



**Improved elements of the eclipsing binary  
Fr178 Aur = ASASSN-V J060836.30+515728.7**

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**Abstract:** Fr178 Aur = ASASSN-V J060836.30+515728.7 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 star is listed as variable in the ASAS and ATLAS data bases.

### Introduction

Fr178 Aur = ASASSN-V J060836.30+515728.7 was discovered as a photometric variable by Peter Frank in the year 2011 and classified as eclipsing binary. The amplitude is given as 0.55 mag, 15.00-15.55 mag (V). The variable is listed in the ATLAS [1] and ASAS-SN-Variable Stars Database [2,3].

During these studies, we furthermore discovered several period solutions for this star in an extensive datasheet prepared by the ATLAS project. Only one of these periods that we found by ATLAS is similar to ours. We have at our disposal 28 time series with approx. 4200 images that were taken between 2010 and 2020. The observation time per night was between 2 and 8 hours.

Since the minima derived from our data cannot be represented by the ASAS-SN and ATLAS period, we have used our data to present an improved period solution. The designation ASASSN-V J060836.29+515728.8 registered in the VSX [4] does not exist in the ASAS-SN Variable Stars Database. This designation is not identical to the designation from the ASAS-SN Variable Stars Database provided by the ASAS-SN project.

## Periods known so far:

Simbad [5]	no information
ASAS-SN	1.5141188 d
ATLAS	1.514057 d
VSX	1.5141 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
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## Data analysis

Muniwin [6] and self-written programs by Franz Agerer and Lienhard Pagel [7] 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

All coordinates are taken from the Gaia EDR3 catalogue [8].

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

## **Fr178 Aur = ASASSN-V J060836.30+515728.7**

Cross-ID's

= UCAC3 284-091355

= UCAC4 710-042264

= ATOID J092.1512+51.9580

= 2MASS 06083629+5157288

= Gaia EDR3 972304802528259584

Right ascension: 06h08m36.2992s at epoch and equinox J2000

Declination: +51° 57' 28.841" at epoch and equinox J2000

Barycentric right ascension (ICRS) at Epoch=2016.0: 92.151210639° +/- 0.05 mas

Barycentric declination (ICRS) at Epoch=2016.0: +51.958001873° +/- 0.05 mas

Gaia EDR3 Catalog:

14.871494 mag G-band mean magnitude (350-1000 nm)

15.354198 mag Integrated BP mean magnitude (330- 680 nm)

14.205842 mag Integrated RP mean magnitude (640-1000 nm)

1.148356 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) and assuming that the true phase of Min II is exactly 0.5.

Our ephemeris represents an improvement over the ASAS-SN and ATLAS periods, since our minima cannot be reproduced with any of these periods.

The amplitude for Min I is given as 0.55 mag, 15.00-15.55 mag and for Min II as 0.12 mag, 15.00-15.12 mag.

### Fr178 Aur = ASASSN-V J060836.30+515728.7 (improved elements)

Amplitude: Min I: 0.55 mag (instr.)      Min II: 0.12 mag (instr.)

Type: EA type eclipsing binary

Min I = HJD (UTC)  $2458481.3309 + 1.5140778 * E$   
 $\pm 0.0005 \quad \pm 0.0000007$

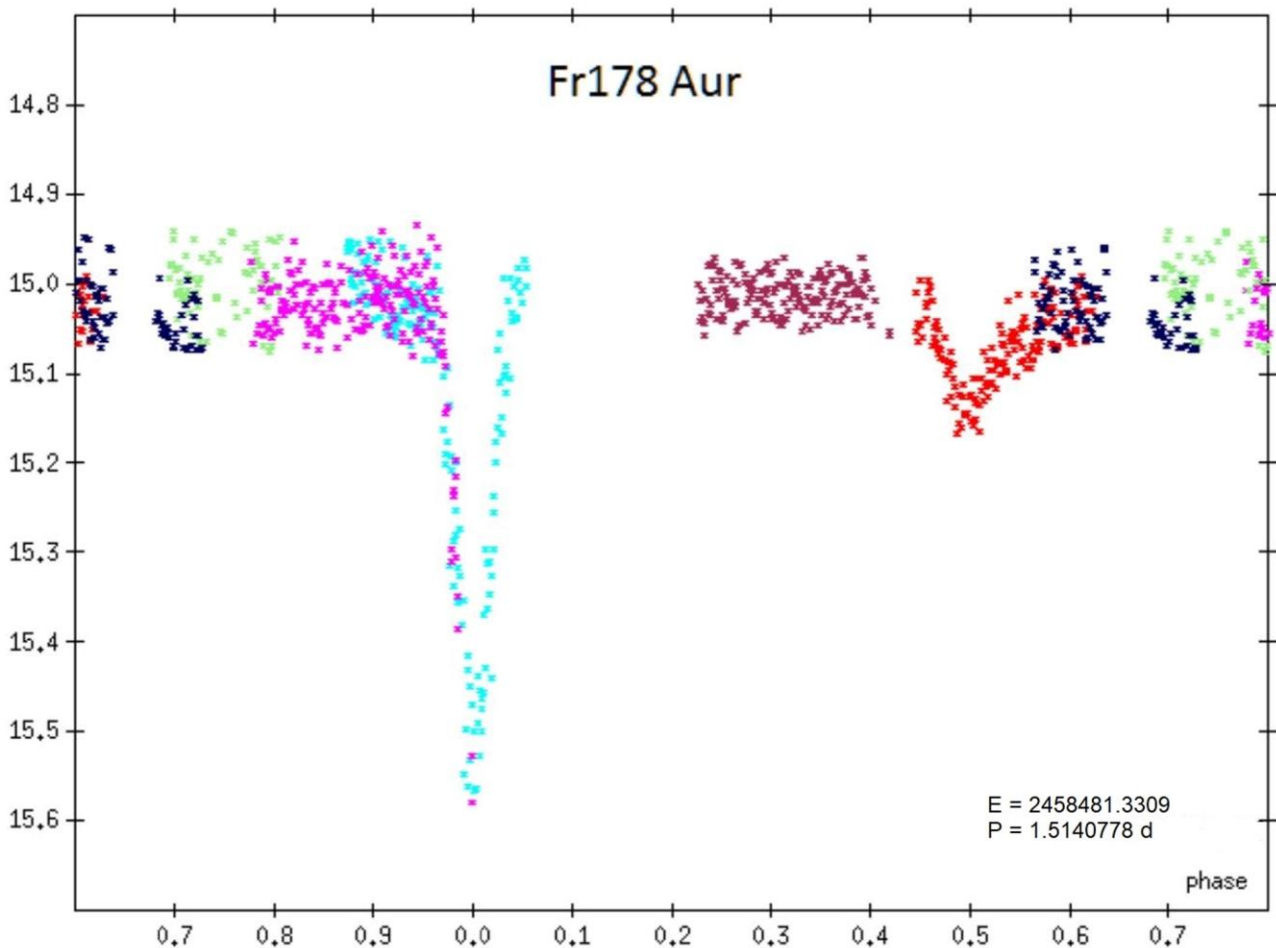


Figure 1: Phased light curve of Fr178 Aur = ASASSN-V J060836.30+515728.7 using the ephemeris given by the authors. The vertical axis shows raw instrumental magnitudes. Different colors denote different observing nights. Only the data points from the better nights were used to display the light curve. A FLI Proline 16803 camera + V-filter (2016-2020) was used.

Observer	HJD-Date Minimum	Type	Epoch	O-C (d)
P. Frank	2456013.3853	I	-1630	0.0012
W. Moschner	2457814.3775	II	-440.5	-0.0021
W. Moschner	2458175.4864	I	-202	-0.0008
P. Frank	2458405.6257	I	-50	-0.0013
P. Frank	2458481.3308	I	0	-0.0001
W. Moschner	2458854.5535	II	246.5	0.0024
W. Moschner	2459288.3343	I	533	-0.0001
W. Moschner	2459297.4181	I	539	-0.0007
P. Frank	2459309.5338	I	547	0.0023
W. Moschner	2459527.5575	I	691	-0.0011
W. Moschner	2459618.4028	I	751	-0.0005

Table 1: Minima Fr178 Aur = ASASSN-V J060836.30+515728.7, O-C using the ephemeris given by the authors. The O-C of the secondary minima were calculated assuming that the true phase is at exactly 0.5.

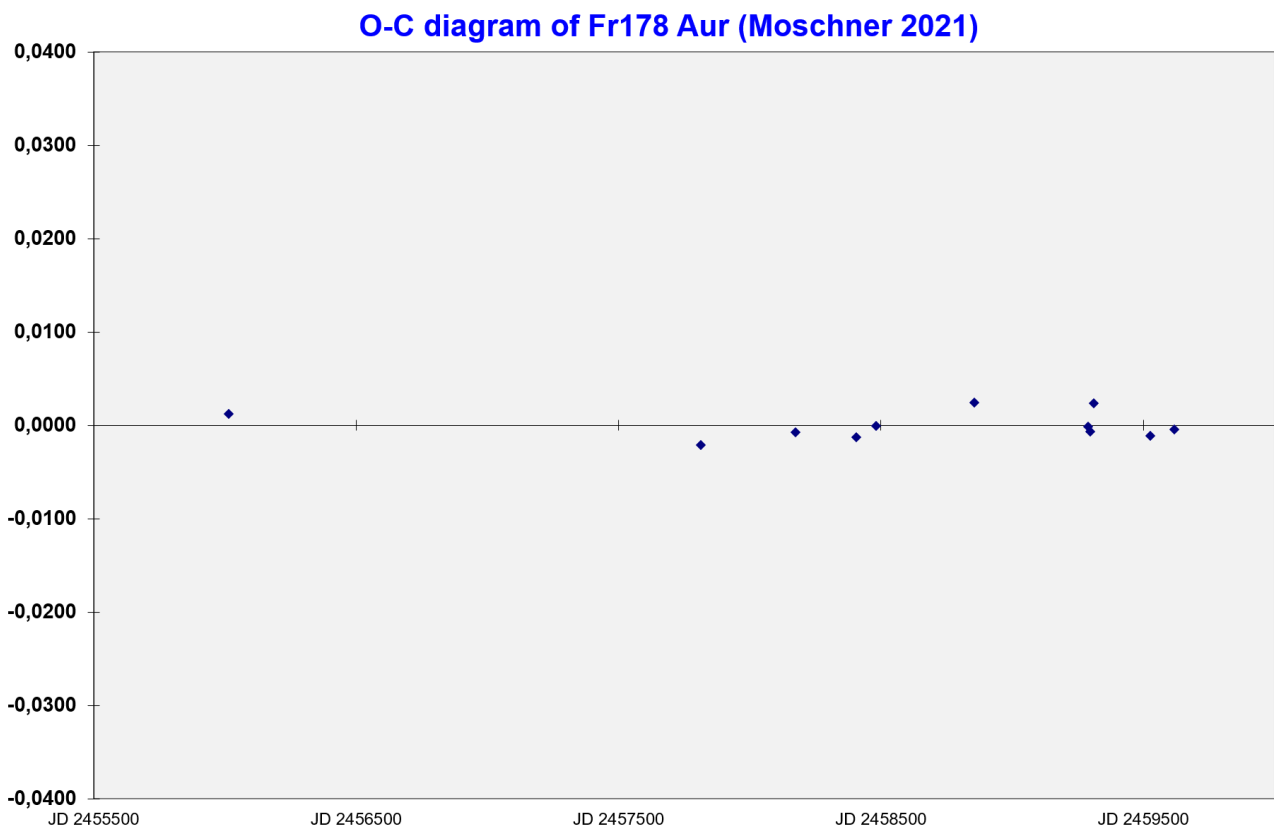


Figure 2: O-C-diagram for Fr178 Aur = ASASSN-V J060836.30+515728.7 using the ephemeris given by the authors.

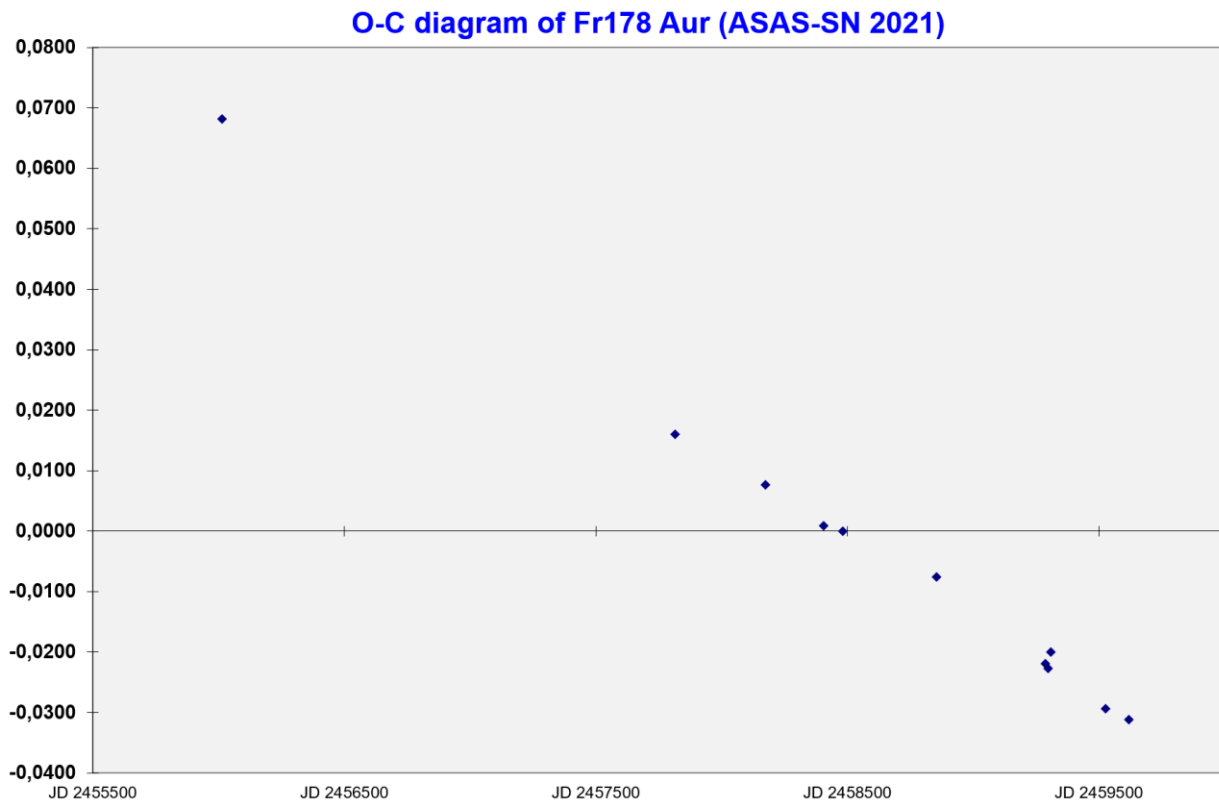


Figure 3: O-C-diagram for Fr178 Aur = ASASSN-V J060836.30+515728.7 using the period from ASAS-SN (1.5141188 d).

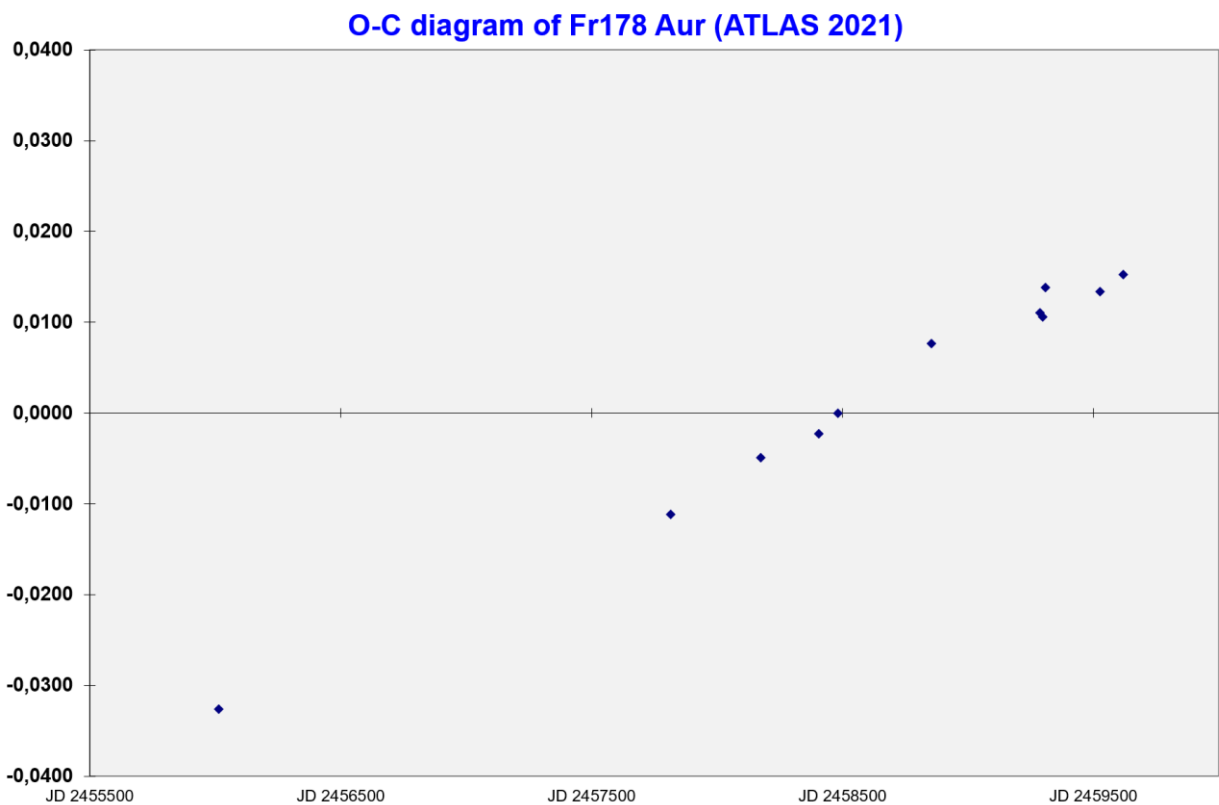


Figure 4: O-C-diagram for Fr178 Aur = ASASSN-V J060836.30+515728.7 using the period from ATLAS (1.514057 d).

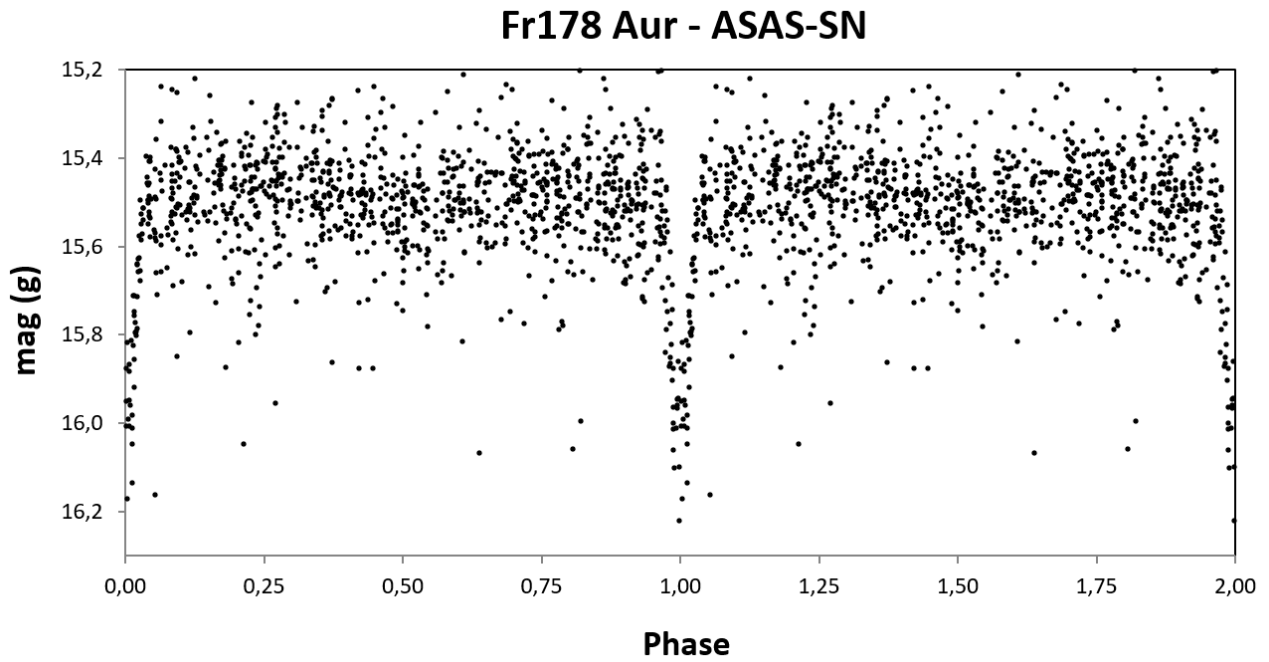


Figure 5: Phased light curve of Fr178 Aur = ASASSN-V J060836.30+515728.7 using the improved elements and data from ASAS-SN (g-Band).

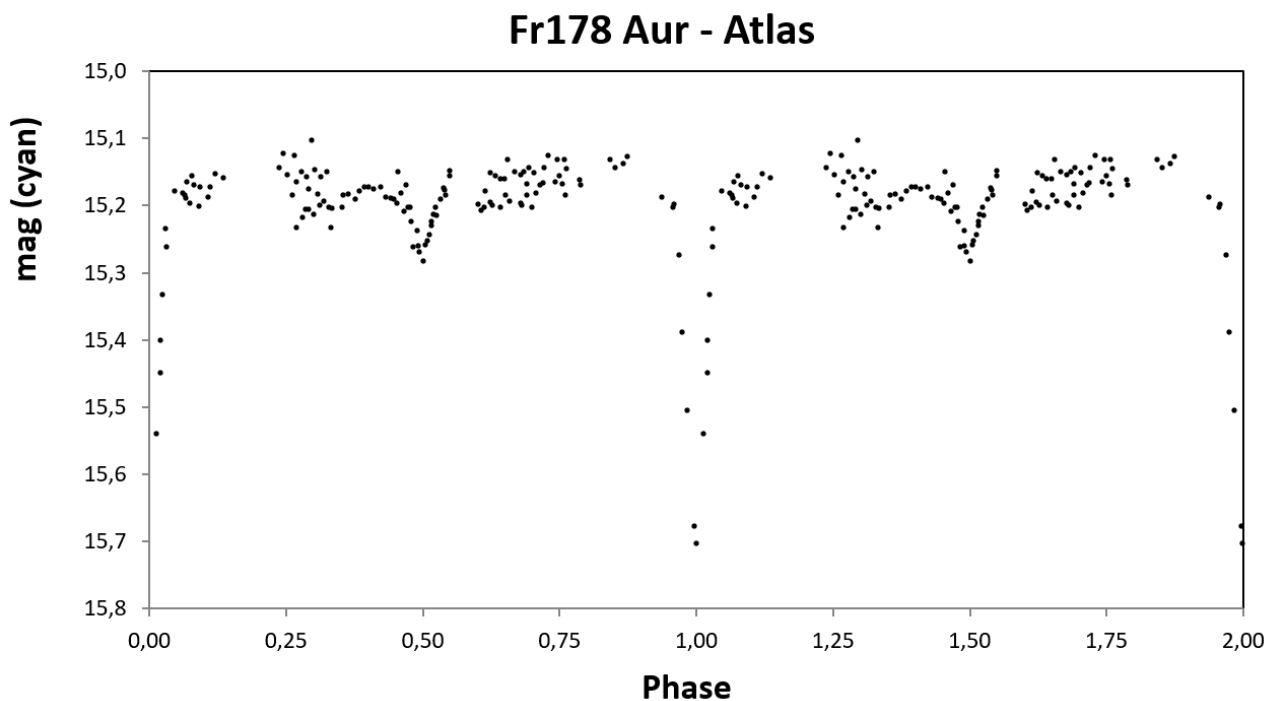


Figure 6: Phased light curve of Fr178 Aur = ASASSN-V J060836.30+515728.7 using the improved elements and data from ATLAS (Cyan-Filter 420-650 nm).

## Acknowledgements

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

## References

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