

Quick DSLR Johnson V photometry and two weeks of follow-up observations of Nova Del 2013 at its maximum phase

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Abstract

A DSLR camera has been successfully used for quick photometry of the Nova Del 2013 in suburban sky conditions. We report eighteen photometry estimates of Nova Del 2013 performed since August 15.91 2013 at the Pope Silvester II's Astronomical Observatory in Bukowiec. We started using a Canon EOS 600D DSLR camera on a standard photographic tripod. The visual estimate of the Nova was 5.1 mag compared with the V measurement of 5.028 mag using HIP 101769 (F5, 3.62 mag), HIP 101958 (B9V, 3.77 mag) and HIP 97649 (A7V, 0.77 mag) as a reference stars. The star brightness has been monitored using a Canon EOS 400D DSLR camera throughout the following nights, contributing to the study of the early stages, before the maximum, of the brightest nova for the Northern hemisphere in the last decade. The calibration of the method is described.

keywords: nova, Nova Del 2013, photometry, DSLR photometry

Introduction

On August 14, 2013, Koichi Itagaki[1] discovered a nova in Delphinus using a 180-mm reflector with a CCD camera. Its initial visual magnitude was estimated at 6.8. The object received a temporary designation of PNVJ20233073+2046041, soon changed to Nova Del 2013 after confirmation. The nova continued to brighten for a few days after discovery, reaching a peak of 4.24.3 mag around August 16.5. Being a naked-eye object it has been accessible even to the most modest astronomical instruments, as well as it has been an excellent target for DLSR (*Digital single-lens reflex camera*) photometry. The possibility of conducting a standardized DSLR photometry has been conclusively demonstrated by several researchers, including Hoot (2007)[3], Páta et al. (2010)[5] and

recently by Kloppenburg et al. (2012)[4].

Since the set of Johnson filters bought by us has not yet been delivered, being aware of the opportunity, we have decided to perform such photometry on August 15, despite presence of clouds. Six follow-up sessions on Aug 16-17 and 22-25 have also been performed due to improved weather conditions and in order to verify the preliminary results, as well as to contribute to the study of this interesting nova.

Initial photometry

We report a very quick and rough DSLR photometry estimate of Nova Del 2013 performed on JD 2456520.41 (Aug 15.91) at the Pope Sylvester II's Astronomical Observatory in Bukowiec (N 51°41'28,23" E 019°40'32,80" h=214). For the original observations, we used a Canon EOS 600D DSLR camera with 18-55mm IS II lens set to focal length of 18mm (35mm equivalent focal length of 28.8mm) on a standard, unguided photographic tripod. The focal length had been chosen for the ease of rough pointing under light-polluted suburban skies, for reducing tracking errors and a wide field of view due to the very limited time in our disposal. The camera itself had not been modified apart from enhancing its firmware with the current Magic Lantern software. Prior to the observation, a number of dark (3) and flat (3) frames were obtained at the sensor cooled to ambient temperature. Bias frames were generated during image preprocessing. The series of images (10) taken at ISO 3200 and exposure times of 8 seconds was preprocessed (bias, dark and flat subtraction; alignment; channel separation). The whole imaging process was completed within a few minutes. Aperture photometry was performed on the series of G-frames using the IRAF software package and compared to the output from IRIS. Instrumental magnitudes for the nova and HIP 101769 (F5, 3.62 mag), HIP 101958 (B9V, 3.77 mag) and HIP 97649 (A7V, 0.77 mag) for comparison have been obtained. Calibration was performed, taking into account the air mass of 2.709 and atmospheric extinction using the method proposed by Henden and Kaitchuck (1982)[2], as well as SIMBAD

catalogue values for reference stars. While the Visual estimate of the Nova at the time of obtaining the image series was 5.1 ± 0.1 mag, the (transformed) V estimate was 5.028 ± 0.05 . Results of the observation have been submitted to the AAVSO database.

Follow-up photometry

During the course of the seven follow-up sessions, we used a Canon EOS 400D DSLR camera with EF-S 18-55mm kit lens again set to focal length of 18mm positioned a standard tripod. The camera, again, has not been modified apart from 400plus firmware enhancement. Again, prior to the observation, a number of dark (10) and flat (10) frames have been obtained in the course of each session. During session one (on Aug 15.91=JD 2456521.42) a series of 30 images at ISO 800 and exposure time of 20 seconds has been taken, 20 of which have been chosen for final processing based on the position of stars on frames. During session two (on JD 2456522.41) a series of 20 images at ISO 800 and exposure time of 15 seconds has been obtained. During session three (on JD 2456527.40) a series of 12 images at ISO 800 and exposure time of 15 seconds has been obtained. During session four (on JD 2456528.35) a series of 16 images at ISO 800 and exposure time of 15 seconds has been obtained. Sessions five to seven (on JD 2456529.32, 2456530.35 and 2456533.33) consisted of 8 exposures at ISO 800 of 20 seconds each. Again, instrumental magnitudes have been measured and compared to results from the same reference stars as in the course of the original observation and calibration was performed for airmasses of 1.864, 1.881, 1.844, 2.737, 1.752, 2.487 and 2.881 respectively.

Session one resulted in an estimate of Vis 4.6 ± 0.1 mag while the (transformed) V estimate was 4.76 ± 0.05 . As a result of session two, we obtained a Vis estimate of 4.8 ± 0.1 mag and the (transformed) V estimate of 4.86 ± 0.05 . Session three yielded estimates of Vis 5.8 ± 0.1 mag and the (transformed) V estimate of 5.857 ± 0.05 . Session four resulted in Vis estimate of 5.9 ± 0.1 mag and the (transformed) V estimate of 6.048 ± 0.05 . Session five gave estimates of Vis. 6.1 ± 0.1 mag and (transformed) V of 6.227 ± 0.05 mag while session six

resulted in estimates of Vis. 6.2 ± 0.1 mag and (transformed) V of 6.285 ± 0.05 mag and session seven resulted in estimates of Vis. 6.5 ± 0.1 mag and (transformed) V of 6.71 ± 0.05 mag. Again, all results have been submitted to the AAVSO database.

Summarized results of all observations are presented in table 1.

In fig. 3 the Nova is followed visually up to the nebular phase from other urban contexts by C. Sigismondi (SGQ) with a similar agreement of the visual estimates to the AAVSO collective data.

Discussion

The nova was easy to spot even in suburban conditions and at current brightness makes a good target for DSLR photometry. We have also confirmed the possibility of using a unmodified consumer-grade DSLR hardware (Canon EOS 600D). Despite a low number of dark and flat frames ($n=3$) and a short series of exposures ($n=10$), the results obtained are in general agreement with collective AAVSO data (fig. 1). Similar results have been obtained with an increased number of exposures taken at a lower ISO and longer times (with regard to ADU saturation). An increased number of comparison stars would also allow for increased accuracy. A wide frame (fig. 2) allowed for easy pointing of the camera, therefore similar results are possible with an older DSLR without a live image view (making DSLRs such as 350D or 400D an equally useable choice, as confirmed during the follow-up sessions). It is therefore feasible quickly and inexpensively to produce reasonably adequate Johnson V photometry with such modest means. Needless to say, taking a larger number of frames does produce even better results, but in case of a need to quickly estimate an object's brightness, a short series of dark and flat frames, as well as a relatively low number of exposures is sufficient, though preferably at lower ISO settings. Similar comment can be made in relation to the choice of reference catalogue and despite the possible errors introduced by pulling SIMBAD data (a reason why its use is contraindicated when more precise catalogues are available (Kloppenborg et al., 2012 [4]), it remains a valid reference for quick estimates such as the one presented in this

paper. Image processing can be performed with variety of software packages and, at least in case of IRAF, largely automated, which makes it even easier, and therefore more accessible to both amateur astronomers and amateur astronomical observatories, allowing them to participate in collaborative research projects, at least regarding Johnson V photometry. While not as accurate as proper CCD/UBV photometry, with proper training it can produce reasonably adequate scientific results. It can also be an excellent training before moving on to CCD photometric techniques.

Acknowledgement

We acknowledge with thanks the plots of Nova Del 2013's lightcurve (figures 1-3) based on observations from the AAVSO International Database as contributed by observers worldwide and used in this research.

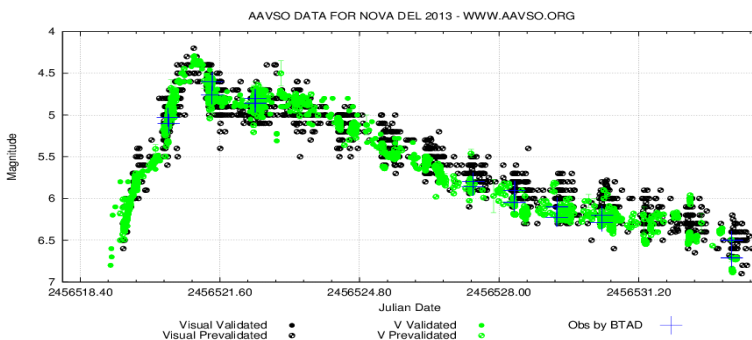


Fig. 1. A light-curve of Nova Del 2013 during the reported period of observations. Plot courtesy of AAVSO. Visual and Johnson V estimates obtained during the imaging session have been marked with a cross (BTAD obs code). Data obtained at the observatory seem to be in good agreement with other observations reported to AAVSO, confirming the suitability of DSLR observations in case of a bright Nova, such as Nova Del 2013.

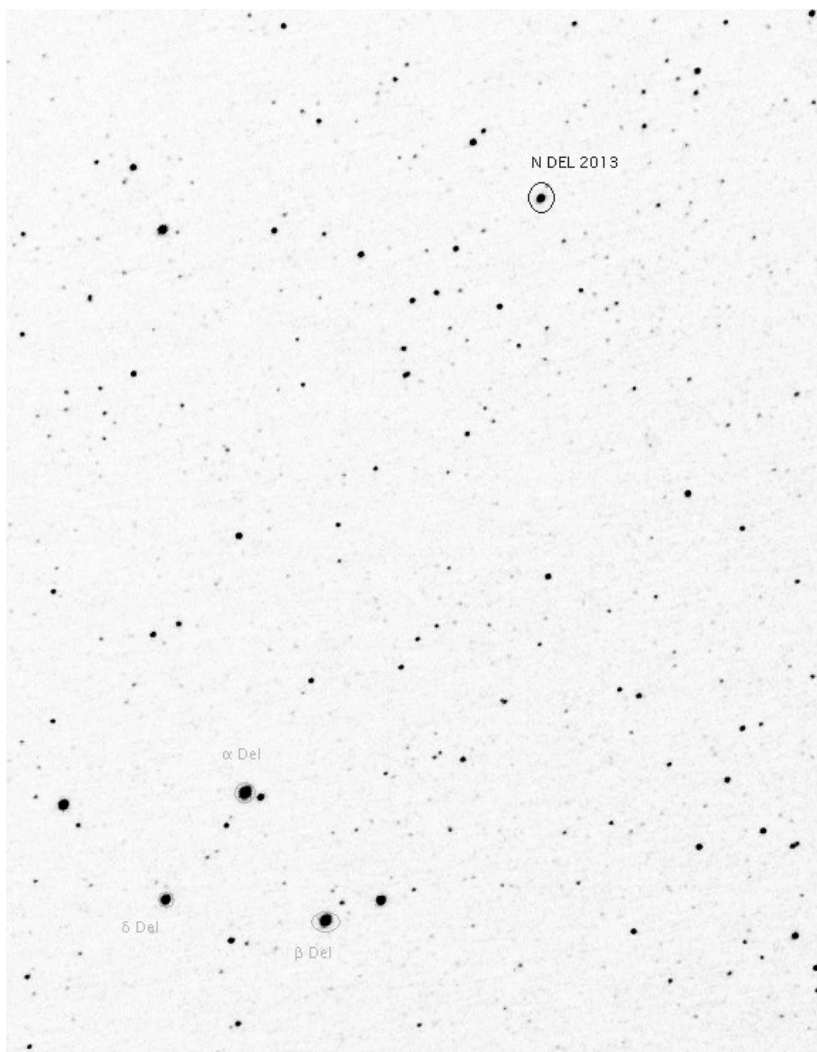


Fig. 2. *The Nova Del 2013 (little circle up-left) along with characteristic shapes of Delphinus as taken during our original observing session. Stacked image from the series of exposures by M. Kata, processing by T. Banys.*

date	type	mag	error	airmass	instrument
2456520.41	DSLR / V	5.028	0.05	2.709	CanonEOS 600D
2456520.4256	visual	5.1	0.1	-	10x50 binoculars
2456521.42083	DSLR / V	4.76	0.05	1.864	CanonEOS 400D
2456521.42228	visual	4.6	0.1	-	10x50 binoculars
2456522.41111	DSLR / V	4.86	0.05	1.881	CanonEOS 400D
2456522.41157	visual	4.8	0.1	-	10x50 binoculars
2456527.40	DSLR / V	5.857	0.05	1.844	CanonEOS 400D
2456527.4064	visual	5.8	0.1	-	10x50 binoculars
2456528.35	DSLR / V	6.048	0.05	2.737	CanonEOS 400D
2456528.3527	visual	5.9	0.1	-	10x50 binoculars
2456529.32	DSLR / V	6.227	0.05	1.752	CanonEOS 400D
2456529.32639	visual	6.1	0.1	-	10x50 binoculars
2456530.35	DSLR / V	6.285	0.05	2.487	CanonEOS 400D
2456530.35708	visual	6.2	0.1	-	10x50 binoculars
2456533.33	DSLR/V	6.71	0.05	2.881	CanonEOS 400D
2456533.3333	visual	6.5	0.1	-	10x50 binoculars

Tab 1. A list of observations performed (weather permitting) on Nova Del 2013.

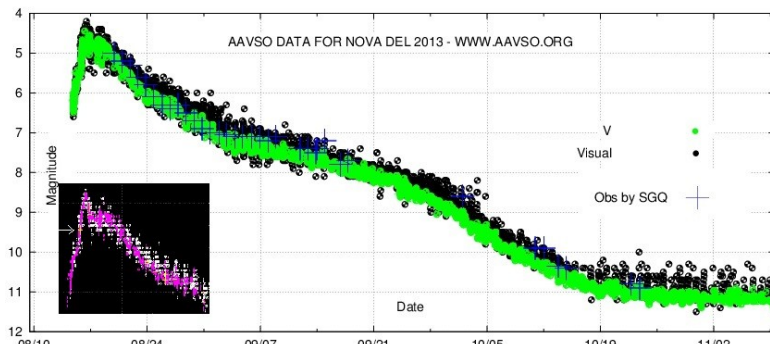


Fig.3. The light curve of the first three months, up to the nebular phase of the Nova Del 2013. AAVSO data and SGQ (C. Sigismondi [6]) visual observations from Rome and Lanciano (both urban sites), with binoculars 12x50 and telescopes 30x75 and 50x203 (Schmidt Cassegrain). The box at bottom left contains the observations of BTAD code in the period of time described in the text from 15.91 to 28.83 August 2013.

Bibliography

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IAU Central Bureau for Astronomical Telegrams' "Transient Object Followup Report" for PNV J20233073+2046041 is available online at:
<http://www.cbat.eps.harvard.edu/unconf/followups/J20233073+2046041.html>