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THE RECOVERY PHASE AFTER THE 2009.0-EVENT OF η CARINÆ

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It is currently accepted that the massive and luminous star η Carinæ is comprised of at least a binary system, with a 5.5 years orbital period (e.g. Damineli et al., 2000). This assertion was firstly based on the evidence of many optical spectroscopic events registered since 1948 (Gaviola, 1953) up to the present (see Damineli et al., 2008 and references therein). Observations performed in other wavelengths from X-rays to mm-wavelengths confirmed that related events occurred with the same period and almost at the same orbital phase. Particularly, we reported the occurrence of a photometric event at the time of an expected spectroscopic event for 2003.5 (Fernández-Lajús et al., 2003).

At the beginning of 2009, η Car experienced a new "event", which was detected in different spectral regions (Corcoran, 2009; Fernández-Lajús et al., 2010, hereafter Paper II; Abraham, Breaklini and Miceli, 2009). This event indicates the starting of "cycle 12", enumerating the cycles since 1948 (Groh and Damineli, 2004). In Paper II, we presented the CCD optical ground-based photometry of the complete event, showing an "eclipse-like" feature similar to that we recorded in 2003.5. After the 2009.0 event, we continued the observations to register the light curves behaviour during the recovery phase after the "eclipse-like" event and to compare the evolution at the same orbital phases of the previous cycle reported by Fernández-Lajús et al. (2009, hereafter Paper I).

In this paper, we present the $BVRI$ and Hα CCD photometry of the recovery phase after the 2009.0 event, up to the end of our η Car 2009 observing season. The CCD images were acquired using the "Virpi S. Niemela" telescope at La Plata Observatory, with the same instrumental configuration already described in detail in Papers I and II. More than 8500 images were obtained during 79 nights between March 31 and August 25, 2009. As stated in Paper I, bias, dark and 'twilight' flat-field frames were meant to be acquired every night. However, on several occasions bad weather conditions prevented us from obtaining good quality flat-fields images. Even though we attempted to process images with Master calibrations frames, the resulting light curves presented a large number of points out of scale as a consequence of many bad quality flat-fields. For this reason, we decided to present only the data obtained from the uncalibrated images, considering that the light curves were practically the same as those obtained with the calibrated images. However, the calibration images were used to check the overall behaviour of the telescope and detector.

The resulting $BVRI$ and Hα light curves are depicted in Fig. 1. The η Car differential magnitudes, their mean values and its rms errors were determined as explained in Paper I. The typical rms errors of our data (also represented in Fig. 1) are: $\epsilon_B = 0.015$, $\epsilon_V = 0.006$, $\epsilon_R = 0.010$, $\epsilon_I = 0.015$ and $\epsilon_{H\alpha} = 0.015$ mag. The light curves are smoothed using natural cubic splines. These splines were extended backward using the data published in Paper II, in order to display the 2009.0 "eclipse-like" event observed during our 2009 observing season. The orbital phases are marked in the top axis. They are determined using the ephemeris given in Paper II and adding '11', which is the number of cycles from the first event registered in 1948 up to the date of the event (JD 2452819.8 or $\phi = 0$) related with that ephemeris (see Damineli et al., 2008).

The light curves of Fig. 1 show that the system keeps a brightening trend in the five photometric bands. It is remarkable that the brightening rate during this phase is higher than 0.4 mag year^{-1} in the BVR bands, 0.3 mag year^{-1} in I, and almost 0.9 mag year^{-1} in Hα. Thus, η Car has reached the magnitude $V \sim 4.6$, the maximum brightness achieved in the last one and a half century.

The differential photometry data of η Car and the two other nearby stars in the field, namely CPD -59 2627 and CPD -59 2628, are available online as an electronic table (`5915-t1.txt`) at the IBVS website. An example of the table is shown in Table 2 in Paper I.

The new time-series presented in this paper together with those already published in Papers I and II constitute the longest based-time of self-consistent photometric data of η Car currently available, which are useful for a better understanding of the present state of this object.

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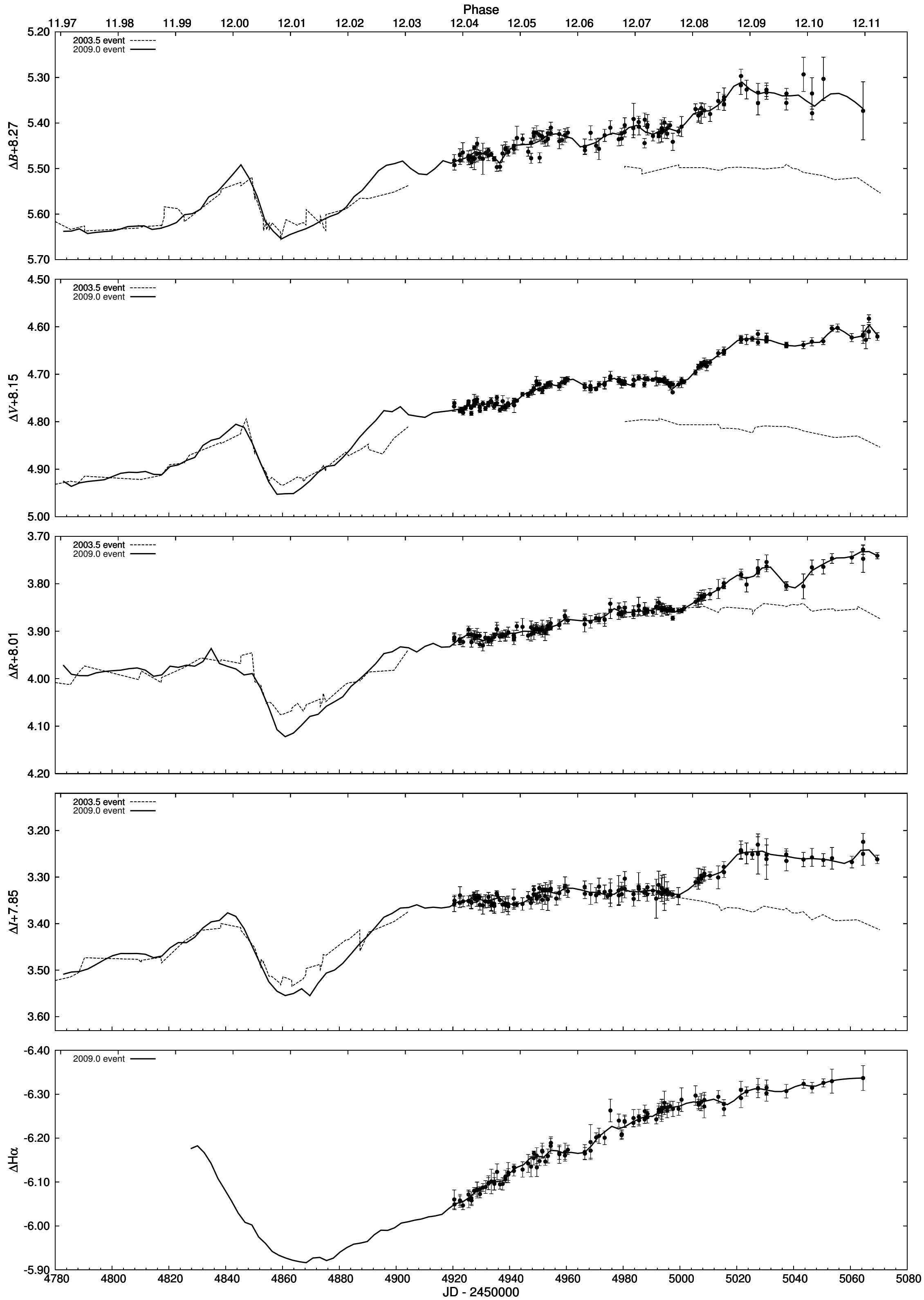

Figure 1. $BVRI$ and Hα light curves of η Car observed between March 31 and August 25, 2009. Bars represent the standard deviations of the mean values. The data were smoothed using splines. Along the top axis, orbital phases are indicated according to Paper II. The previous cycle light curves (dashed lines) were y-shifted to display them together for comparison.

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ERRATUM FOR IBVS 5838

In IBVS 5838, first page, third paragraph, the comparison star of V841 Cen is mentioned with two different HD numbers. The correct name of the star is HD 128227.

The Editors