

U, B, V, R_c, I_c Photometric Observations of the Dwarf Nova DX Andromedae During the Years 2018–2019

Corrado Spogli

Via Palazzolo 21 Frazione, Spada 06020 Gubbio (PG), Italy; corradospogli@yahoo.it

Gianni Rocchi

Via Achille Grandi 14, 06038 Spello (PG), Italy; giannirocchi2@gmail.com

Dario Vergari

Via Cantalmaggi 24, 06024 Gubbio (PG), Italy

Stefano Ciprini

Space Science Data Center, Agenzia Spaziale Italiana (SSDC-ASI), I-00133, Roma, Italy, and Istituto Nazionale di Fisica Nucleare (INFN), Sezione di Roma Tor Vergata, I-00133, Roma, Italy; stefano.ciprini.asdc@gmail.com

Received August 26, 2020; revised September 16, 2020; accepted September 16, 2020

Abstract In this paper we present U, B, V, R_c, I_c photometric observations of the dwarf nova DX Andromedae made in the years 2018–2019 at the private Rocchi observatory located in Spello (Umbria). We observed the variable for 86 nights in B, V, R_c, I_c photometric filters. We detected an outburst of this dwarf nova. We summarize the significant variations in the color indices during the outburst cycle and in the minimum phase.

1. Introduction

Cataclysmic variables are binaries with a white dwarf accreting from a main sequence or subgiant companion. An important subclass is the dwarf novae. They are characterized by recurrent outbursts in the optical light curve, and typical amplitudes of the outbursts are in the range of 2 to 6 magnitudes. The outbursts occur at intervals typically ranging from a few days to months. These values are typical for the most pre-eminent members of the class, but the less well studied class of WZ Sge objects have longer recurrence times and may dominate the total population of CVs. DX Andromedae was discovered by Romano (1958) as a variable star and it was clear by the early 1960s that DX And could be classified as a dwarf nova of the U Gem type (Weber 1962). Data held by the AAVSO extending back to the early 1980s (Mattei 1980) show that the outburst occur at intervals of between eight months and a year. Bruch *et al.* (1987) observed DX And photographically over 10 nights between 1980 and 1983 and caught the star once in outburst. Echevarria (1984) observed the variable photometrically in UBVR_i and listed colors for DX And, (B–V)=0.3 and (U–B)=–0.55, that were obtained when the variable was at an intermediate level of brightness (mv=13.5). In 1987 another outburst was observed by members of the AAVSO (Mattei *et al.* 1987). Spectroscopic observations were made by Bruch (1989), who reported that DX And exhibits a considerable contribution of the secondary star to the continuum energy distribution as well as the line spectrum. Drew *et al.* (1993) determined a binary period of 0.44167 day and a mass ratio of 0.96 through spectroscopic observations when DX And was at minimum.

Drew *et al.* (1993) reported that the distance to DX And is 630 pc and the star is 180 pc below the galactic plane. Recent measurements estimate the distance for this variable at 599 pc;

this value can be found in the Gaia catalog (Gaia Collab. 2016, 2018). Hilditch (1995) found that the star shows light variations over the 10.6-h orbital period explained primarily by an ellipsoidal variation of amplitude 0.13 mag caused by synchronous rotation of the roche-lobe-filling companion star. Hilditch (1995) studied the color indices (R–I) and classified the secondary of DX And as a KO-1 V star. Now DX And is a well-known dwarf nova with a long outburst recurrence time (270–330 days (Šimon 2000)) and a long orbital period (P=10.6 hours, Bruch *et al.* 1997). Spogli *et al.* (2006, 2007) reported UBVR_i observations of two outbursts of this star and the relative light curves. Spogli *et al.* (2006), analyzing 40 photometric observations in the R_c filter at minimum, reported a phase-diagram of DX And in quiescence considering a hypothetical period of 10.645 days. This variation is superimposed on an ellipsoidal variation well defined by Hilditch (1995). The origin of the additional variability is unknown; probably there is a third body around the binary system, but with the small number of data points, random or red noise variability cannot be ruled out easily. In this paper we present the results of our observations made in the years 2018–2019 at Gianni Rocchi’s amateur astronomical observatory.

2. Photometric observations and light curve

The star was monitored for 86 nights from 28 September 2018 to 7 March 2019. The outburst of this dwarf nova began on 8 December 2018 and it ended on 26 December 2018. We observed DX And during the outburst for 10 nights, all the nights it was possible. The rise phase lasted two days. The maximum of the outburst was reached on 10 December 2018. The star remained at maximum for another two days before starting a slow decline that lasted until 26 December. All the

observations were obtained with a 0.12-m f/7 apochromatic refractor telescope by Skywatcher Esprit trade-mark, equipped with an Orion G3 CCD camera (Sony Ic × 419all), R_c, I_c Schuler filters, and U, B, V Baader filters. The exposure time was 240 sec. Our photometric system has been carefully tested by observing the M67 sequence (Chevalier and Ilovaisky 1991). The CCD frames were first corrected for de-biasing and flat fielding, then processed for aperture photometry. All the B, V, R_c, I_c data were obtained in differential photometry using the photometric comparison stars C1, C2 reported by Spogli *et al.* (2007). The U magnitudes were measured only during the outburst and for a few days after the decline when the star was in minimum phase. We note that the outburst amplitude is larger at higher frequencies: that is, in the different bands we have $\Delta U=5.4$, $\Delta B=4.8$, $\Delta V=3.7$, $\Delta R_c=3.1$, $\Delta I_c=3.0$. All photometric data are reported in Table 1. Data are not corrected for interstellar reddening.

In Table 2 we report the maximum and minimum values, and the mean values at minimum for DX And.

In Figure 1 we report the light curve of DX And during the years 2018–2019 in all the filters we used at Gianni Rocchi's private amateur observatory. We left out the error bars because they are smaller than the data points here.

If we consider only a single filter, the light curve is well represented by Figure 2 in which we can see clearly an outburst of type B (Drew *et al.* 1990).

In type B outbursts the instability occurs as a result of redistribution of the surface density in the inner parts of the disc and propagation inward and outward. Hence, the outburst begins almost simultaneously at all wavelengths and the emission is very strong in the U band. The instability of the B type outburst, starting in the inner parts of the disk and propagating outwards (inside-out outburst), produces a rather symmetric light curve with a relatively low mass transfer rate (Smak 1984).

The oscillations are between R_c magnitudes 14.4 and 14.7. The star oscillates between V magnitudes 15.0 and 15.3. In B band at minimum there is a wide scattering of values. The star oscillates between B magnitudes 15.8 and 16.3.

The mean value is around I_c = 14.05 magnitude, but there is a large scattering from 13.8 to 14.4 of I_c magnitude. We calculated the difference in magnitude between one comparison star and the other, and we found that the mean value of $I(c2) - I(c1) = 0.72 \pm 0.08$ magnitude and the data display on a straight line. Therefore, the sky around Spello is not affected by pollution, and the large scattering is a peculiar feature of the variable.

3. A study of color indices

During the minimum phase the color indices of DX And are fairly stable and they oscillate around mean values. In the outburst phase there is rapid variation in all color indices that is tending to assume negative values or close to zero. Data on color indices are reported in Table 3. Our data are in agreement with the color indices reported by Hildtch (1995) and Echevarria *et al.* (1984) for a secondary of KO-1 V.

In Figure 8 we can see that during the maximum of the outburst the color index (U–B) is included between –0.5 and –1 and during the decline between –0.5 and 0.0. At minimum

(U–B) varies from 0 to 0.5.

In Figure 9 we can see that at minimum (B–V) is between 1.4 and 0.6, while in outburst it is between 0.2 and 0.0.

At minimum (V–I_c) is between 1.4 and 0.6, while in outburst it is between 0.2 and 0.4.

4. The time series in V and R_c bands

We performed time series observations on two nights for DX And, on 06 February 2019 and 08 February 2019, the first in R_c band, the second in V. The star was observed in R_c for almost 2.1 hours for a total of 32 photometric observations, while with the V filter 34 photometric observations were obtained over 2.3 hours. In Tables 4 and 5 we report all data. In Table 6 we report the data for a star in the field of DX And. We can see the stability of this star in respect to DX And, which confirms that our photometric system is stable and that the dwarf nova is affected by flickering caused by variations in the mass transfer rate from the secondary to the disc and to the primary. The oscillations in V are between magnitudes 14.95 and 15.20, while in R_c they are between 14.40 and 14.63.

5. Conclusions

We have presented our U, B, V, R_c, I_c observations of DX And, a dwarf nova characterized by a long interval between two consecutive outbursts. The star has been observed for 86 nights: 76 nights when the star was at minimum and 10 nights when the star was in outburst.

The profile of the outburst and the time-scales confirm the results obtained by Šimon (2000). Also, the color indices are in substantial agreement with our previous B, V, R_c, I_c observations (Spogli *et al.* 1998, 2006, 2007). These new data increase the historical database on this variable source and they can help to constrain theoretical models.

6. Acknowledgements

Thanks to the boys of the Cero di Sant'Antonio and to the St. Anthony Corporation bearers with whom Corrado Spogli has shared the honor of carrying on his shoulders the "Cero of St. Anthony" (a heavy candle-shaped wooden structure) up to Mount Ingino in Gubbio for almost fifty years every May 15th to celebrate the Patron Saint of the city that is Saint Ubaldo.

References

- Bruch, A. 1989, *Astron. Astrophys., Suppl. Ser.*, **78**, 145.
- Bruch, A., Fischer, F.-J., and Wilmsen, U. 1987, *Astron. Astrophys., Suppl. Ser.*, **70**, 481.
- Bruch, A., Vriellmann S., Hessman F. V., Kochsiek, A., and Schimpke, T. 1997, *Astron. Astrophys.*, **327**, 1107.
- Chevalier, C., and Ilovaisky, S. A. 1991, *Astron. Astrophys., Suppl. Ser.*, **90**, 225.
- Drew, J. E., Hoare, M. G., and Woods, J. A. 1990, *Mon. Not. Roy. Astron. Soc.*, **250**, 144.
- Drew, J. E., Jones, D. H. P., and Woods, J. A. 1993, *Mon. Not. Roy. Astron. Soc.*, **260**, 803.

- Echevarria, J. 1984, *Rev. Mex. Astron. Astrofis.*, **9**, 99.
 Gaia Collaboration, et al. 2016, *Astron. Astrophys.*, **595A**, 1.
 Gaia Collaboration, et al. 2018, *Astron. Astrophys.*, **616A**, 1.
 Hilditch, R. W. 1995, *Mon. Not. Roy. Astron. Soc.*, **273**, 675.
 Mattei, J. A. 1980, private communication.
 Mattei, J. A., Langhans, T., and Dyck, G. 1987, *IAU Circ.*, No. 4387, 1.
 Romano, G. 1958, *Mem. Soc. Astron. Ital.*, **29**, 177.
 Šimon V. 2000, *Astron. Astrophys.*, **364**, 694.
 Smak J. 1984, *Acta Astron.*, **34**, 161.
 Spogli, C., Fiorucci, M., Capezzali, D., Rocchi, G., Mancinelli, V., Brunozzi, P., and Fagotti, P. 2006, *Inf. Bur. Var. Stars*, No. 5716, 1.
 Spogli, C., Fiorucci, M., Rocchi G., and Capezzali, D. 2007, *Inf. Bur. Var. Stars*, No. 5792, 1.
 Spogli, C., Fiorucci, M., and Tosti, G. 1998, *Astron. Astrophys. Suppl. Ser.*, **130**, 485.
 Weber, R. 1962, *Mem. Soc. Astron. Ital.*, **33**, 39.

Table 1. U, B, V, R_c, I_c observed magnitude data for the dwarf nova DX And.

Date	JD (2450000.0+)	U	Error	B	Error	V	Error	R _c	Error	I _c	Error
09/23/18	8386.25	—	—	16.24	0.02	15.01	0.01	14.52	0.01	13.98	0.01
09/26/18	8388.30	—	—	0.68	0.02	15.14	0.01	14.47	0.01	14.06	0.02
09/27/18	8389.26	—	—	15.97	0.02	15.13	0.01	14.55	0.01	—	—
09/28/18	8390.26	—	—	16.19	0.02	15.18	0.01	14.58	0.01	—	—
09/29/18	8391.36	—	—	—	—	15.25	0.02	—	—	—	—
10/02/18	8394.33	—	—	16.08	0.04	15.06	0.02	14.53	0.01	14.09	0.02
10/03/18	8395.26	—	—	16.16	0.02	15.24	0.01	14.68	0.01	14.08	0.01
10/07/18	8399.30	—	—	16.41	0.02	15.22	0.01	14.66	0.04	14.39	0.01
10/08/18	8400.28	—	—	16.08	0.01	15.11	0.03	14.48	0.01	13.91	0.01
10/12/18	8404.27	—	—	16.09	0.02	15.06	0.02	14.47	0.01	13.97	0.01
10/13/18	8405.27	—	—	15.93	0.02	15.09	0.01	14.59	0.01	13.96	0.02
10/19/18	8411.25	—	—	15.99	0.05	15.16	0.01	14.55	0.01	13.94	0.04
10/20/18	8412.24	—	—	16.31	0.02	15.09	0.01	14.58	0.01	14.09	0.02
10/22/18	8414.25	—	—	16.18	0.05	15.21	0.03	14.54	0.01	14.21	0.03
10/23/18	8415.25	—	—	16.03	0.01	15.03	0.01	14.34	0.02	13.99	0.03
10/24/18	8416.26	—	—	16.04	0.02	15.21	0.01	14.61	0.01	13.97	0.01
10/25/18	8417.25	—	—	15.92	0.02	15.11	0.02	14.63	0.01	14.03	0.02
11/06/18	8429.25	—	—	16.21	0.01	15.12	0.03	14.63	0.01	14.33	0.01
11/08/18	8431.31	—	—	16.05	0.05	15.11	0.05	14.46	0.03	13.94	0.04
11/09/18	8432.34	—	—	16.01	0.01	15.21	0.01	14.55	0.02	14.33	0.01
11/10/18	8433.26	—	—	16.04	0.02	15.15	0.01	14.58	0.01	13.97	0.01
11/11/18	8434.24	—	—	16.06	0.02	15.12	0.02	14.49	0.01	13.95	0.02
11/12/18	8435.27	—	—	15.86	0.04	15.08	0.01	14.54	0.03	14.07	0.03
11/13/18	8436.26	—	—	16.11	0.01	15.13	0.03	14.43	0.02	13.89	0.04
11/15/18	8438.27	—	—	15.99	0.02	15.10	0.02	14.51	0.04	13.93	0.01
11/16/18	8439.25	—	—	16.07	0.01	15.11	0.01	14.49	0.01	13.94	0.03
11/17/18	8440.26	—	—	16.19	0.01	15.19	0.01	14.61	0.01	14.13	0.03
11/18/18	8441.21	—	—	16.02	0.01	15.16	0.02	14.52	0.01	13.95	0.02
11/28/18	8451.27	—	—	15.97	0.01	15.12	0.02	14.58	0.01	14.05	0.02
11/29/18	8452.28	—	—	15.89	0.05	15.02	0.04	14.51	0.01	13.96	0.05
11/01/18	8454.22	—	—	16.06	0.01	15.11	0.02	14.53	0.01	13.95	0.02
12/04/18	8457.33	—	—	16.03	0.05	15.08	0.04	14.66	0.01	13.99	0.05
12/05/18	8458.26	—	—	16.05	0.01	14.89	0.02	14.45	0.01	13.72	0.05
12/08/18	8461.21	—	—	12.41	0.02	12.38	0.01	12.22	0.01	12.17	0.03
12/08/18	8461.22	—	—	12.34	0.03	12.35	0.03	12.19	0.01	12.09	0.03
12/08/18	8461.23	—	—	12.39	0.05	12.36	0.02	12.18	0.05	12.11	0.02
12/08/18	8461.25	—	—	12.34	0.01	12.35	0.03	12.22	0.03	12.08	0.01
12/08/18	8461.26	—	—	12.35	0.01	12.37	0.05	12.19	0.01	12.12	0.03
12/08/18	8461.28	—	—	12.37	0.05	12.32	0.04	12.20	0.01	—	—
12/09/18	8462.30	11.61	0.11	11.83	0.01	11.81	0.03	11.68	0.02	11.59	0.02
12/10/18	8463.23	11.11	0.14	11.69	0.02	11.72	0.03	11.48	0.02	11.45	0.04
12/10/18	8463.25	11.03	0.05	11.68	0.02	11.69	0.02	11.57	0.02	11.42	0.04
12/10/18	8463.27	10.94	0.05	11.67	0.02	11.70	0.02	11.54	0.02	11.41	0.04
12/10/18	8463.37	11.15	0.02	11.72	0.02	11.71	0.02	11.51	0.02	11.45	0.02
12/11/18	8464.24	11.11	0.12	11.71	0.03	11.69	0.02	11.54	0.02	11.44	0.04
12/11/18	8464.26	11.27	0.01	11.76	0.01	11.73	0.02	11.56	0.02	11.41	0.05
12/11/18	8464.28	11.14	0.08	11.85	0.01	11.74	0.01	11.58	0.01	11.48	0.02
12/11/18	8464.29	11.28	0.04	11.79	0.02	11.76	0.02	11.57	0.02	11.44	0.01
12/11/18	8464.31	11.23	0.03	11.71	0.02	11.71	0.02	11.51	0.02	11.41	0.01
12/11/18	8464.34	11.16	0.04	11.77	0.02	11.68	0.02	11.52	0.02	11.47	0.01
12/11/18	8464.35	11.22	0.02	11.73	0.02	11.65	0.02	11.49	0.02	11.38	0.01
12/12/18	8465.22	11.08	0.15	11.73	0.01	11.71	0.01	11.52	0.01	11.44	0.05
12/15/18	8468.25	11.45	0.02	12.06	0.01	11.95	0.01	11.81	0.01	11.65	0.02

Table continued on next page

Table 1. U, B, V, R_c, I_c observed magnitude data for the dwarf nova DX And, cont.

<i>Date</i>	<i>JD</i> (2450000.0+)	<i>U</i>	<i>Error</i>	<i>B</i>	<i>Error</i>	<i>V</i>	<i>Error</i>	<i>R_c</i>	<i>Error</i>	<i>I_c</i>	<i>Error</i>
12/18/18	8471.27	11.78	0.21	12.43	0.01	12.28	0.02	12.08	0.02	11.92	0.03
12/23/18	8476.37	13.33	0.16	13.64	0.05	13.44	0.02	13.14	0.02	12.81	0.02
12/23/18	8476.39	13.36	0.04	—	—	—	—	—	—	—	—
12/23/18	8476.39	13.41	0.05	—	—	—	—	—	—	—	—
12/23/18	8476.40	13.32	0.07	—	—	—	—	—	—	—	—
12/25/18	8478.20	14.41	0.03	14.65	0.01	14.34	0.01	13.93	0.01	13.62	0.01
12/25/18	8478.21	14.35	0.02	—	—	—	—	—	—	—	—
12/25/18	8478.21	14.41	0.04	—	—	—	—	—	—	—	—
12/25/18	8478.21	14.29	0.03	—	—	—	—	—	—	—	—
12/25/18	8478.22	14.27	0.05	—	—	—	—	—	—	—	—
12/26/18	8479.19	15.01	0.14	15.29	0.02	14.71	0.01	14.17	0.01	13.70	0.02
12/26/18	8479.21	15.37	0.07	—	—	—	—	—	—	—	—
12/27/18	8480.26	15.74	0.04	15.72	0.02	14.94	0.01	14.39	0.01	13.93	0.01
12/27/18	8480.27	15.91	0.03	—	—	—	—	—	—	—	—
12/29/18	8482.20	—	—	15.92	0.02	15.06	0.01	14.41	0.02	13.91	0.02
12/30/18	8483.20	16.43	0.02	15.91	0.02	14.99	0.01	14.39	0.01	13.88	0.03
12/31/18	8484.20	—	—	15.84	0.01	15.11	0.02	14.51	0.02	13.94	0.02
01/01/19	8485.24	—	—	16.07	0.03	15.06	0.04	14.46	0.01	13.91	0.01
01/02/19	8486.20	—	—	15.91	0.02	15.12	0.02	14.48	0.01	14.04	0.02
01/03/19	8487.20	16.27	0.02	15.97	0.01	15.07	0.02	14.47	0.01	14.03	0.01
01/04/19	8488.20	15.51	0.03	16.02	0.02	15.02	0.04	14.51	0.05	14.24	0.05
01/06/19	8490.19	16.08	0.01	15.95	0.05	15.03	0.01	14.39	0.03	13.85	0.03
01/07/19	8491.26	16.15	0.05	15.89	0.05	15.11	0.03	14.55	0.02	13.84	0.01
01/09/19	8493.28	16.16	0.03	15.96	0.04	15.04	0.03	14.48	0.02	13.99	0.01
01/11/19	8495.27	16.04	0.01	15.92	0.02	15.07	0.03	14.51	0.01	13.88	0.01
01/12/19	8496.20	15.96	0.05	15.98	0.01	15.09	0.01	14.50	0.04	13.76	0.04
01/14/19	8498.27	16.25	0.02	16.21	0.01	15.14	0.01	14.57	0.01	13.87	0.02
01/15/19	8499.23	—	—	15.81	0.02	15.06	0.03	14.46	0.02	13.97	0.03
01/18/19	8502.28	—	—	16.11	0.02	15.17	0.03	14.53	0.02	14.02	0.02
01/26/19	8510.22	—	—	15.98	0.01	15.18	0.03	14.55	0.01	14.22	0.01
01/28/19	8512.35	—	—	15.91	0.01	15.12	0.02	14.62	0.02	13.98	0.01
02/04/19	8519.25	—	—	15.85	0.04	15.22	0.01	14.64	0.01	14.29	0.01
02/05/19	8520.23	—	—	15.97	0.05	15.03	0.01	14.51	0.01	13.86	0.01
02/06/19	8521.23	—	—	16.31	0.02	15.18	0.01	14.55	0.01	14.04	0.01
02/07/19	8522.23	—	—	15.83	0.01	15.11	0.05	14.56	0.02	13.76	0.01
02/08/19	8523.25	—	—	15.85	0.03	15.08	0.01	14.52	0.01	14.03	0.01
02/12/19	8527.23	—	—	15.89	0.03	15.02	0.01	14.47	0.01	13.91	0.01
02/13/19	8528.26	—	—	16.23	0.02	15.24	0.02	14.61	0.01	13.98	0.01
02/14/19	8529.23	—	—	16.13	0.05	15.09	0.01	14.49	0.03	13.88	0.01
02/15/19	8530.32	—	—	15.56	0.01	15.28	0.01	14.54	0.01	14.02	0.01
02/16/19	8531.24	—	—	16.02	0.04	15.05	0.03	14.44	0.01	14.01	0.01
02/17/19	8532.23	—	—	16.49	0.01	15.14	0.01	14.56	0.01	13.87	0.01
02/18/19	8533.24	—	—	15.81	0.04	15.13	0.03	14.47	0.04	13.75	0.02
02/18/19	8533.25	—	—	16.16	0.02	15.16	0.01	14.55	0.01	13.97	0.01
02/18/19	8533.27	—	—	15.79	0.05	15.01	0.01	14.48	0.01	14.01	0.02
02/18/19	8533.28	—	—	15.75	0.04	15.06	0.03	14.53	0.01	14.02	0.01
02/20/19	8535.26	—	—	15.79	0.02	15.09	0.02	14.61	0.02	14.01	0.02
02/21/19	8536.25	—	—	16.03	0.03	15.18	0.01	14.51	0.03	13.86	0.02
02/21/19	8536.26	—	—	—	—	15.21	0.00	—	—	—	—
02/21/19	8536.26	—	—	—	—	15.05	0.01	—	—	—	—
02/21/19	8536.26	—	—	—	—	15.15	0.03	—	—	—	—
02/21/19	8536.27	—	—	—	—	15.09	0.01	—	—	—	—
02/22/19	8537.25	—	—	16.10	0.02	15.15	0.02	14.49	0.02	13.84	0.01
02/23/19	8538.30	—	—	15.68	0.04	15.13	0.01	14.47	0.02	13.79	0.01
02/24/19	8539.25	—	—	15.57	0.02	15.33	0.02	14.76	0.01	—	—
02/25/19	8540.29	—	—	15.77	0.02	15.07	0.02	14.55	0.02	13.84	0.01
02/26/19	8541.25	—	—	—	—	—	—	14.56	0.04	13.79	0.01
02/27/19	8542.26	—	—	15.87	0.01	14.89	0.02	14.48	0.02	13.92	0.02
02/28/19	8543.26	—	—	15.84	0.02	15.23	0.02	14.46	0.02	13.88	0.02
02/28/19	8543.27	—	—	15.85	0.05	15.17	0.04	14.53	0.02	14.40	0.04
02/28/19	8543.29	—	—	—	—	15.09	0.02	14.54	0.02	14.24	0.01
03/03/19	8546.24	—	—	—	—	15.03	0.01	14.32	0.05	13.95	0.05
03/04/19	8547.25	—	—	—	—	15.21	0.01	14.47	0.01	14.01	0.04
03/05/19	8548.26	—	—	16.09	0.03	15.11	0.02	14.46	0.02	13.84	0.01
03/05/19	8548.27	—	—	15.71	0.04	15.17	0.03	14.72	0.02	13.79	0.01
03/07/19	8550.25	—	—	15.96	0.02	15.13	0.03	14.49	0.01	14.17	0.01

Table 2. The main characteristics of the photometric data.

	U	$Error$	B	$Error$	V	$Error$	R_c	$Error$	I_c	$Error$
Maximum Values	10.94	0.05	11.69	0.02	11.65	0.02	11.51	0.02	11.38	0.02
Minimum Values	16.43	0.02	16.49	0.02	15.33	0.02	14.76	0.02	14.40	0.04
Mean Values at Minimum	16.10	0.20	15.98	0.17	15.11	0.07	14.52	0.07	13.98	0.14
Mean Values at Maximum	11.17	0.16	11.74	0.05	11.71	0.04	11.54	0.05	11.44	0.05

Table 3. The mean values of color indices of DX And.

	$(U-B)$	$Error$	$(B-V)$	$Error$	$(V-R_c)$	$Error$	(R_c-I_c)	$Error$	$(V-I_c)$	$Error$
Mean Values Maximum	-0.56	0.13	0.03	0.04	0.17	0.03	0.09	0.04	0.27	0.03
Mean Values Minimum	0.23	0.19	0.87	0.17	0.59	0.07	0.53	0.14	1.12	0.13

Table 4. Time series observations in the V band.

$Date$	JD (2458523.000+)	$Magnitude V$	$Error$	$Date$	JD (2458523.000+)	$Magnitude V$	$Error$
08/02/19	258	15.13	0.02	08/02/19	305	15.14	0.01
08/02/19	260	15.09	0.01	08/02/19	308	14.95	0.01
08/02/19	263	15.01	0.01	08/02/19	311	15.11	0.01
08/02/19	266	15.09	0.02	08/02/19	314	15.08	0.01
08/02/19	269	15.01	0.02	08/02/19	316	15.13	0.01
08/02/19	272	15.14	0.01	08/02/19	319	15.13	0.01
08/02/19	274	15.01	0.01	08/02/19	322	15.06	0.01
08/02/19	277	15.08	0.02	08/02/19	325	15.09	0.00
08/02/19	281	15.01	0.01	08/02/19	328	15.02	0.05
08/02/19	283	15.11	0.02	08/02/19	331	15.06	0.03
08/02/19	286	15.05	0.01	08/02/19	334	15.02	0.01
08/02/19	288	15.11	0.02	08/02/19	336	15.16	0.03
08/02/19	292	14.98	0.01	08/02/19	339	15.04	0.04
08/02/19	294	15.08	0.02	08/02/19	342	15.05	0.04
08/02/19	297	15.08	0.01	08/02/19	344	15.22	0.02
08/02/19	301	15.02	0.01	08/02/19	347	15.17	0.02
08/02/19	303	15.08	0.01	08/02/19	351	15.11	0.01

Table 5. Time series observations in the R_c band.

$Date$	JD (2458521.000+)	$Magnitude R$	$Error$	$Date$	JD (2458521.000+)	$Magnitude R$	$Error$
06/02/19	239	14.55	0.01	06/02/19	287	14.49	0.01
06/02/19	242	14.58	0.01	06/02/19	290	14.51	0.01
06/02/19	245	14.54	0.01	06/02/19	292	14.41	0.04
06/02/19	248	14.56	0.01	06/02/19	295	14.63	0.01
06/02/19	253	14.48	0.01	06/02/19	298	14.55	0.01
06/02/19	256	14.53	0.01	06/02/19	301	14.48	0.02
06/02/19	259	14.48	0.02	06/02/19	304	14.59	0.01
06/02/19	262	14.51	0.02	06/02/19	306	14.60	0.03
06/02/19	265	14.49	0.01	06/02/19	309	14.50	0.02
06/02/19	267	14.59	0.01	06/02/19	312	14.49	0.01
06/02/19	270	14.54	0.01	06/02/19	315	14.46	0.01
06/02/19	273	14.49	0.01	06/02/19	321	14.47	0.01
06/02/19	276	14.53	0.01	06/02/19	323	14.48	0.01
06/02/19	278	14.54	0.02	06/02/19	326	14.49	0.01
06/02/19	281	14.51	0.02	06/02/19	329	14.60	0.04
06/02/19	284	14.56	0.01	06/02/19	332	14.48	0.01

Table 6. Time series observations of a stable star: the TYC 3242 352.

Date	JD	Magnitude V	Error	Date	JD	Magnitude V	Error
08/02/19	2458523.258	11.76	0.01	08/02/19	2458523.305	11.72	0.03
08/02/19	2458523.260	11.78	0.02	08/02/19	2458523.308	11.79	0.04
08/02/19	2458523.263	11.77	0.05	08/02/19	2458523.311	11.72	0.03
08/02/19	2458523.266	11.73	0.02	08/02/19	2458523.314	11.77	0.01
08/02/19	2458523.269	11.78	0.04	08/02/19	2458523.316	11.77	0.01
08/02/19	2458523.272	11.79	0.02	08/02/19	2458523.319	11.76	0.06
08/02/19	2458523.274	11.78	0.01	08/02/19	2458523.322	11.74	0.02
08/02/19	2458523.277	11.76	0.01	08/02/19	2458523.325	11.80	0.02
08/02/19	2458523.280	11.77	0.02	08/02/19	2458523.328	11.73	0.03
08/02/19	2458523.283	11.76	0.03	08/02/19	2458523.331	11.75	0.01
08/02/19	2458523.286	11.78	0.03	08/02/19	2458523.333	11.78	0.02
08/02/19	2458523.288	11.75	0.03	08/02/19	2458523.336	11.76	0.02
08/02/19	2458523.291	11.75	0.03	08/02/19	2458523.339	11.74	0.02
08/02/19	2458523.294	11.75	0.06	08/02/19	2458523.342	11.76	0.01
08/02/19	2458523.297	11.74	0.01	08/02/19	2458523.341	11.75	0.02
08/02/19	2458523.301	11.76	0.01	08/02/19	2458523.347	11.69	0.04
08/02/19	2458523.302	11.79	0.02	08/02/19	2458523.350	11.74	0.02

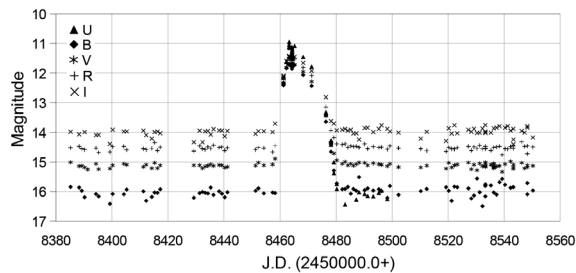


Figure 1. Light curve of DX And during the years 2018–2019 in UBVRI_c filters.

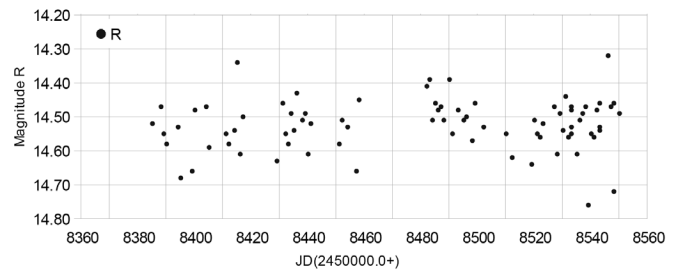


Figure 4. Light curve of DX And, phase at minimum, without the outburst in R_c band.

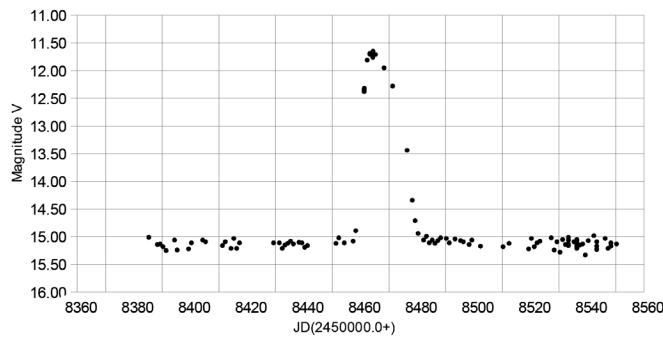


Figure 2. Light curve of DX And during the years 2018–2019 in V band.

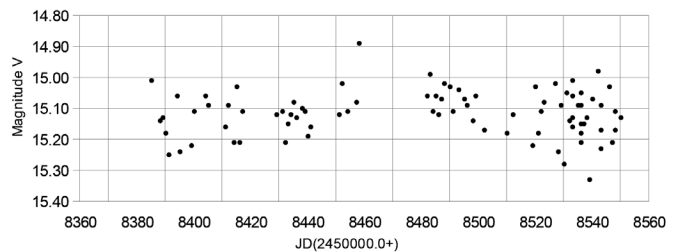


Figure 5. Light curve of DX And in V band at minimum.

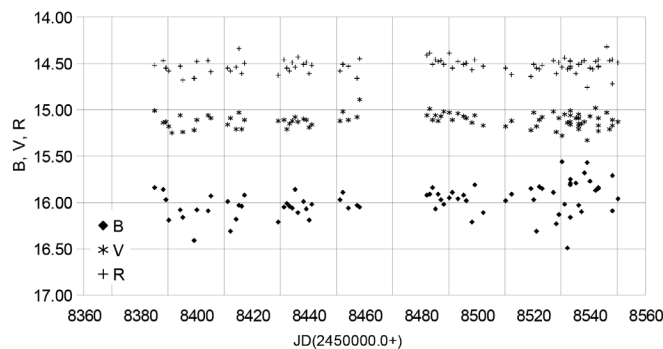


Figure 3. Light curves of DX And, phase at minimum, in the filter B, V, R_c without the outburst.

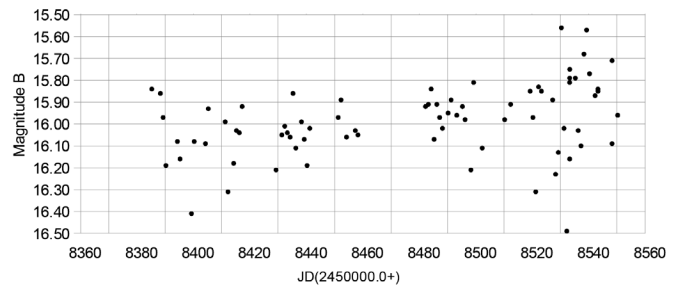


Figure 6. The light curve of DX And, phase at minimum, in B band.

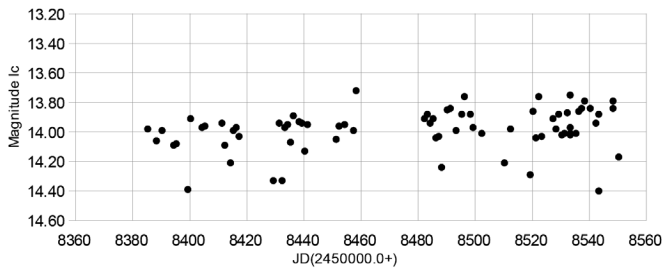


Figure 7. DX And. In I_c band at minimum there is a wide scattering of values.

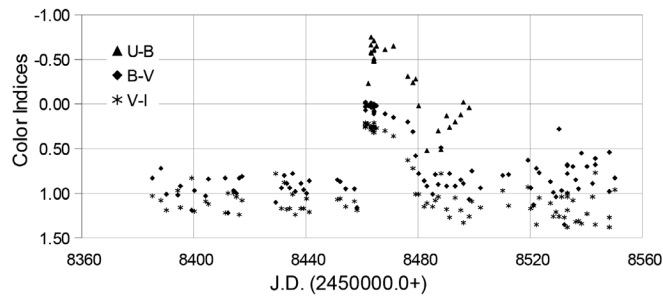


Figure 8. DX And, 2018–2019. The variations of color indices (U–B), (B–V), and (V–I) with time.

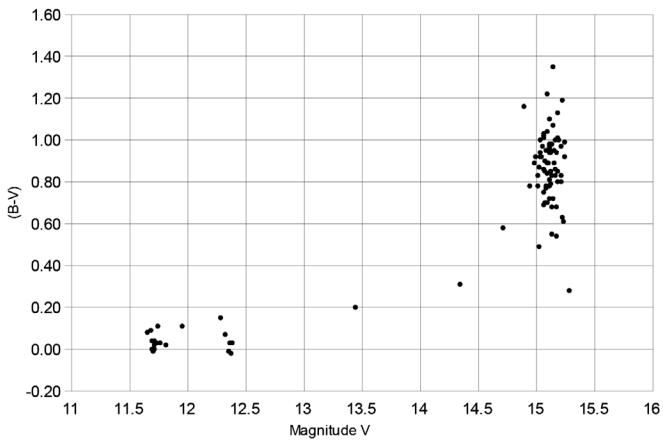


Figure 9. DX And. The color index (B–V) for V magnitude.

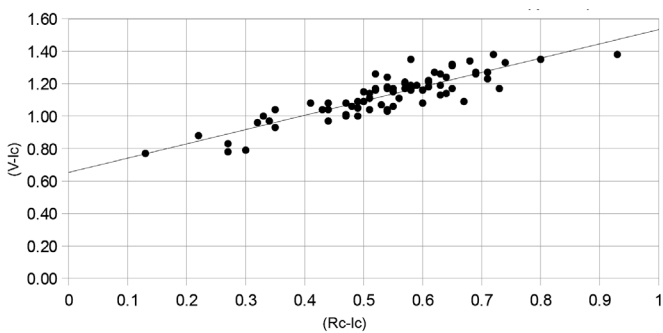


Figure 10. DX And. The color index (V– I_c) as a function of (R_c – I_c) at minimum.

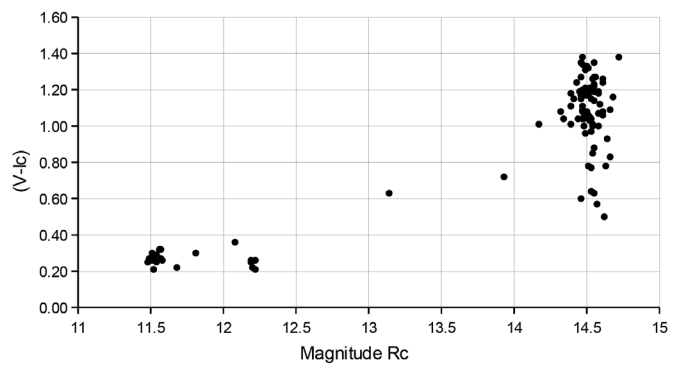


Figure 11. DX And. The color index (V– I_c) for magnitude R_c .

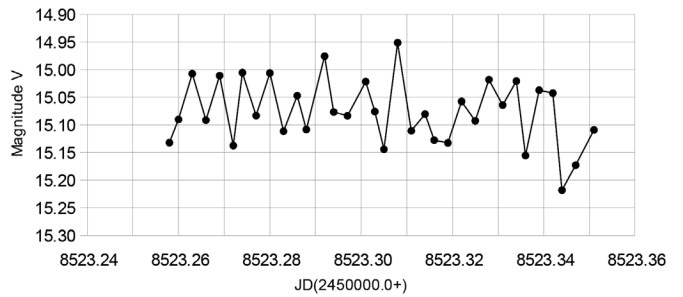


Figure 12. DX And. Time series observations in V band.

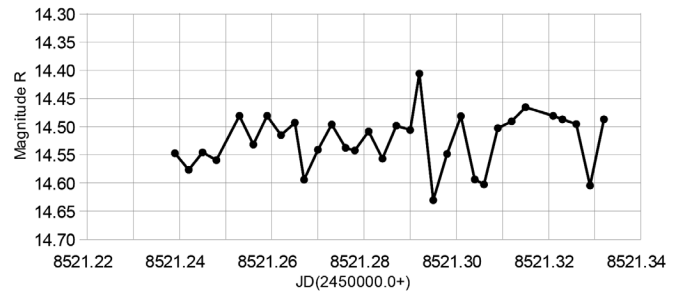


Figure 13. DX And. Time series observations in R_c band.

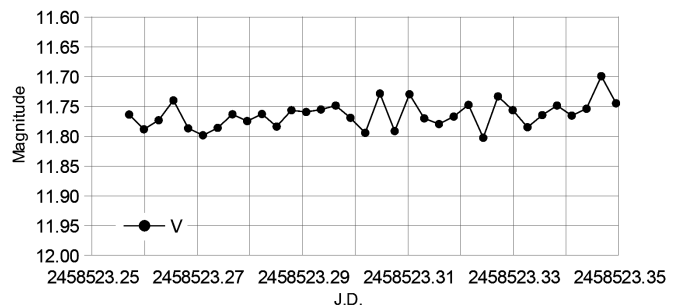


Figure 14. Time series observations of TYC 3242 352.