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Change of period and improved elements of the eclipsing binary Fr280 Lyr = ATO J287.0785+29.5885

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Abstract: *The variability of Fr280 Lyr was discovered by Peter Frank in 2011, who classified it as an eclipsing binary. The authors published the discovery in 2018 in BAVJ No. 21 [1]. Additional observations up to 2018 show a period change in the O-C diagram. The authors present a phased light curve from the ATLAS Project and their own data, a list of primary and secondary minima, O-C diagrams and an improved period solution of the star.*

Observations

400 mm ASA Astrograph f/3.7 - f = 1471 mm, FLI Proline 16803 CCD-Camera - V-filter - t = 120 sec.
Wolfgang Moschner, Astrocamp/Nerpio, Spain
102 mm 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 [2] and self-written programs by Franz Agerer and Lienhard Pagel [3] were used for the analysis of the frames, after bias, dark and flatfield correction. The weighted average of 5 comparison stars was used.

Explanations:
HJD = heliocentric UTC timings (JD) of the observed minima
All coordinates are taken from the Gaia DR3 catalogue [4]. The coordinates (epoch J2000) are computed by VizieR, and are not part of the original data from Gaia (note that the coordinates are computed from the positions and the proper motions).

Fr280 Lyr

Cross-IDs
= ZTF J190818.84+293518.8
= ATO J287.0785+29.5885
= Gaia DR3 2037853478206037632
= UCAC4 598-071837
= 2MASS J19081884+2935188
= USNO B1.0 1195-0325821
= WISE J190818.8+293518

Gaia DR3 catalogue:
Right ascension: 19h08m18.8467s at Epoch J2000
Declination: +29° 35' 18.802" at Epoch J2000
14.5974 mag G-band mean magnitude (350-1000 nm)
14.9054 mag Integrated BP mean magnitude (330-680 nm)
14.1044 mag Integrated RP mean magnitude (640-1000 nm)
0.8010 mag BP-RP

Periods known so far:

VSX [5]	0.408626 d	ATLAS [8]	0.408631 d
BAVJ021 [1]	0.408626 d	WISE [9]	0.4086237 d
ASAS-SN [6]	no information	Gaia [10]	0.4086263 d
ZTF g-band [7]	0.4086258 d		

Results

The variability of Fr280 Lyr = ATO J287.0785+29.5885 was discovered by Peter Frank in 2011, who classified it as an eclipsing binary. The authors published the discovery with a first period in 2018 in BAVJ No. 021 [1]. Further observations up to 2024 have served to monitor the period. In the O-C diagram, we now see a period change after the years 2018/19.

The updated orbital elements are applicable to the post-2019 period. The period has increased by 0.5 seconds. The variable should be monitored further in the future, since further period changes are to be expected. A physical interpretation of the phenomenon cannot be made here.

The presented elements were calculated by the method of least squares, taking into account all our minima from JD 2458601 to JD 2460530 (see table below). Data from this star were also recently processed by the ATLAS project [8].

The VSX database, the ATLAS database, the ZTF database and the WISE database also list the star as variable, but with different periods. The variable is not listed in the ASAS-SN Variable Star Database [6]. The period in the VSX database was taken from BAVJ No. 021. The period of Gaia was calculated by us from the value of the column 'Freq d/1' (frequency) of the Gaia database DR3 Part 4. Variability [10]. Databases such as Gaia, ZTF, ATLAS and WISE can provide different period values due to deviating observational data.

We had 8100 data points of our own available for our analysis.

The authors recommend continuing to monitor the star in the coming years, as period changes can also be expected in the future. The original measured values can be provided by the authors on request for your own research.

Fr280 Lyr Elements with period after the period change
These elements are valid from approx. JD 2458601
Type = EW
Min. I = HJD 2458712.5370 + 0.40863140*E
±0.0007 ±0.00000020

Observer	HJD-Date Minimum	Type	Epoch	O-C (d)
P. Frank	**2455074.5394**	**I**	**-8903**	**0.0478**
P. Frank	**2455380.4004**	**II**	**-8154.5**	**0.0482**
P. Frank	**2455385.4986**	**I**	**-8142**	**0.0385**
P. Frank	**2455409.4067**	**II**	**-8083.5**	**0.0416**
P. Frank	**2455418.3919**	**II**	**-8061.5**	**0.0369**
P. Frank	**2455429.4327**	**II**	**-8034.5**	**0.0447**
P. Frank	**2456568.4716**	**I**	**-5247**	**0.0236**
P. Frank	**2456579.3008**	**II**	**-5220.5**	**0.0240**
P. Frank	**2456590.3310**	**II**	**-5193.5**	**0.0212**
P. Frank	**2456596.2552**	**I**	**-5179**	**0.0202**
P. Frank	**2456918.4633**	**II**	**-4390.5**	**0.0225**
Moschner/Frank	**2457618.4372**	**II**	**-2677.5**	**0.0108**
Moschner/Frank	**2457626.4061**	**I**	**-2658**	**0.0114**
Moschner/Frank	**2457899.5749**	**II**	**-1989.5**	**0.0101**
Moschner/Frank	**2457921.4346**	**I**	**-1936**	**0.0080**
Moschner/Frank	**2457921.6427**	**II**	**-1935.5**	**0.0118**

Moschner/Frank	**2457935.5334**	**II**	**-1901.5**	**0.0090**
Moschner/Frank	**2457949.4267**	**II**	**-1867.5**	**0.0088**
Moschner/Frank	**2457949.6298**	**I**	**-1867**	**0.0076**
Moschner/Frank	**2457950.4470**	**I**	**-1865**	**0.0076**
Moschner/Frank	**2458022.3651**	**I**	**-1689**	**0.0065**
P. Frank	**2458043.4089**	**II**	**-1637.5**	**0.0058**
W. Moschner	**2458324.5473**	**II**	**-949.5**	**0.0058**
W. Moschner	**2458601.5955**	**II**	**-271.5**	**0.0019**
W. Moschner	**2458682.5046**	**II**	**-73.5**	**0.0020**
W. Moschner	**2458705.3867**	**II**	**-17.5**	**0.0007**
W. Moschner	**2458712.5370**	**I**	**0**	**0.0000**
P. Frank	**2458987.5497**	**I**	**673**	**0.0038**
W. Moschner	**2458990.6098**	**II**	**680.5**	**-0.0008**
W. Moschner	**2459025.5483**	**I**	**766**	**-0.0003**
W. Moschner	**2459035.5576**	**I**	**790.5**	**-0.0025**
W. Moschner	**2459035.5582**	**I**	**790.5**	**-0.0019**
W. Moschner	**2459038.4148**	**I**	**797.5**	**-0.0057**
W. Moschner	**2459038.6255**	**I**	**798**	**0.0007**
P. Frank	**2459043.5293**	**I**	**810**	**0.0008**
W. Moschner	**2459047.4078**	**I**	**819.5**	**-0.0026**
W. Moschner	**2459047.6137**	**I**	**820**	**-0.0010**
W. Moschner	**2459062.5296**	**I**	**856.5**	**-0.0002**
W. Moschner	**2459067.4291**	**I**	**868.5**	**-0.0042**
W. Moschner	**2459083.3690**	**I**	**907.5**	**-0.0010**
W. Moschner	**2459095.4249**	**I**	**937**	**0.0003**
W. Moschner	**2459391.4799**	**II**	**1661.5**	**0.0018**
W. Moschner	**2459401.4879**	**I**	**1686**	**-0.0016**
W. Moschner	**2459411.4990**	**II**	**1710.5**	**-0.0020**
W. Moschner	**2459443.3727**	**II**	**1788.5**	**-0.0016**
W. Moschner	**2459730.6396**	**II**	**2491.5**	**-0.0025**
W. Moschner	**2459751.4792**	**II**	**2542.5**	**-0.0031**
W. Moschner	**2459757.4026**	**I**	**2557**	**-0.0048**
W. Moschner	**2459757.6081**	**II**	**2557.5**	**-0.0037**
W. Moschner	**2459768.4374**	**I**	**2584**	**-0.0031**
W. Moschner	**2459770.4807**	**I**	**2589**	**-0.0030**
W. Moschner	**2459784.3799**	**I**	**2623**	**0.0027**
W. Moschner	**2459784.5805**	**II**	**2623.5**	**-0.0010**
W. Moschner	**2459806.4417**	**I**	**2677**	**-0.0016**
W. Moschner	**2459814.4060**	**II**	**2696.5**	**-0.0056**
W. Moschner	**2460142.5463**	**II**	**3499.5**	**0.0037**
W. Moschner	**2460169.5100**	**II**	**3565.5**	**-0.0022**
W. Moschner	**2460477.6183**	**II**	**4319.5**	**-0.0020**
W. Moschner	**2460495.3972**	**I**	**4363**	**0.0014**
W. Moschner	**2460500.5035**	**II**	**4375.5**	**-0.0002**
W. Moschner	**2460505.4069**	**II**	**4387.5**	**-0.0004**
W. Moschner	**2460517.4612**	**I**	**4417**	**-0.0007**
W. Moschner	**2460530.5358**	**I**	**4449**	**-0.0023**

Table 1: Minima of Fr280 Lyr = ATO J287.0785+29.5885 using the elements after the period change. The O-C of the secondary minima were calculated assuming that the true phase is at exactly at 0.5.

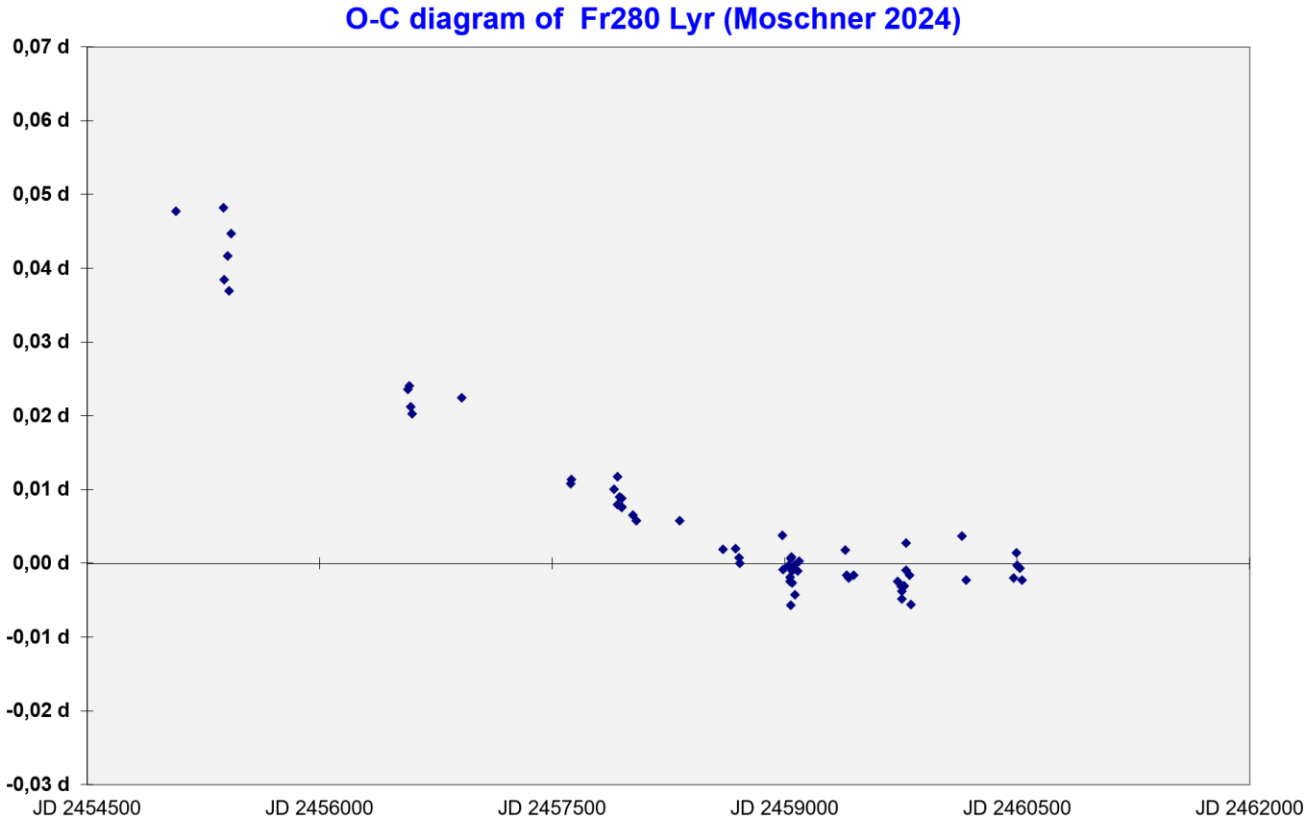

Figure 1: O-C-diagram of Fr280 Lyr = ATO J287.0785+29.5885 using the ephemeris after the period jump given by the authors. These CCD minima between 2019 and 2024 were used to calculate the period.

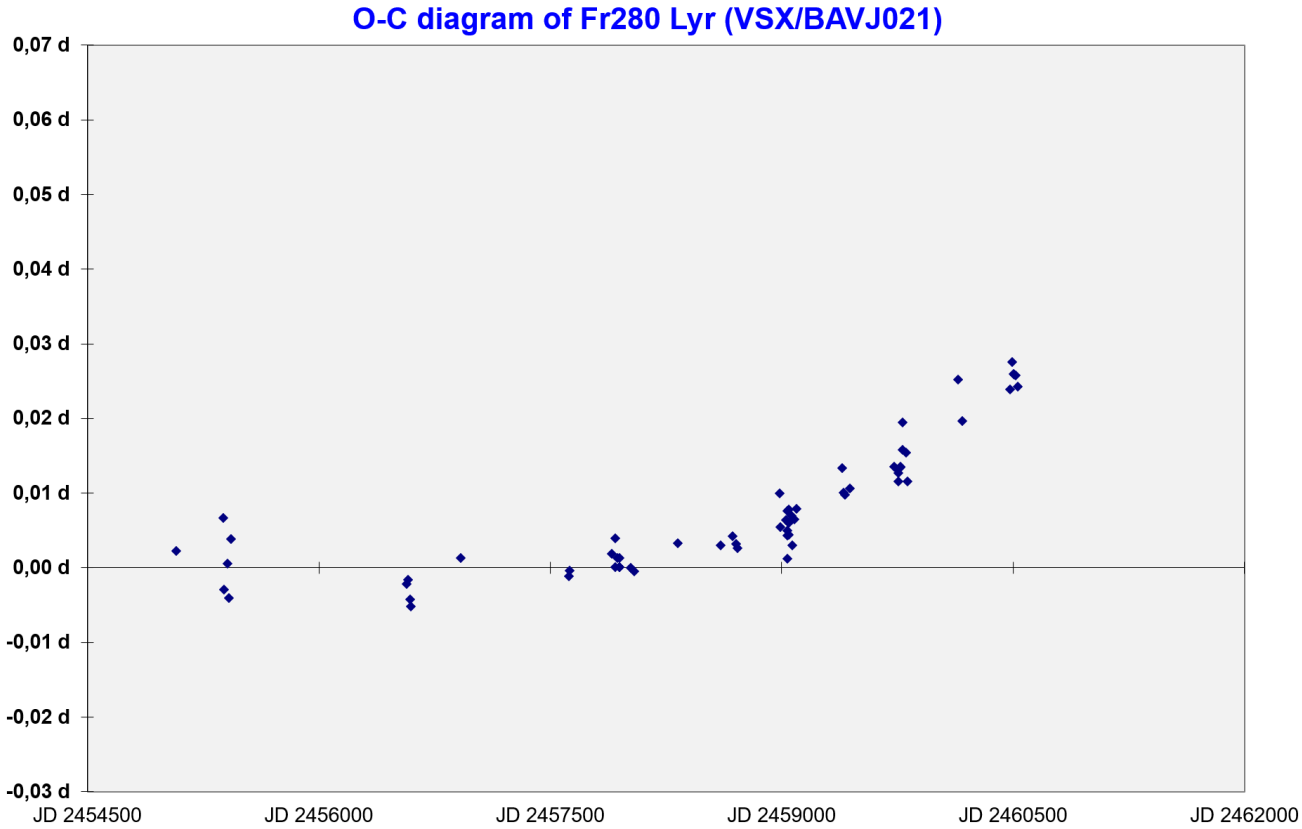

Figure 2: O-C-diagram of Fr280 Lyr = ATO J287.0785+29.5885 using the period from the VSX and BAVJ021 (0.408626 d).

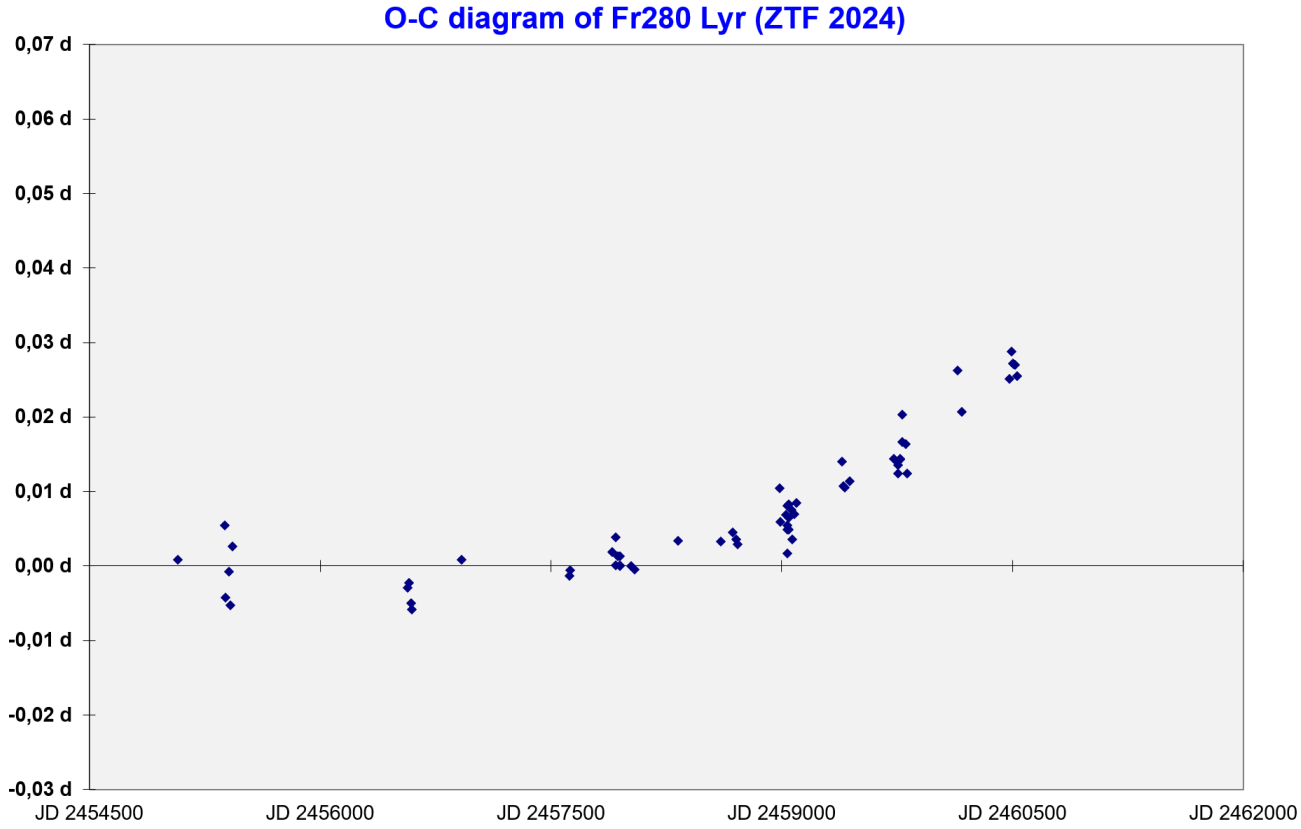

Figure 3: O-C-diagram of Fr280 Lyr = ATO J287.0785+29.5885 using the period from the ZTF database g-band (0.4086258 d).

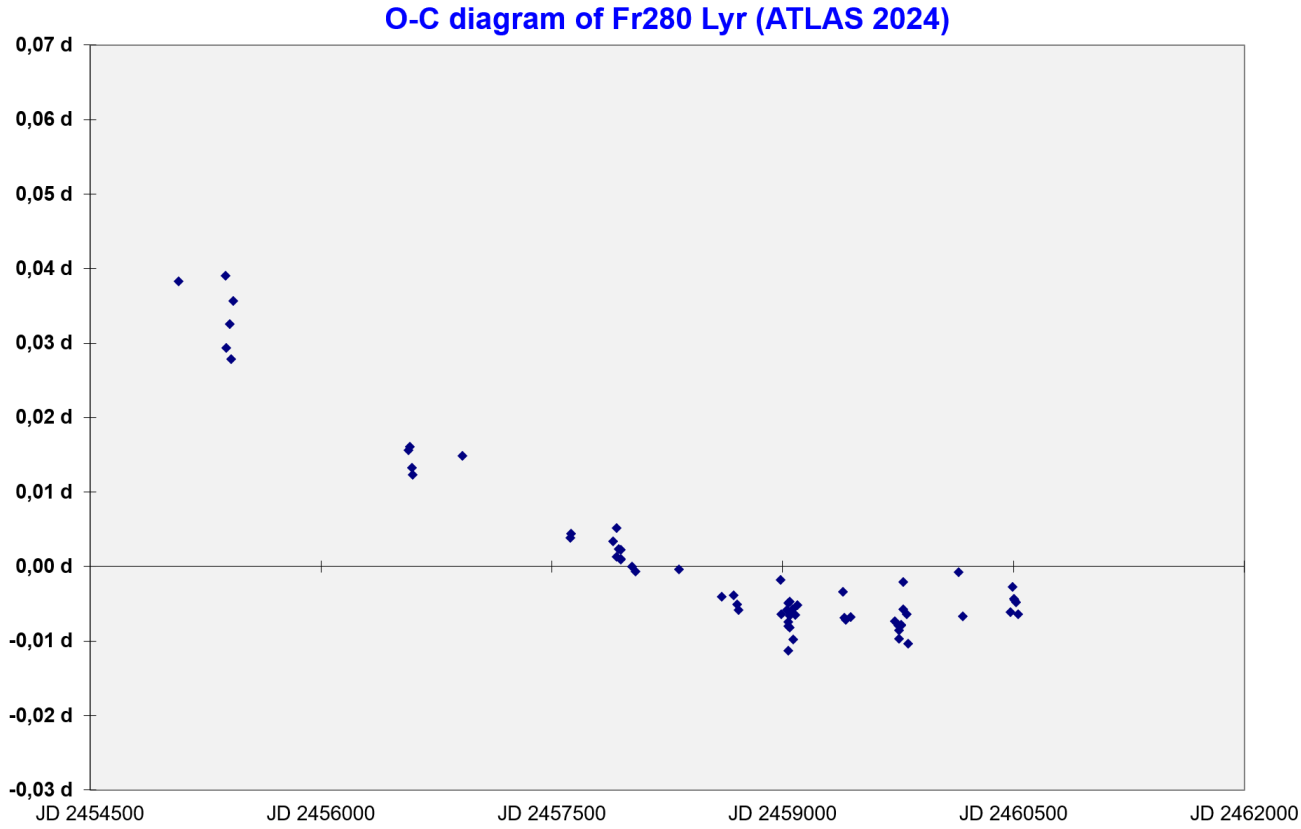

Figure 4: O-C-diagram of Fr280 Lyr = ATO J287.0785+29.5885 using the period from the ATLAS database (0.408631 d).

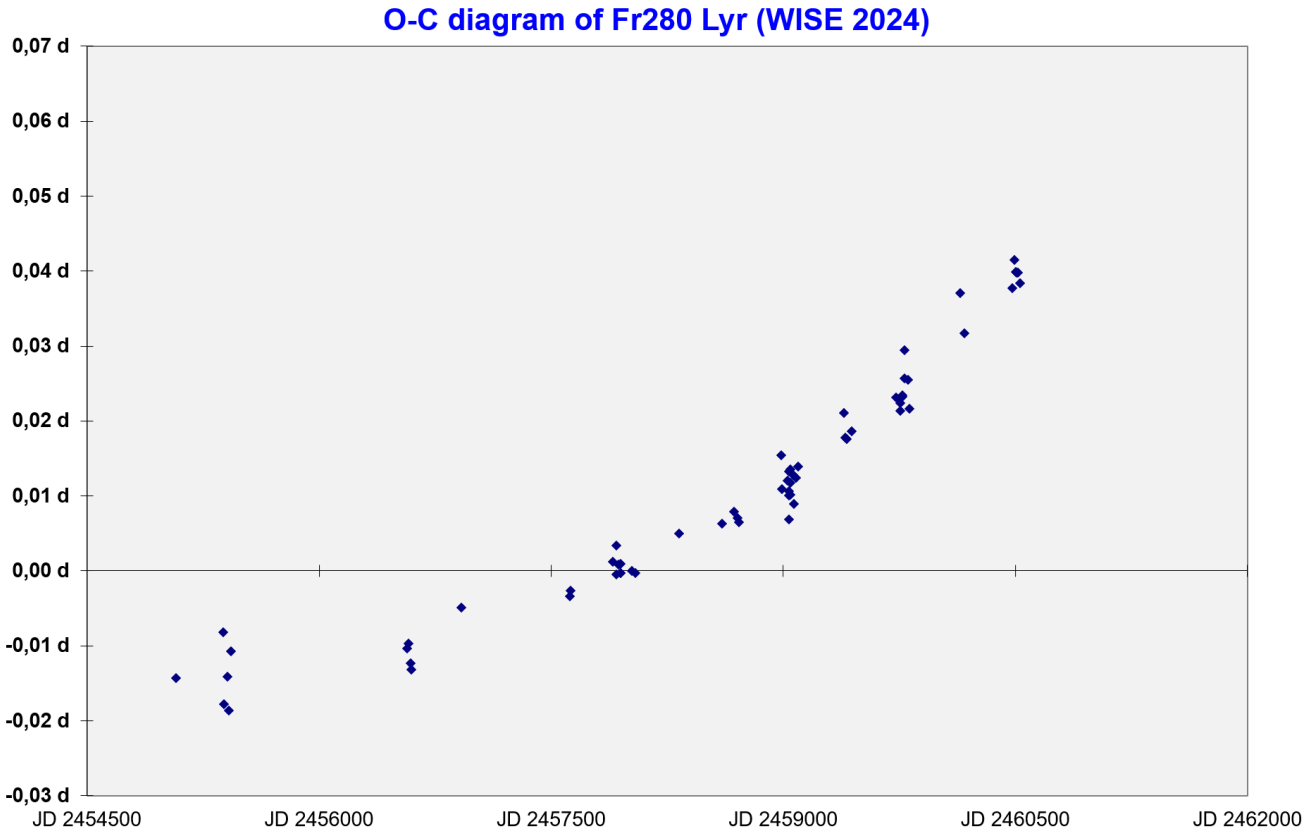

Figure 5: O-C-diagram of Fr280 Lyr = ATO J287.0785+29.5885 using the period from the WISE database (0.4086237 d).

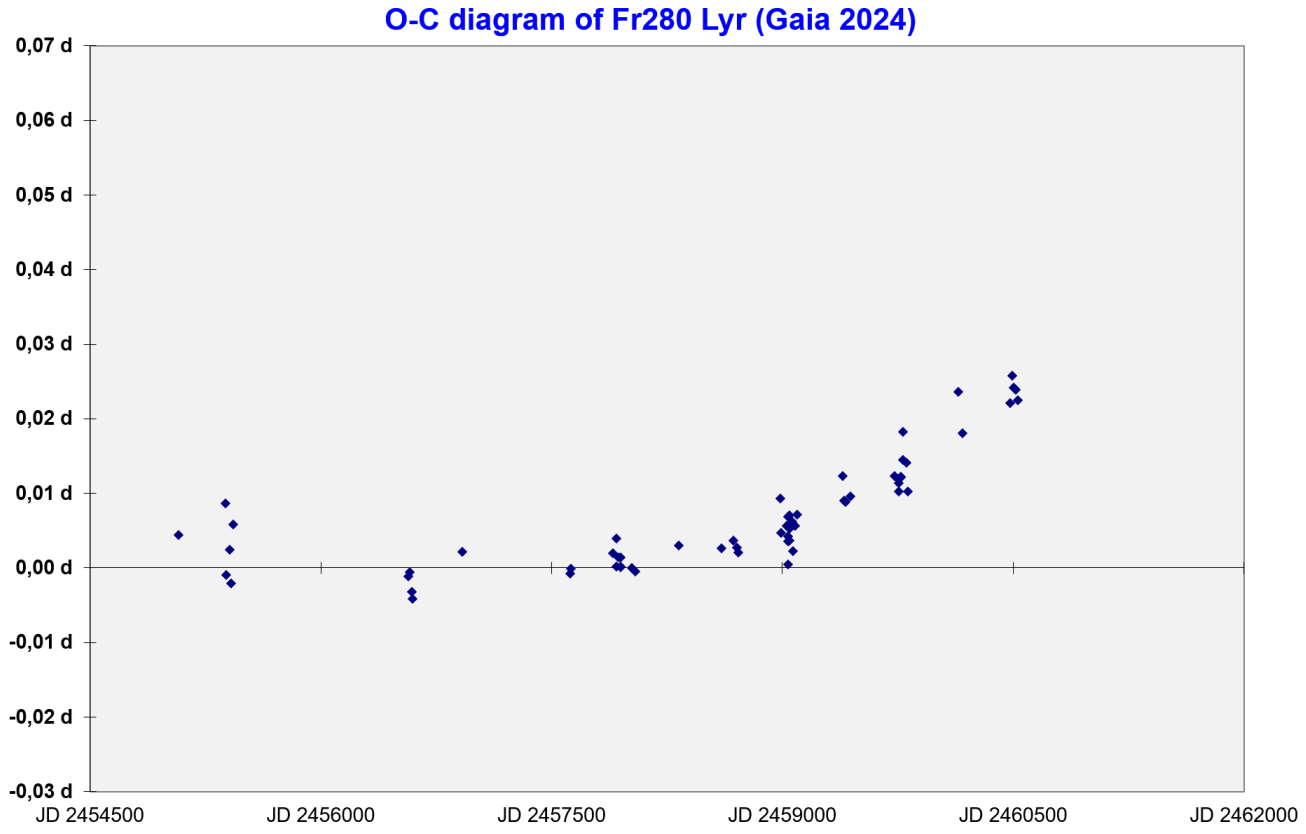

Figure 6: O-C-diagram of Fr280 Lyr = ATO J287.0785+29.5885 using the period from the Gaia database (0.4086263 d).

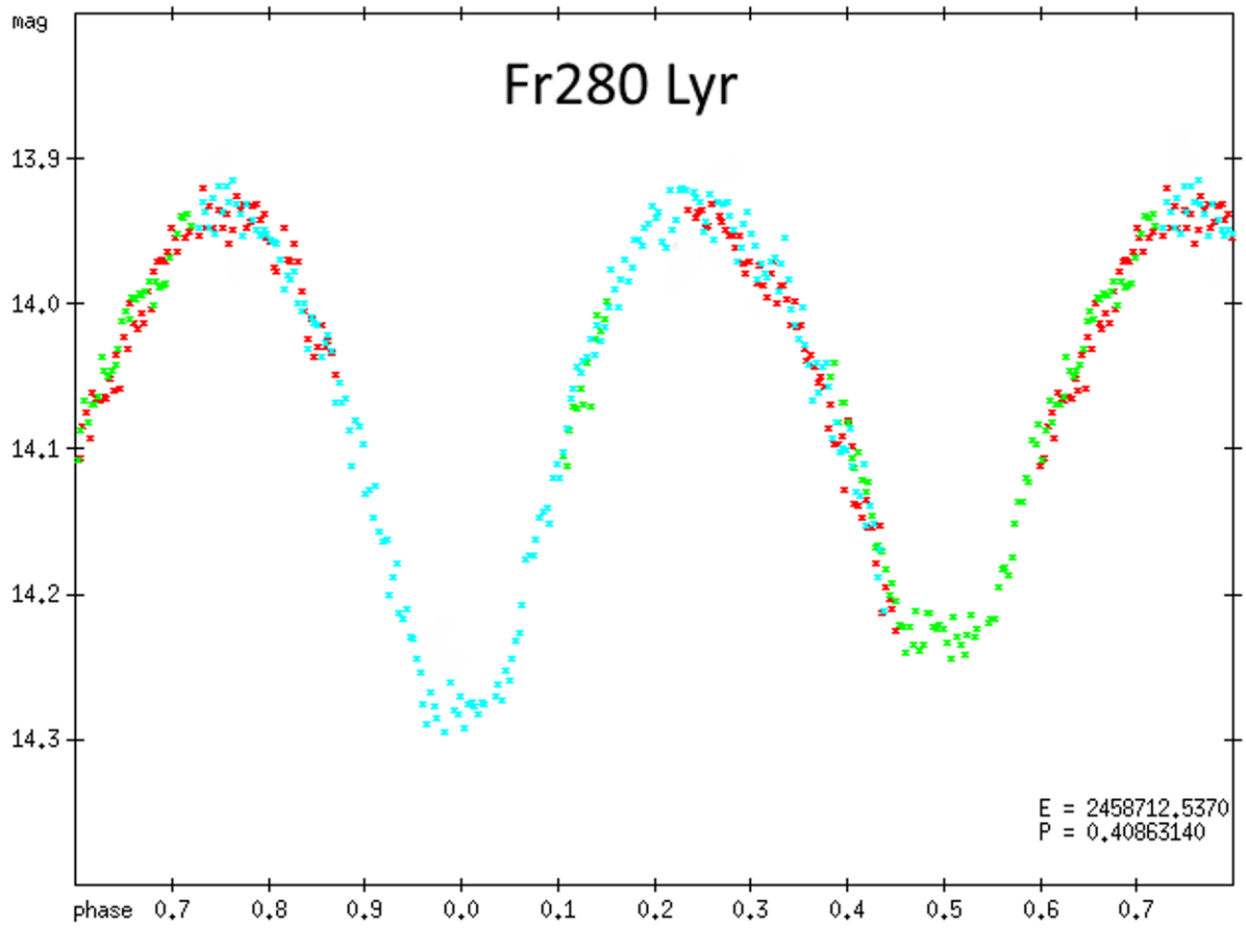

Figure 7: Phased lightcurve of Fr280 Lyr = ATO J287.0785+29.5885 with the data (year 2014) from our telescope in Nerpio/Spain (V-Filter) using the ephemeris after the period jump given by the authors. The data used are also from the period after the period jump.

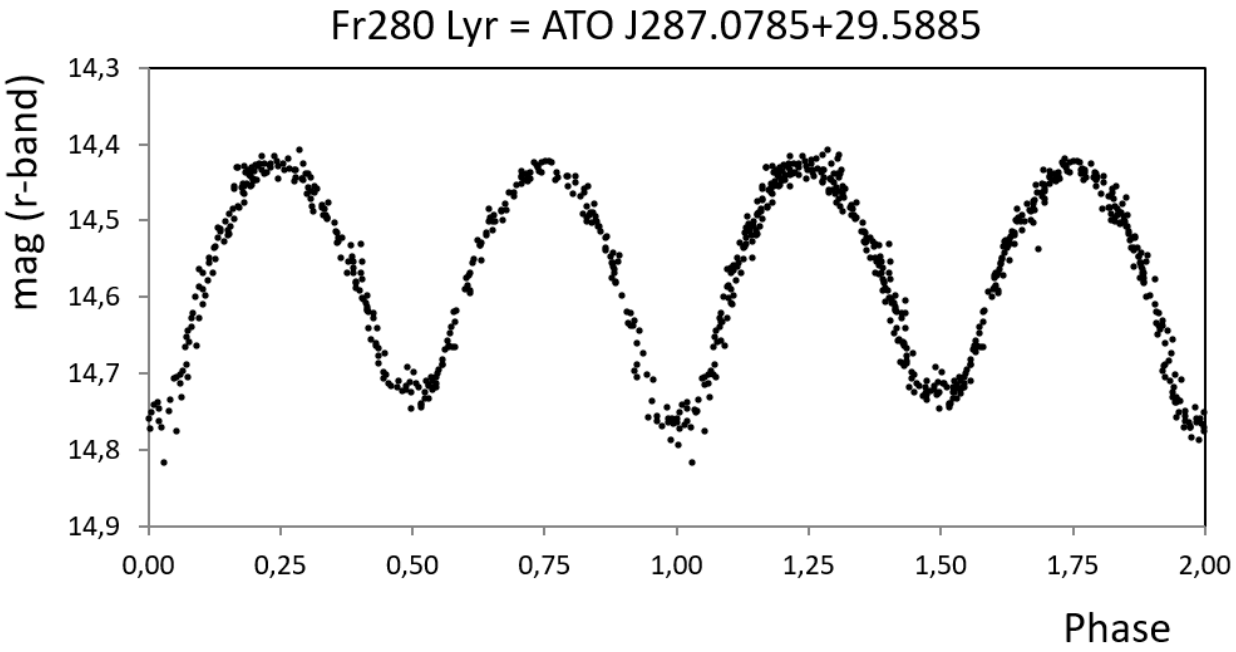

Figure 8: Phased lightcurve of Fr280 Lyr = ATO J287.0785+29.5885 with the data of the ZTF project (r-band) using the ephemeris after the period jump given by the authors. The data used are also from the period after the period jump.

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