs G. de, Eggen O.J., 1952, PASP 64, 185.

The observations are available at http://lilen.fcaglp.unlp.edu.ar/EtaCar