



Improved elements of the new eclipsing binary Fr316 Cyg = UCAC3 244-166481

Moschner, Wolfgang
Lennestadt, Germany
email: wolfgang.moschner@t-online.de

Frank, Peter
Velden, Germany
email: frank.velden@t-online.de

Bernhard, Klaus
Linz, Austria
email: Klaus1967Bernhard@gmx.at

Bundesdeutsche Arbeitsgemeinschaft für Veränderliche Sterne e.V.

December 2020

Abstract: *Fr316 Cyg = UCAC3 244-166481 Cyg was discovered by Peter Frank in the year 2011 and classified as EW 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 known at ASAS-SN and ATLAS.*

Introduction

Fr316 Cyg = UCAC3 244-166481 Cyg was discovered as a photometric variable by Peter Frank in the year 2011 and classified as eclipsing binary. The amplitude is given as 0.36 mag, 13.82-14.18 mag (V). The variable is listed in the ATLAS [1] and ASAS-SN-Variable Star Database [2]. ASAS-SN specifies RRC as the type.

During these studies, we furthermore discovered several period solutions for this star in an extensive datasheet prepared by the ATLAS project [1]. Only one of these periods (ATLAS) is similar to ours. We have at our disposal 25 time series with approx. 4400 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 ASAS-SN and ATLAS periods, we have used our data to present an improved period solution.

Periods known so far:

Simbad	no information
ASAS-SN	0.370852 d (Typ = RRC)
ATLAS	0.741715 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).

Fr316 Cyg

Cross-ID's
= **UCAC3 244-166481**
= **Gaia DR2 2045086031343701632**
= **ATOID J292.6343+31.9365**
= **ASASSN-V J193032.25+315611.7**

Right ascension: 19h30m32.2476s at epoch and equinox J2000
Declination: +31° 56' 11.709" at epoch and equinox J2000
Barycentric right ascension (ICRS) at Epoch=2015.5: 292.634355715° +/- 0.01 mas
Barycentric declination (ICRS) at Epoch=2015.5: +31.936571188° +/- 0.02 mas

Gaia DR2 Catalog:
14.1222 mag G-band mean magnitude
14.3137 mag Integrated BP mean magnitude
13.7762 mag Integrated RP mean magnitude
00.5375 mag BP-RP color

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 all our minima (see table below).

Our ephemeris represents a significant improvement over the ASAS-SN period and all ATLAS periods, since our minima are not represented with all periods known so far.

Fr316 Cyg is not an RRC type as described by ASAS-SN. Fr316 Cyg is an EW star with different heights of the shoulders (possible O'Connell Effect). The variability reaches between Min I and Min II a brightness of 13.82 mag, between Min II and Min I 13.85 mag. The difference between the two shoulders is 0.03 mag.

Fr316 Cyg = UCAC3 244-166481 Cyg improved elements

Amplitude: Min I: 0.36 mag (instr.) Min II: 0.26 mag (instr.)

Type: EW type eclipsing binary

Min I = HJD (UTC) $2457988.4244 + 0.7416963 \cdot E$
 $\pm 0.0014 \pm 0.0000008$

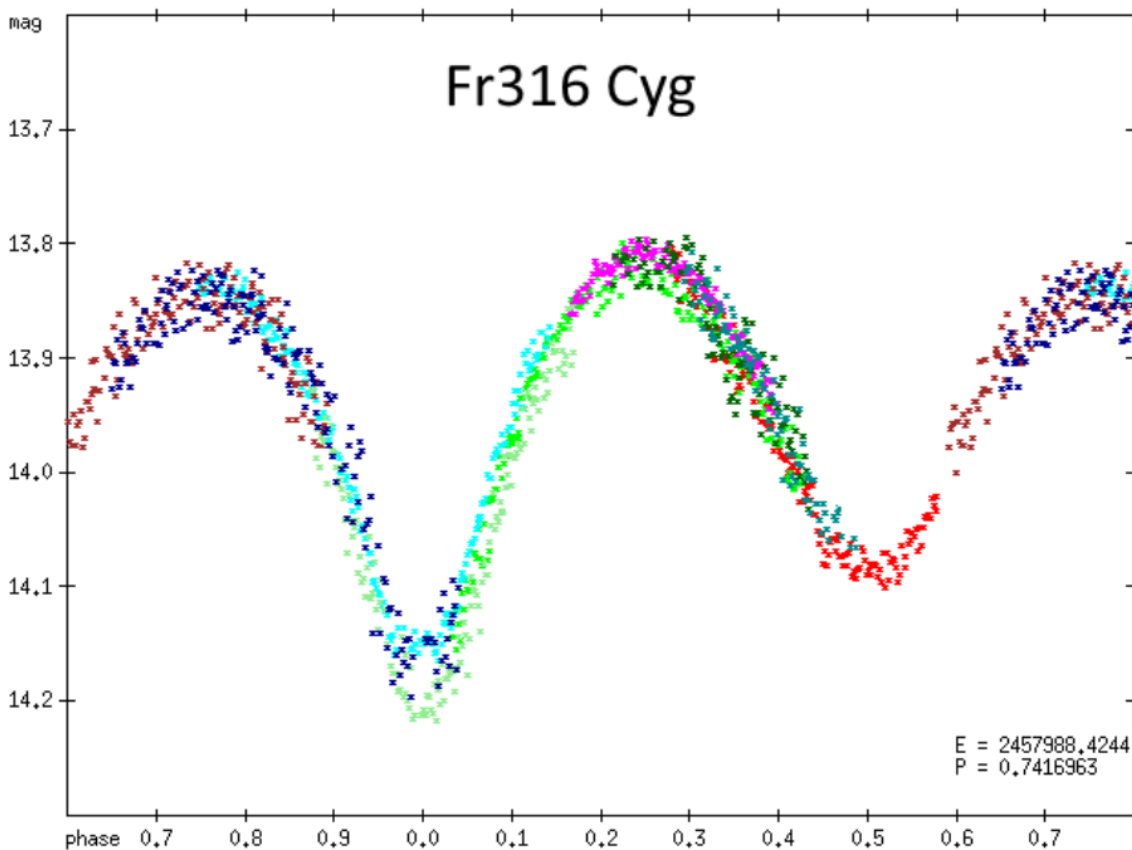


Figure 1: Phased light curve of Fr316 Cyg = UCAC3 244-166481 using the ephemeris given by the authors. The vertical axis shows raw instrumental magnitudes. Different colors denote different observing nights. Only the data points from the better nights were used to display the light curve. An FLI Proline 16803 camera + a V-filter (2016-2020) was used. The presented elements were calculated by taking into account all minima (see table below) with the method of least squares.

Observer	HJD-Date	Type	Epoch	O-C (d)
	Minimum			
P. Frank	2455804.4974	II	-2944.5	-0.0022
P. Frank	2455826.3765	I	-2915	-0.0032
P. Frank	2455838.2547	I	-2899	0.0079
P. Frank	2455894.2558	II	-2823.5	0.0109
P. Frank	2456167.5497	I	-2455	-0.0103
P. Frank	2457246.3528	II	-1000.5	-0.0045
P. Frank	2457632.4047	I	-480	-0.0055
W. Moschner	2457988.4267	I	0	0.0023
P. Frank	2458347.4091	I	484	0.0037
W. Moschner	2458351.4869	II	489.5	0.0022
W. Moschner	2458384.4854	I	534	-0.0048
W. Moschner	2458668.5552	I	917	-0.0047
W. Moschner	2458756.4553	II	1035.5	0.0044
W. Moschner	2458998.6161	I	1362	0.0014
W. Moschner	2459020.4941	II	1391.5	-0.0007
W. Moschner	2459036.4427	I	1413	0.0014
W. Moschner	2459121.3666	II	1527.5	0.0011

Table 1: Minima Fr316 Cyg = UCAC3 244-166481 Cyg, O-C using the ephemeris given by the authors.

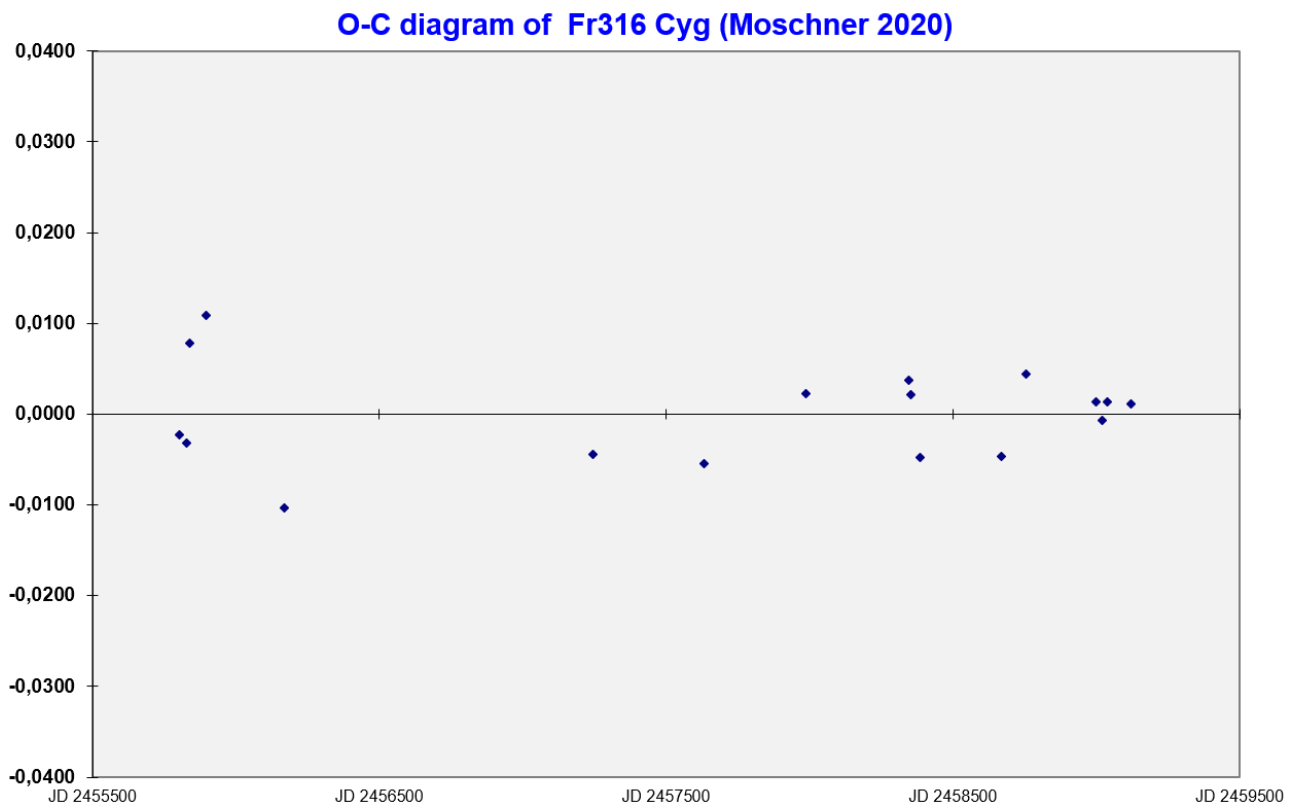


Figure 2: O-C-diagram for Fr316 Cyg = UCAC3 244-166481 Cyg using the ephemeris given by the authors.

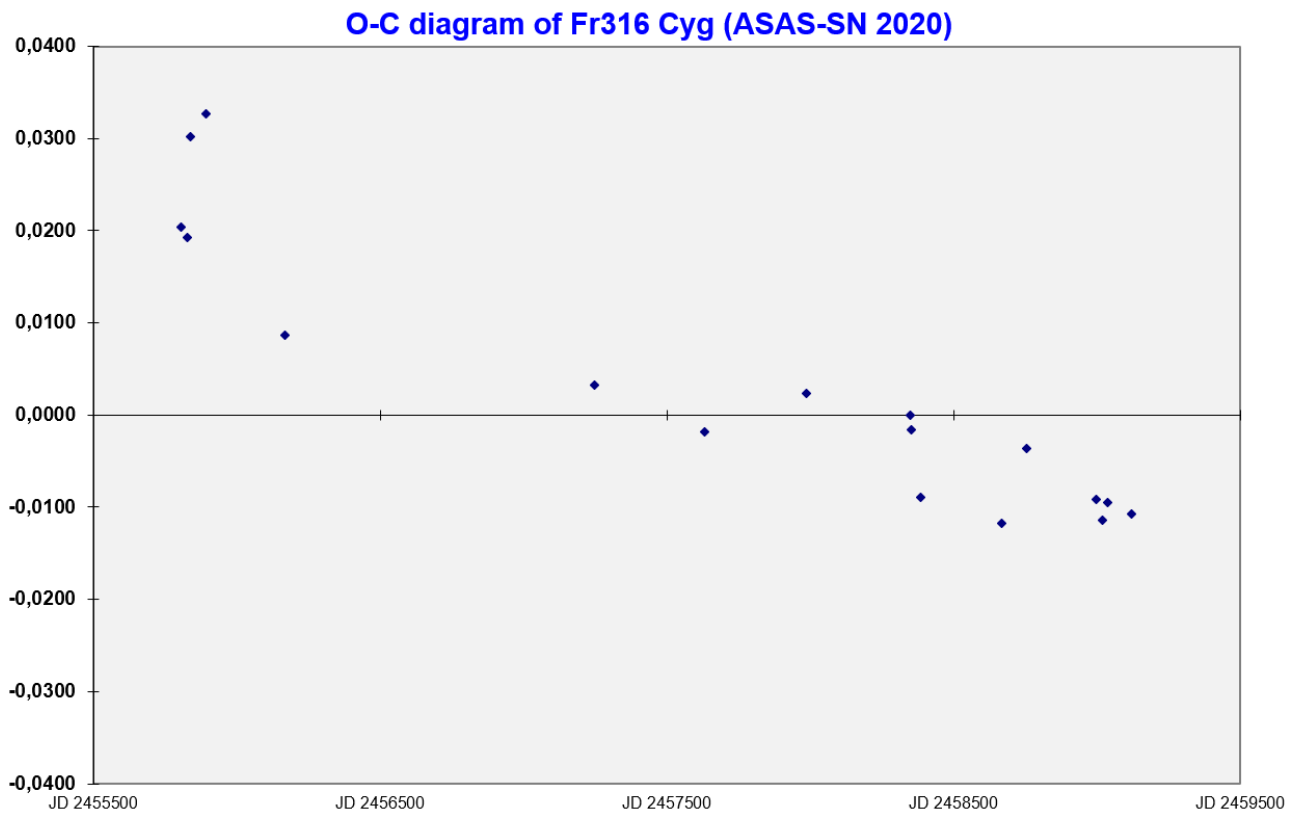


Figure 3: O-C-diagram for Fr316 Cyg = UCAC3 244-166481 Cyg using the period from ASAS-SN. The period was doubled (= 0.741704 d).

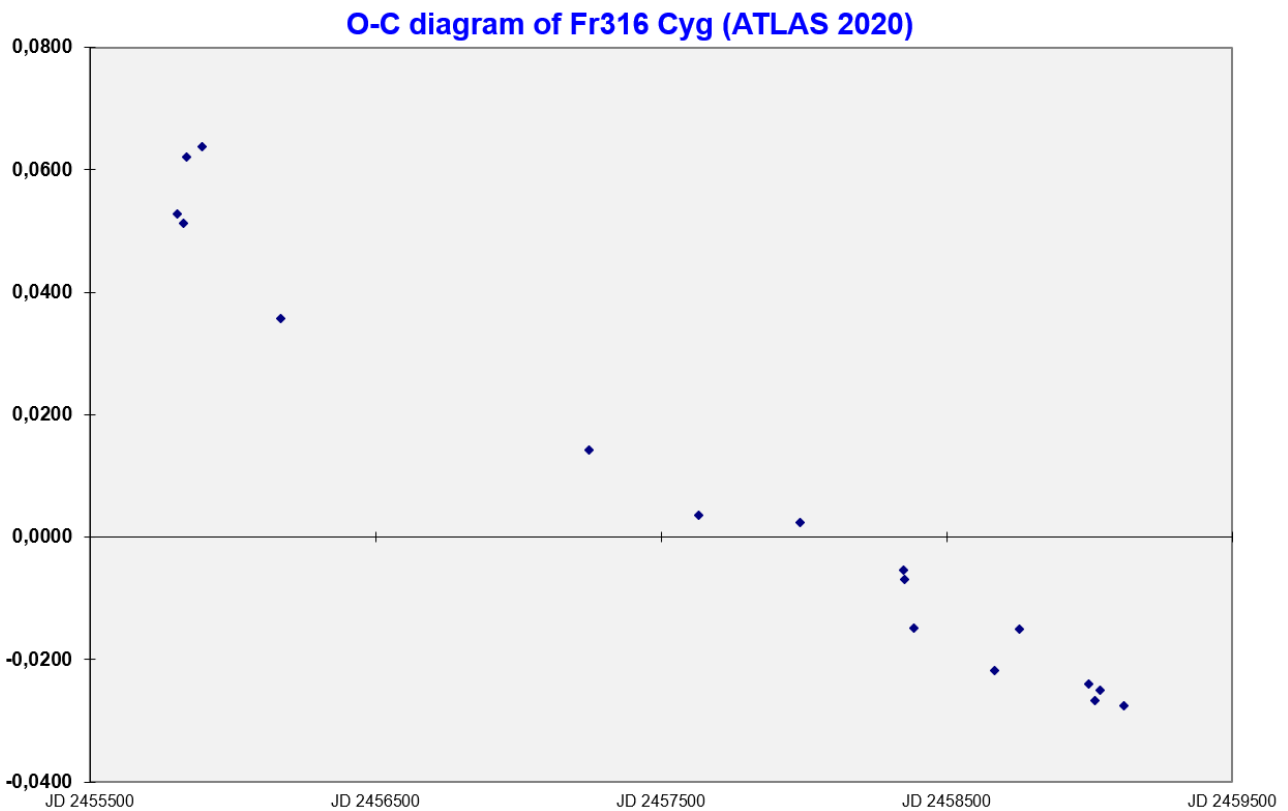


Figure 4: O-C-diagram for Fr316 Cyg = UCAC3 244-166481 Cyg using the period from ATLAS.

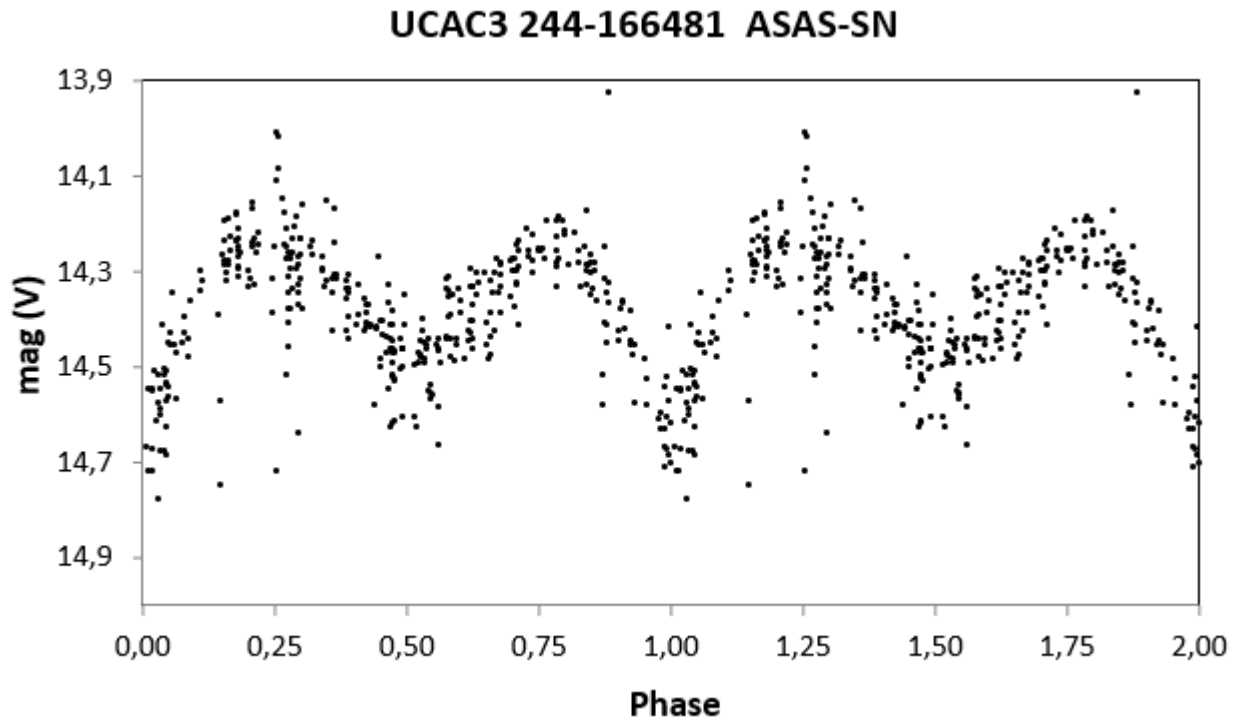


Figure 5: Phased light curve of Fr316 Cyg = UCAC3 244-166481 Cyg using the new elements and data from ASAS-SN.

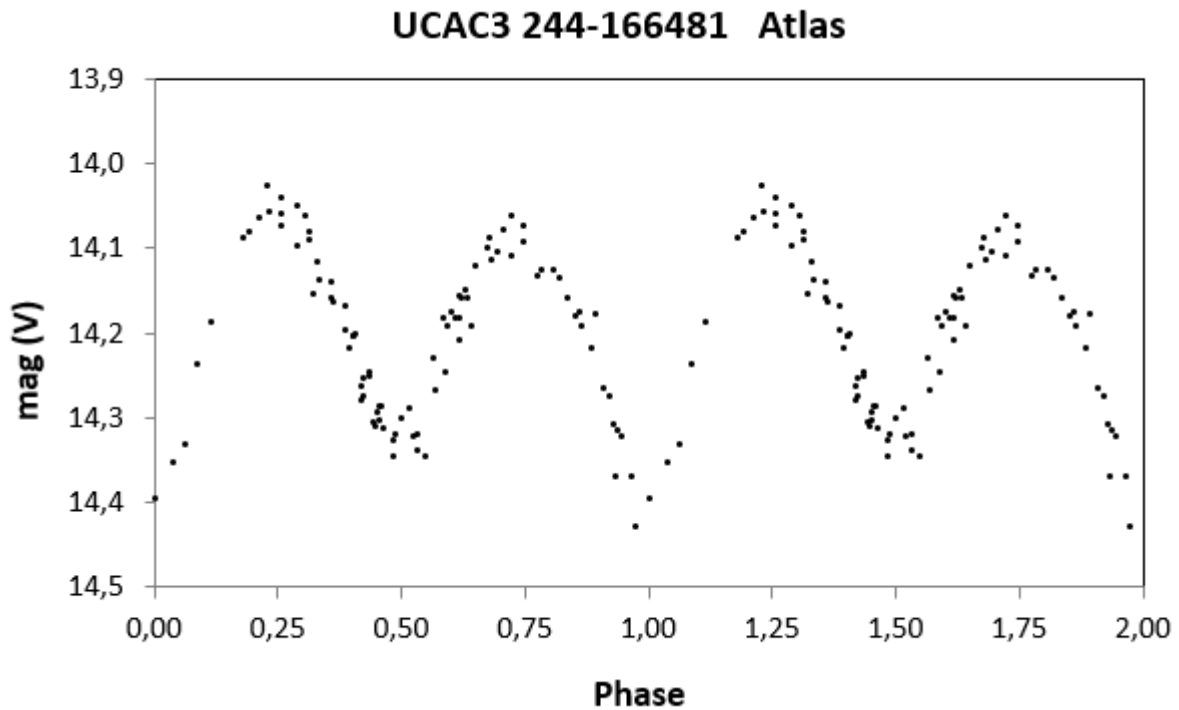


Figure 6: Phased light curve of Fr316 Cyg = UCAC3 244-166481 Cyg using the new elements and data from ATLAS.

Acknowledgements

This research has made use of the SIMBAD database, operated at CDS, Strasbourg, France, the International Variable Star Index (VSX) database, operated at AAVSO, Cambridge, Massachusetts, USA and the ASAS All Star Catalogue operated by the Ohio State University.

The authors thank David Motl [5] for providing his MuniWin photometry program, Franz Agerer (BAV) and Lienhard Pagel (BAV) [6] for providing their personal data analysis program.

References

- [1] 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>
- [2] All-Sky Automated Survey for Supernovae ASAS-SN
<http://www.astronomy.ohio-state.edu/asasn/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>:
- [3] The International Variable Star Index
<https://www.aavso.org/vsx/index.php?view=search.top>
- [4] ZTF Zwicky Transient Facility, Systematic Exploration 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>