BAV Journal

2020 No. 45 ISSN 2366-6706

Bundesdeutsche Arbeitsgemeinschaft für Veränderliche Sterne e.V.

http://bav-astro.de

The period of the eclipsing binary Fr257 = UCAC3 250-234427 Cyg

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November 2020

Abstract: *Fr257 Cyg = UCAC3 250-234427 Cyg was discovered by Peter Frank in the year 2013 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 known at ASAS-SN and ATLAS.*

Introduction

UCAC3 250-234427 Cyg was discovered as a photometric variable by Peter Frank in 2013 and classified as eclipsing binary. The amplitude is given as 0.43 mag, 14.80-15.23 mag (V). The variable is listed in the VSX [1] and the ASAS-SN-Variable Star Database [2].

The star has different IDs in those two databases. In the VSX it is called ASASSN-V J205133.13 + 343105.2, listed in the ASAS-SN Variable Star Database ASASSN-V J205133.00+343104.8. Without a doubt it is the same object. See also BAV Journal No. 038, July 2020 [3]. The Gaia DR2 ID mentioned in the ASAS-SN Variable Star Database is wrong.

During these studies, we furthermore discovered several period solutions for this star in an extensive datasheet prepared by the ATLAS project [4]. Only one of these periods (ASAS-SN) is similar to ours. We have at our disposal 32 time series with approx. 5200 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	2.2199398 d
ATLAS	1.109701 d
VSX	2.2199 d

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).

UCAC3 250-234427 Cyg

Cross-ID's
= Fr257 Cyg
= Gaia DR2 1869248386613852544
= ATOID J312.8880+34.5180
= ASASSN-V J205133.00+343104.8 (ASAS-SN)
= ASASSN-V J205133.13+343105.2 (VSX)

Right ascension: 20h51m33.1291s at epoch and equinox J2000
Declination: +34° 31' 05.176" at epoch and equinox J2000
Barycentric right ascension (ICRS) at Epoch=2015.5: 312.88800596664° +/- 0.01 mas
Barycentric declination (ICRS) at Epoch=2015.5: +34.51806913006° +/- 0.02 mas

Gaia DR2 Catalog:
14.5720 mag G-band mean magnitude (Vega)
15.0141 mag Integrated BP mean magnitude (Vega)
13.9614 mag Integrated RP mean magnitude (Vega)
1.0527 mag BP-RP colour (photBpMeanMag-photRMeanMag)

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 of the ASAS-SN period and all ATLAS periods, since our minima are not represented with any of the published periods so far.

Fr257 = UCAC3 250-234427 Cyg improved elements

Amplitude: Min I: 0.43 mag (instr.) Min II: 0.38 mag (instr.)
Type: EA type eclipsing binary

Min I = HJD (UTC) 2456657.2732 + 2.2199782*E
+-0.0019 +-0.0000023

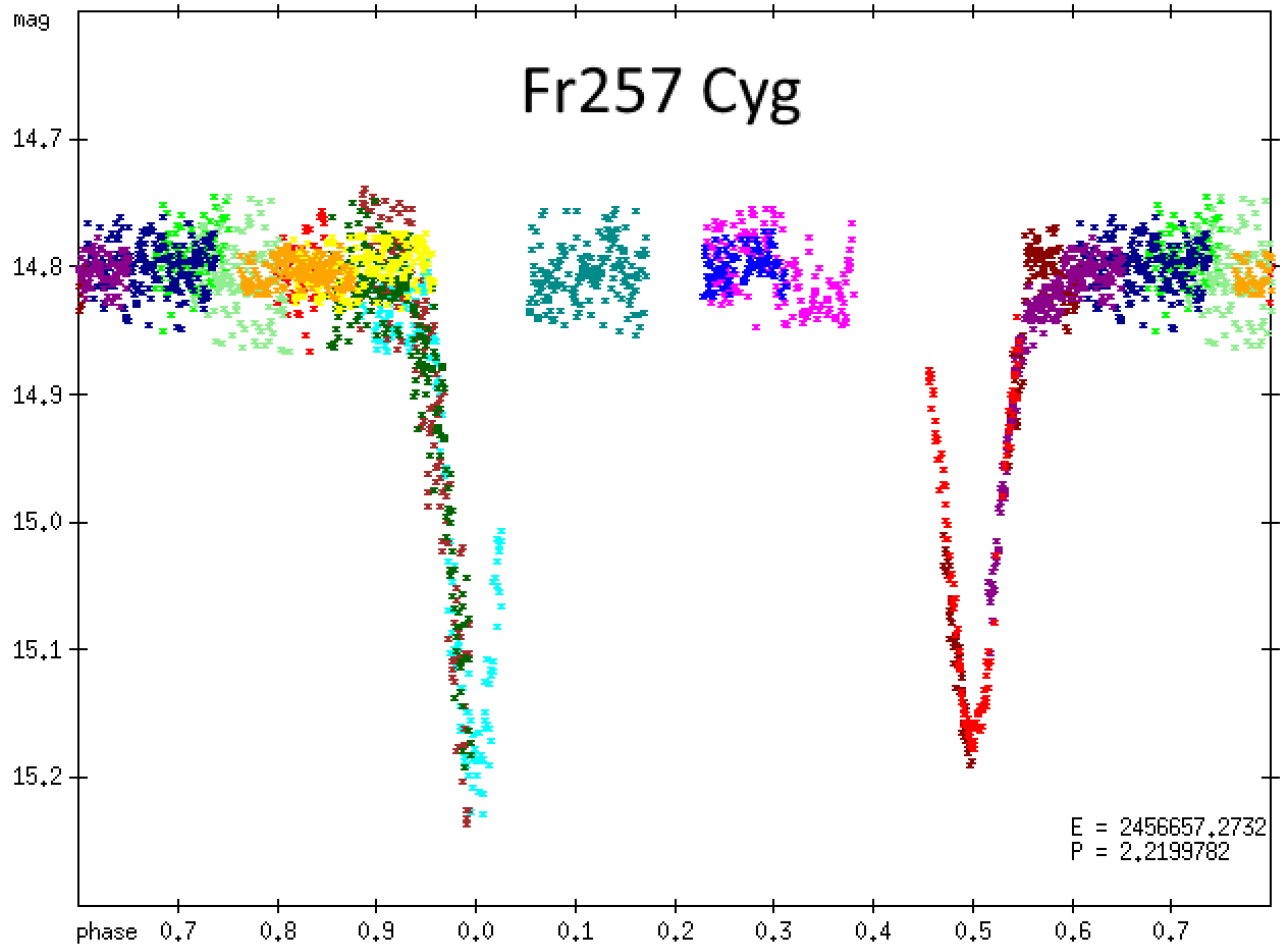

Figure 1: Phased light curve of UCAC3 250-234427 using the ephemeris given by the authors. The vertical axis shows raw instrumental magnitudes. Different colors denote different observing nights. Only the data points from the better nights were used to display the light curve. An FLI Proline 16803 camera + 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	2456657.2742	I	0	0.0010
P. Frank	2457658.4842	I	451	0.0008
Moschner/Frank	2457962.6161	I	588	-0.0043
W. Moschner	2458687.4414	II	914.5	-0.0019
W. Moschner	2459051.5205	II	1078.5	0.0009
P. Frank	2459070.3911	I	1087	0.0015
W. Moschner	2459120.3401	II	1109.5	0.0011

Table 1: Minima UCAC3 250-234427 Cyg, O-C using the ephemeris given by the authors.

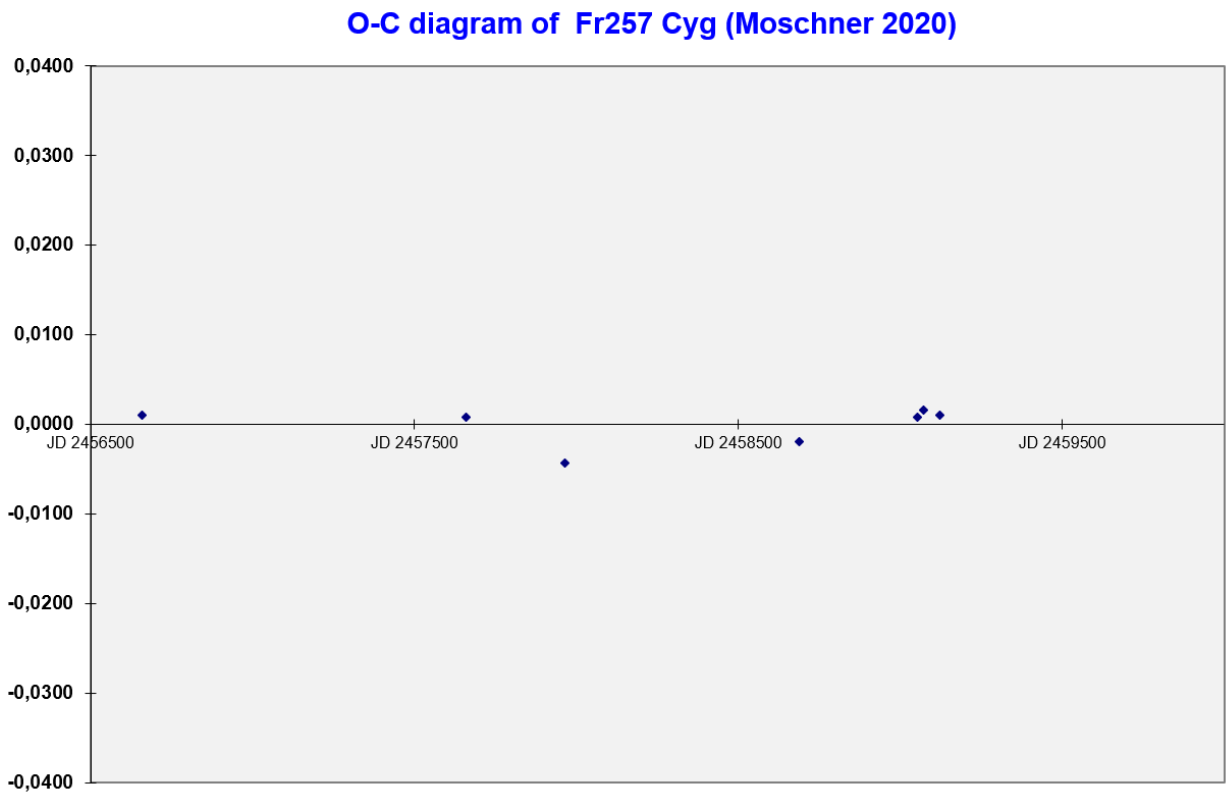

Figure 2: O-C-diagram for UCAC3 250-234427 Cyg using the ephemeris given by the authors.

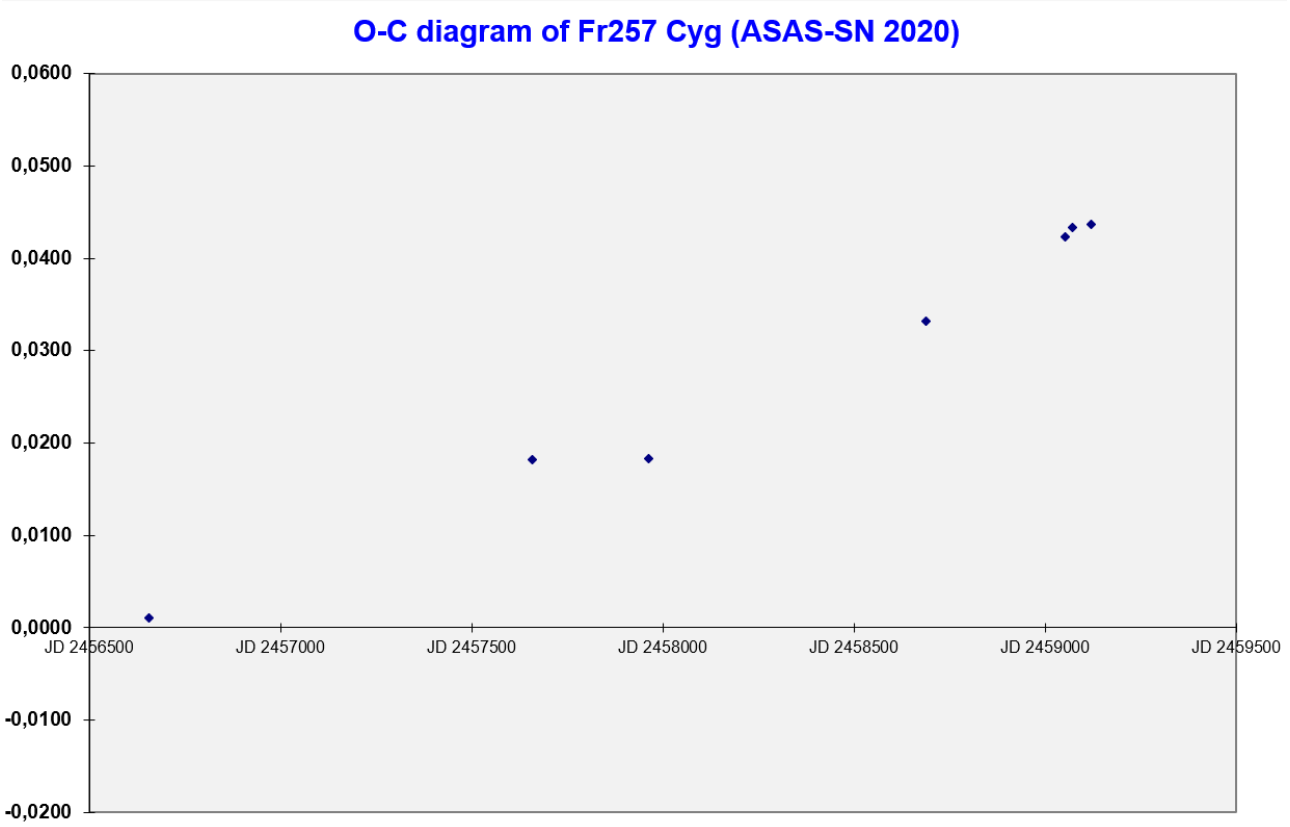

Figure 3: O-C-diagram for UCAC3 250-234427 Cyg using the period from ASAS-SN.

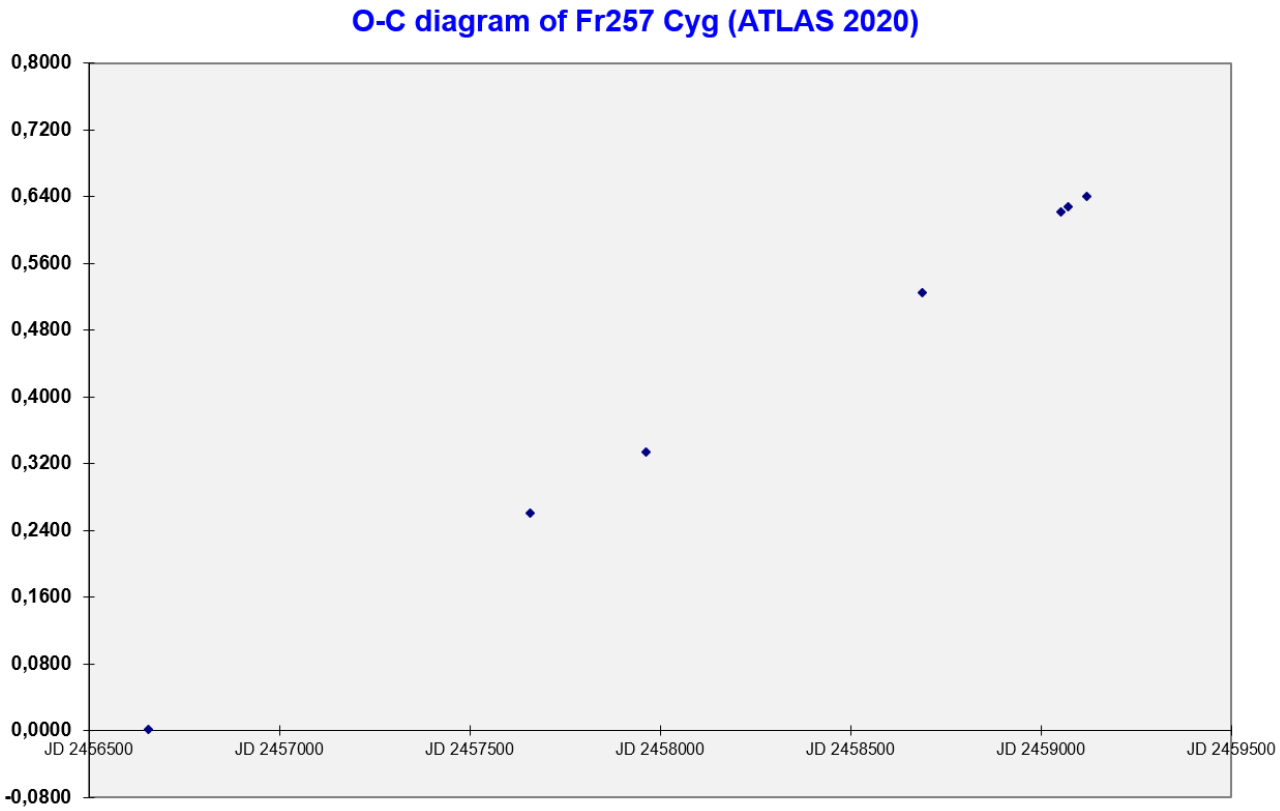

Figure 4: O-C-diagram for UCAC3 250-234427 Cyg using the period from ATLAS. The period was doubled (= 2.219402 d).

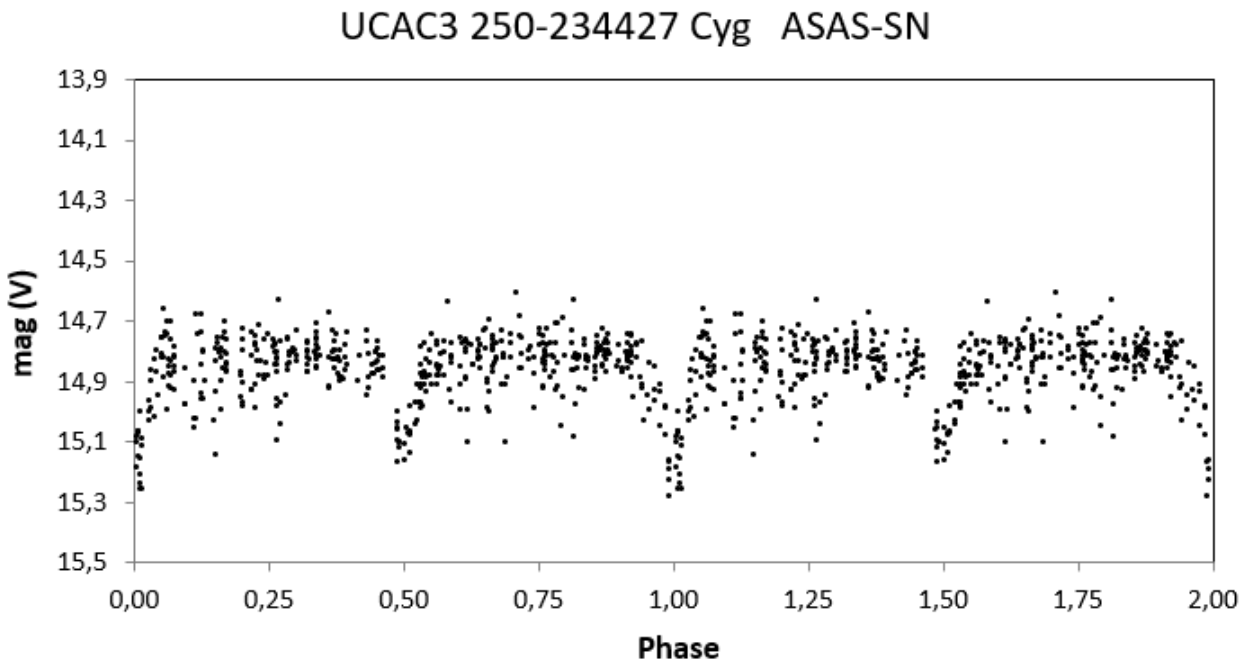

Figure 5: Phased light curve of UCAC3 250-234427 Cyg using the new elements and data from ASAS-SN.

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. The authors also thank Stefan Hümmerich for advice on the preparation of the manuscript.

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