The period of the eclipsing binary
Fr218 = UCAC3 238-156039 Lyr

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Abstract: *Fr218 = UCAC3 238-156039 Lyr was discovered by Peter Frank in the year 2011 and classified as EA eclipsing binary. The authors present a phased light curve, a list of primary and secondary minima, O-C diagrams and an improved period solution of the star. The variable is not listed in the ASAS-SN catalogue and VSX database. The period solution from the ATLAS catalogue is wrong.*

Introduction

Fr218 = UCAC3 238-156039 Lyr was discovered as a photometric variable by Peter Frank in the year 2011 and classified as eclipsing binary. The amplitude is given as 0.49 mag, 11.67-12.16 mag (V). The variable is only listed in the ATLAS Database [1].

During these studies, we furthermore discovered several period solutions for this star in an extensive datasheet prepared by the ATLAS project [2]. None of these periods (ATLAS) is similar to ours. We have at our disposal 21 time series with approx. 3000 images that were taken between 2010 and 2020. The observation time per night was between 2 and 7 hours.

Since the minima derived from our data cannot be represented by the ATLAS periods, we have used our data to present an improved period solution.

Periods known so far:

Simbad	no information
ASAS-SN	no information
ATLAS	1.775202 d
VSX [3]	no information
ZTF [4]	no information

Observations

400mm ASA Astrograph f/3.7
f = 1471 mm
FLI Proline 16803 CCD-Camera
V-filter
t = 120 sec.
Wolfgang Moschner, Astrocamp/Nerpio, Spain

102mm f/5.0 TeleVue Refractor
f = 509 mm
SIGMA 1603 CCD-Camera, Kodak KAF1603ME
IR & UV cut-off filter
t = 90 sec.
Peter Frank, Velden, Germany

Data analysis

Muniwin [5] and self-written programs by Franz Agerer and Lienhard Pagel [6] were used for the analysis of the frames, after bias, dark and flatfield correction of the exposures. The weighted average of five comparison stars was used.

Explanations:

HJD = heliocentric UTC timings (JD) of the observed minima
mag = (raw instrumental) magnitude

G-band mean magnitude   = 350-1000 nm
Integrated BP mean magnitude   = 330- 680 nm
Integrated RP mean magnitude   = 640-1000 nm

Explanations to the light curve:
The colors of the symbols denote different nights.

All coordinates are taken from the Gaia DR2 catalogue [7].

The coordinates (epoch J2000) are computed by VizieR, and are not part of the original data from Gaia (note that the computed coordinates are computed from the positions and the proper motions).

Fr218 Lyr
Cross-ID's
= UCAC3 238-156039
= Gaia DR2 2037658864645686272
= GSC 2134-01572 (11.7)
= ATOID J286.3422+28.7797

Gaia DR2 Catalog:
Right ascension: 19h05m22.1877s at epoch and equinox J2000
Declination: +28° 46' 47.975"   at epoch and equinox J2000
Barycentric right ascension (ICRS) at Epoch=2015.5:   286.34224186258° +/- 0.01 mas
Barycentric declination (ICRS) at Epoch=2015.5:   +28.77974714348° +/- 0.02 mas

12.0218 mag G-band mean magnitude
12.5544 mag Integrated BP mean magnitude
11.3381 mag Integrated RP mean magnitude
1.2163   mag BP-RP colour

Results

With our observations obtained with the 400 mm ASA astrograph in Nerpio we have created a phased light curve. The presented elements were calculated by the method of least squares, taking into account our minima (see Table 1). Only the primary minima were used to calculate the elements.

Our ephemeris represents the first correct period solution for this star.

A Min II with an amplitude of 0.06 mag could be found. In the phased light curve (Fig. 1) of Fr218 Lyr, the secondary eclipse occurs at phase (approximately) 0.50.

Fr218 Lyr = UCAC3 238-156039 Lyr   new elements

Amplitude: Min I: 0.49 mag (instr.)   Min II: 0.06 mag (instr.)
Type: EA type eclipsing binary

Min I =   HJD (UTC) 2457893.5750 + 2.8113581*E
   +-0.0011 +-0.0000030
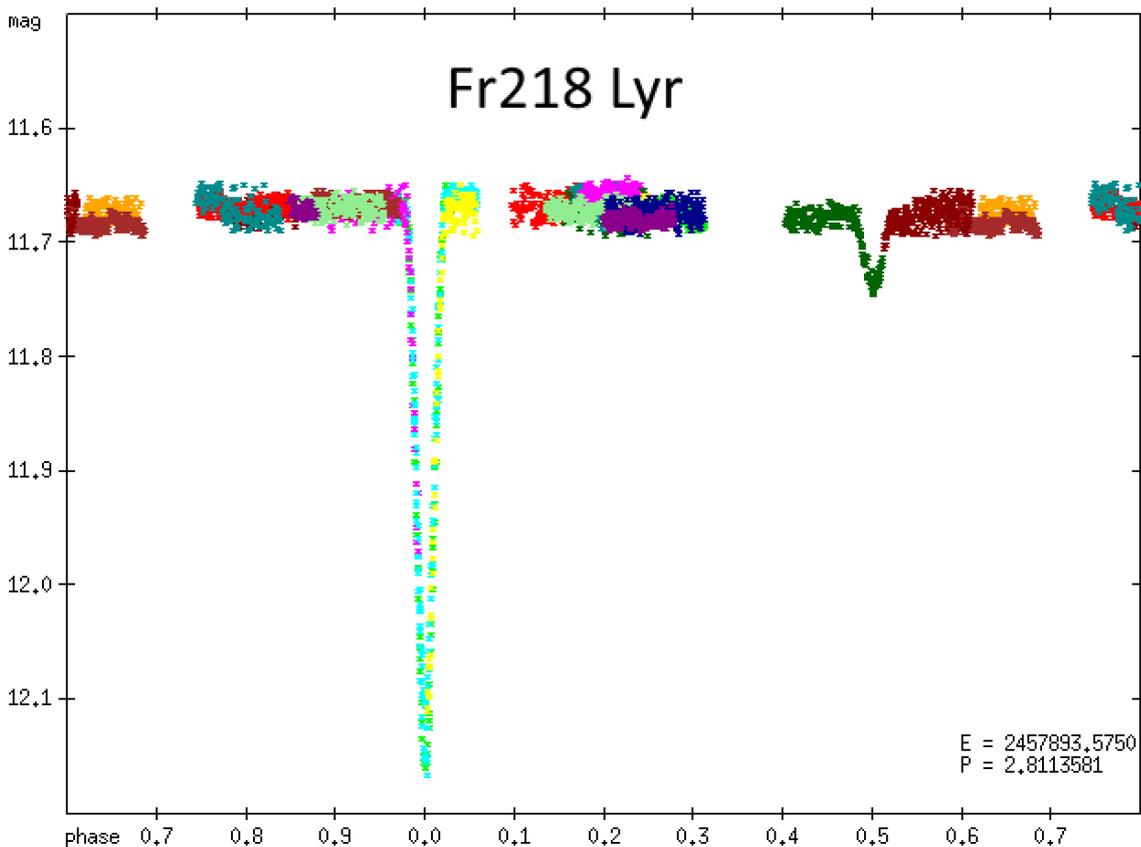
Figure 1: Phased light curve of Fr218 = UCAC3 238-156039 Lyr using the ephemeris given by the authors. The vertical axis shows raw instrumental magnitudes. Different colors denote different observing nights. Only the data points from the better nights were used to display the light curve.

An FLI Proline 16803 camera + a V-filter (2016-2020) was used. The new elements were calculated by taking into account all minima (see Table 1) with the method of least squares.

Observer	HJD-Date Minimum	Type	Epoch	O-C (d)
P. Frank	2456136.4771	I	-625	0.0009
W. Moschner	2457893.5739	I	0	-0.0011
W. Moschner	2457907.6307	I	5	-0.0011
W. Moschner	2458731.3586	I	298	-0.0011
P. Frank	2459043.4227	I	409	0.0022
W. Moschner	2459047.6427	II	410.5	0.0052

Table 1: Minima Fr218 = UCAC3 238-156039 Lyr, O-C using the ephemeris given by the authors. The O-C values of Min II refer to phase 0.5.
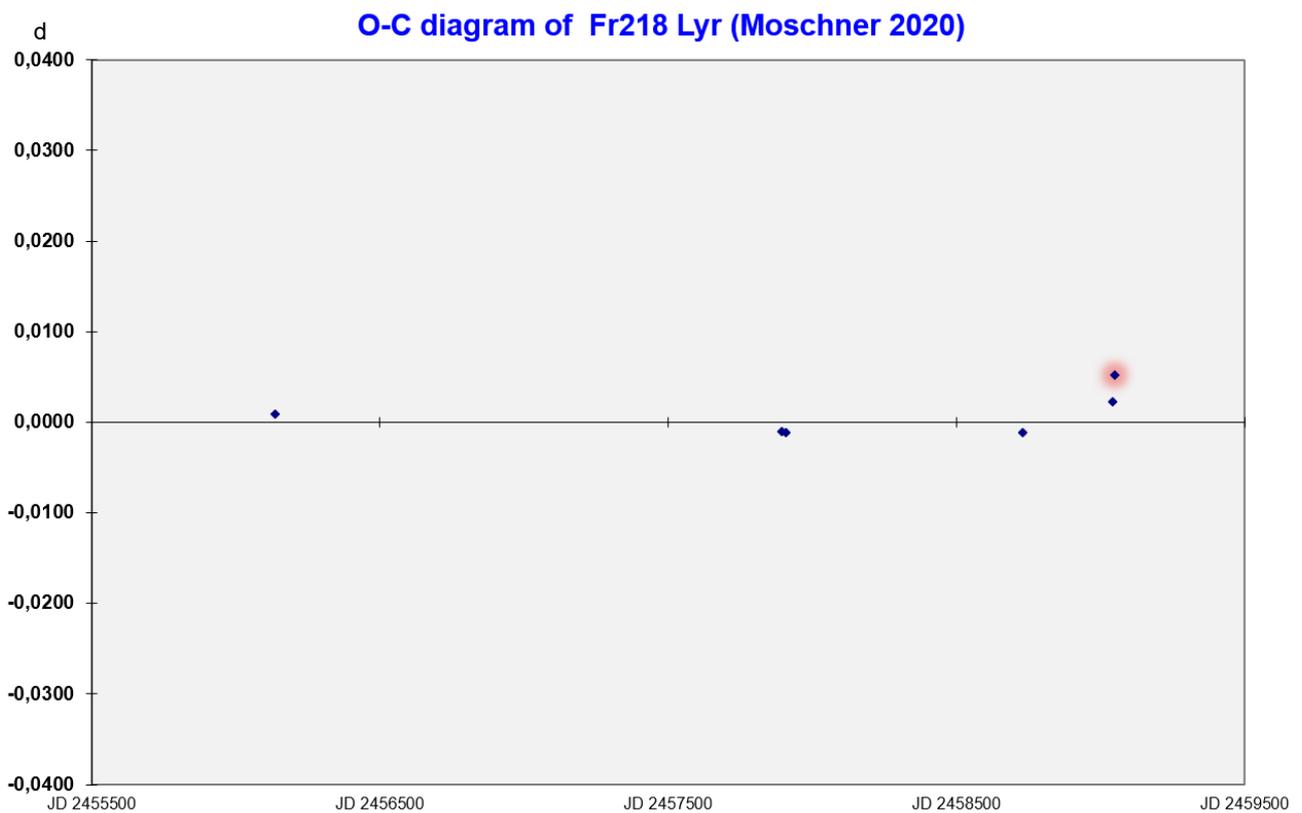
Figure 2: O-C-diagram for Fr218 = UCAC3 238-156039 Lyr using the ephemeris given by the authors. The data point of Min II is marked red in the O-C diagram.
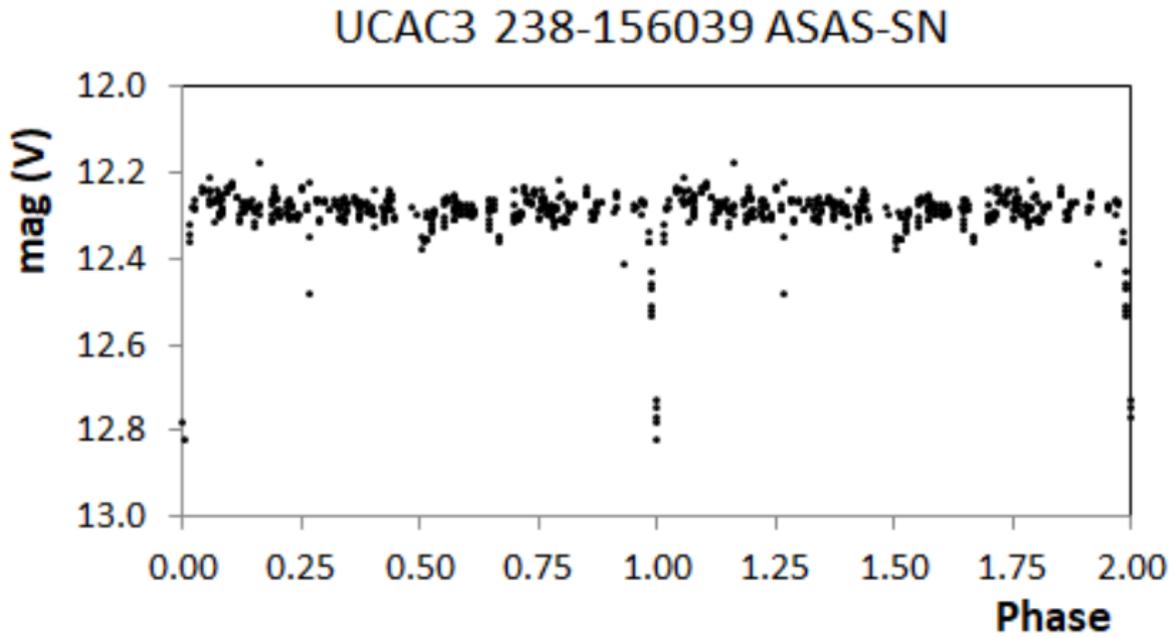
Figure 3: Phased light curve of Fr218 = UCAC3 238-156039 Lyr using the new elements and data from ASAS-SN.
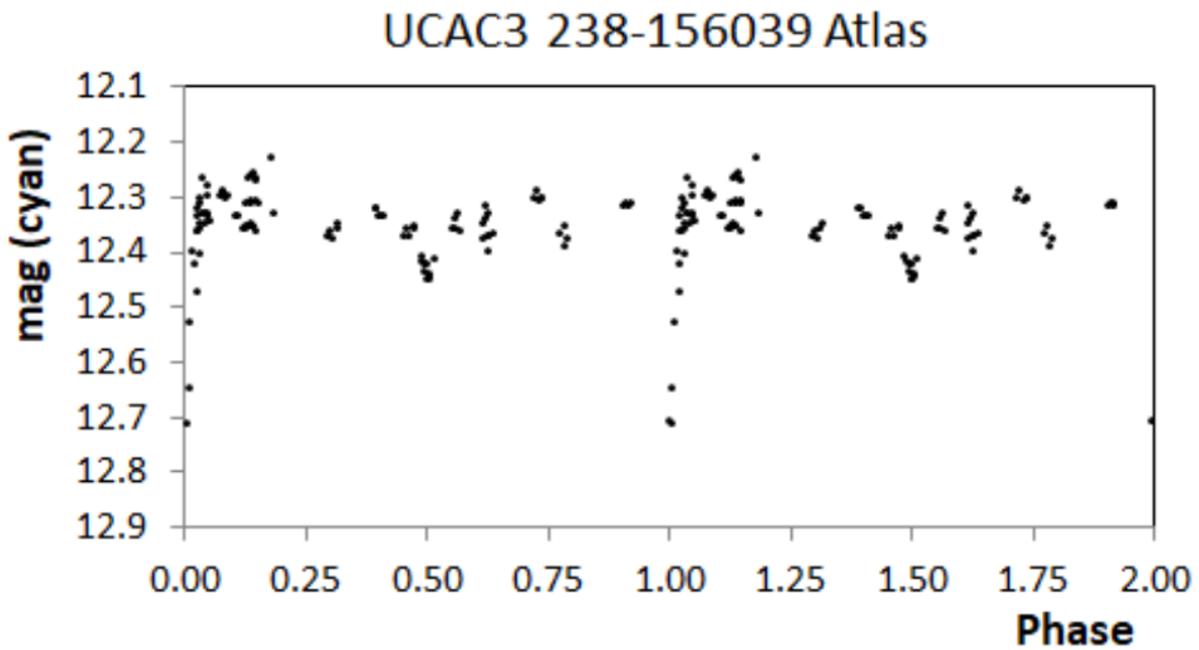

Figure 4: Phased light curve of Fr218 = UCAC3 238-156039 Lyr using the new elements and data from ATLAS.

References

[1] All-Sky Automated Survey for Supernovae ASAS-SN
http://www.astronomy.ohio-state.edu/asassn/index.shtml
Shappee et al., 2014, ApJ, 788, 48S
https://ui.adsabs.harvard.edu/abs/2014ApJ...788...48S
Jayasinghe et al., 2019, MNRAS, 485, 961J
https://ui.adsabs.harvard.edu/abs/2019MNRAS.485..961J:

[2] A first catalog of variable stars measured by ATLAS (Heinze+, 2018)
http://vizier.u-strasbg.fr/cgi-bin/VizieR-3?-source=J/AJ/156/241/table4

[3] The International Variable Star Index
https://www.aavso.org/vsx/index.php?view=search.top

[4] ZTF Zwicky TransientFacility, Systematic Exloration of the Dynamic Sky
https://www.ztf.caltech.edu/

[5] Motl, David: MuniWin,
http://c-munipack.sourceforge.net

[6] Pagel, Lienhard: Starcurve,
https://www.bav-astro.eu/index.php/weiterbildung/tutorials

[7] Gaia DR2 (Gaia Collaboration, 2018)
European Space Agency.
http://vizier.u-strasbg.fr/viz-bin/VizieR?-source=I/345