BAV Journal

2022 No. 66 ISSN 2366-6706

Bundesdeutsche Arbeitsgemeinschaft für Veränderliche Sterne e.V.

http://bav-astro.de

V585 Vul (=Fr35 Vul) with period jump

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Bundesdeutsche Arbeitsgemeinschaft für Veränderliche Sterne e.V.

August 2022

Abstract: *Fr35 Vul was discovered by Peter Frank and classified as short period eclipsing binary in 2008. 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. In 2017, a period jump occurred that can be clearly seen in the O-C diagram. The period has lengthened by approx. 0.49 seconds per orbit due to the period jump.*

Observations

102mm f/5.0 TeleVue Refractor - f = 510 mm - SIGMA 1603 CCD-Camera - -Ir-filter - t = 90 sec.
Peter Frank, Velden, Germany
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

Data analysis

Muniwin [1] and self-written programs by Franz Agerer and Lienhard Pagel [2] were used for the analysis of the frames, after bias, dark and flatfield correction of the exposures. 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 [3]. 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).

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

Fr35 Vul = V585 Vul

Cross-ID's

= UCAC3 231-242192
= ATOID J308.4296+25.1332
= Gaia EDR3 1831736726361298304
= ZTF J203343.09+250759.7

Gaia EDR3 Catalog:
Right ascension: 20h33m43.1077s at Epoch=J2000
Declination: +25° 07' 59.760" at Epoch=J2000
15.6394 mag G-band mean magnitude
15.9979 mag Integrated BP mean magnitude
15.0931 mag Integrated RP mean magnitude
0.8981 mag BP-RP

Periods known so far:

ZTF [4]	0.3925570 d
ASAS-SN [5]	no information
ATLAS [6]	0.392556 d

Results

After the discovery of the variable by Peter Frank in 2008, we systematically observed Fr35 a few years later to determine its period. The VSX database [8] lists the above-mentioned ZTF period with the type EW. The ATLAS database lists several periods and also indicates the type EW. Through our extensive observations between the years 2008 and 2021, we were able to detect a period jump that occurred approximately in 2017. The period has lengthened by approx. 0.49 seconds per orbit due to the period jump. The term period jump refers to the optical impression in the O-C diagram. A physical interpretation is not associated with it.

From our data, we have identified the following elements for the period from 2008 to 2017:

HJD 2454648.5099 + 0.39255450*E

The elements for the period after the period jump from 2017 onwards can be found below, in the header of Table 1.

The presented elements were calculated by the method of least squares, taking into account all our minima from JD 2454648 to JD 2457627 (see table below) for the elements before the period jump. To determine the elements after the period jump, we used our minima from JD 2458336 to 2459498.

Data from this star were also recently processed by the ATLAS project [6] and the ZTF project [7].

Fr35 Vul **Elements with period after the period jump**

Min. = HJD 2458336.56640 + 0.39256020*E

±0.00098 ±0.00000052

Observer	HJD-Date Minimum	Type	Epoch	O-C (d)
P. Frank	2454648.5099	I	-9395	0.0466
P. Frank	2455039.4927	I	-8399	0.0394
P. Frank	2455041.4586	I	-8394	0.0425
P. Frank	2455063.4388	I	-8338	0.0393
P. Frank	2455473.4624	II	-7293.5	0.0338
P. Frank	2455478.3699	I	-7281	0.0343
P. Frank	2455791.4359	II	-6483.5	0.0336
P. Frank	2455830.4900	I	-6384	0.0279
P. Frank	2456521.5835	II	-4623.5	0.0192
P. Frank	2457627.4127	II	-1806.5	0.0063
P. Frank	2457627.6105	I	-1806	0.0078
P. Frank	2458318.5070	I	-46	-0.0016
W. Moschner	2458336.5667	I	0	0.0003
W. Moschner	2458375.4282	I	99	-0.0016
W. Moschner	2458698.5062	I	922	-0.0008
W. Moschner	2458713.4247	I	960	0.0005
W. Moschner	2458713.6220	II	960.5	0.0015
W. Moschner	2458751.5012	I	1057	-0.0014
W. Moschner	2459021.5842	I	1745	0.0002
W. Moschner	2459056.5208	I	1834	-0.0010
W. Moschner	2459074.3835	II	1879.5	0.0002
W. Moschner	2459089.4976	I	1918	0.0008
W. Moschner	2459118.3549	II	1991.5	0.0049
W. Moschner	2459129.3417	II	2019.5	-0.0001
W. Moschner	2459405.5058	I	2723	-0.0021
W. Moschner	2459434.3635	II	2796.5	0.0025
W. Moschner	2459434.5554	I	2797	-0.0019
P. Frank	2459498.3472	II	2959.5	-0.0011

Table 1: Minima Fr35 = V585 Vul, O-C using the elements with period after the period jump.
The O-C of the secondary minima were calculated assuming that the true phase is at exactly 0.5.

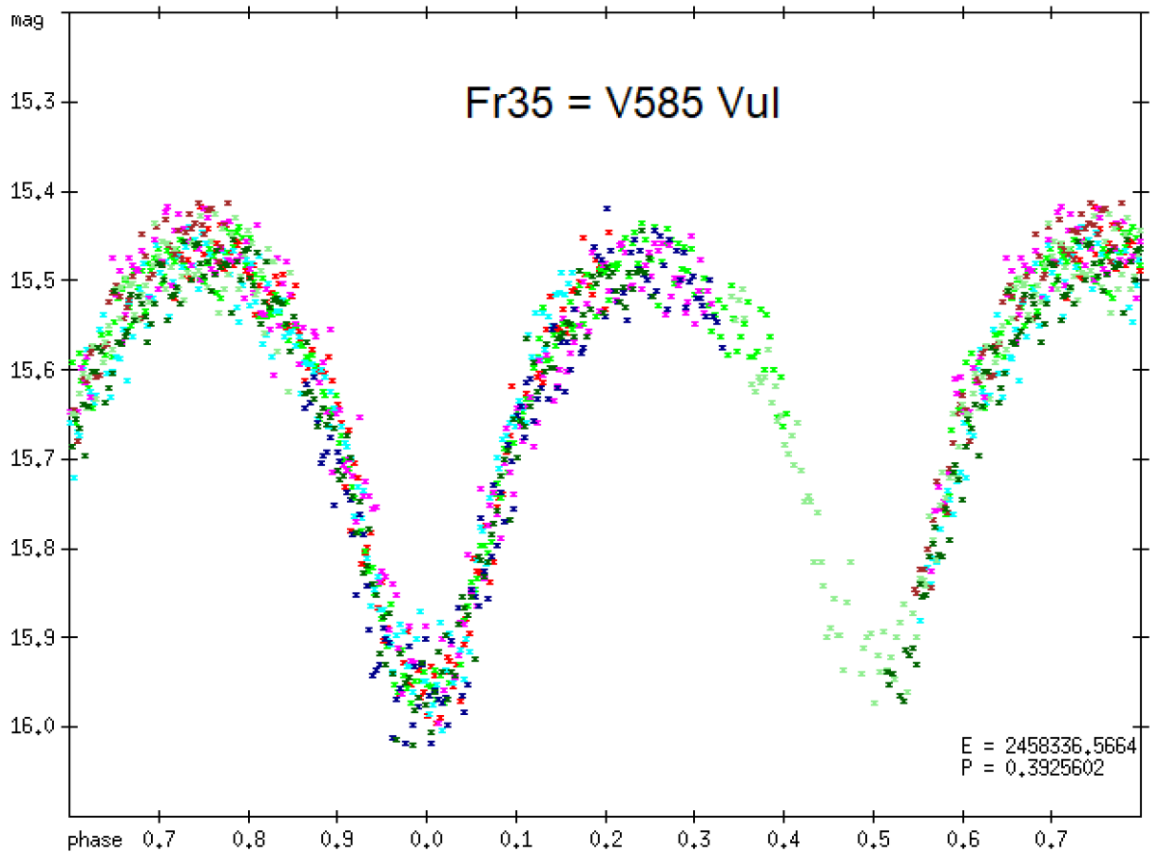

Figure 1a: Phased light curve of Fr35 = V585 Vul using the ephemeris after the period jump given by the authors. The vertical axis shows raw instrumental magnitudes. Different colors denote different observing nights. Only the data points from the better nights were used to display the light curve. A FLI Proline 16803 camera + V-filter (2019+2021) was used.

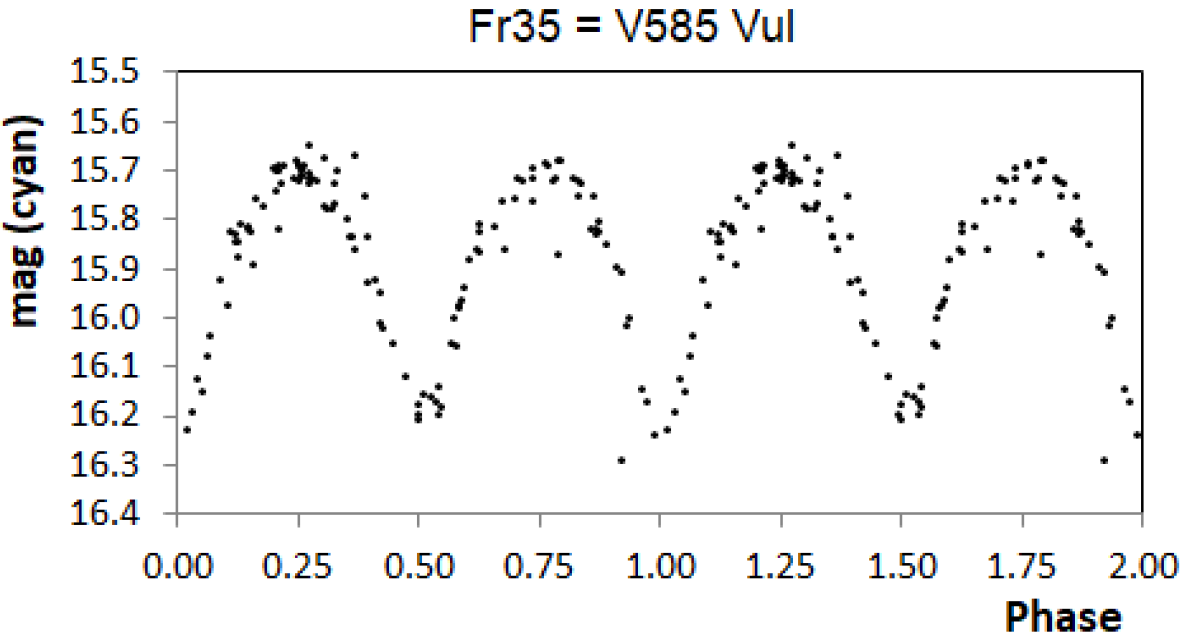

Figure 2: Phased lightcurve of Fr35 = V585 Vul with the data of the ATLAS project using the ephemeris before the period jump given by the authors. The data used are also from the period before the period jump.

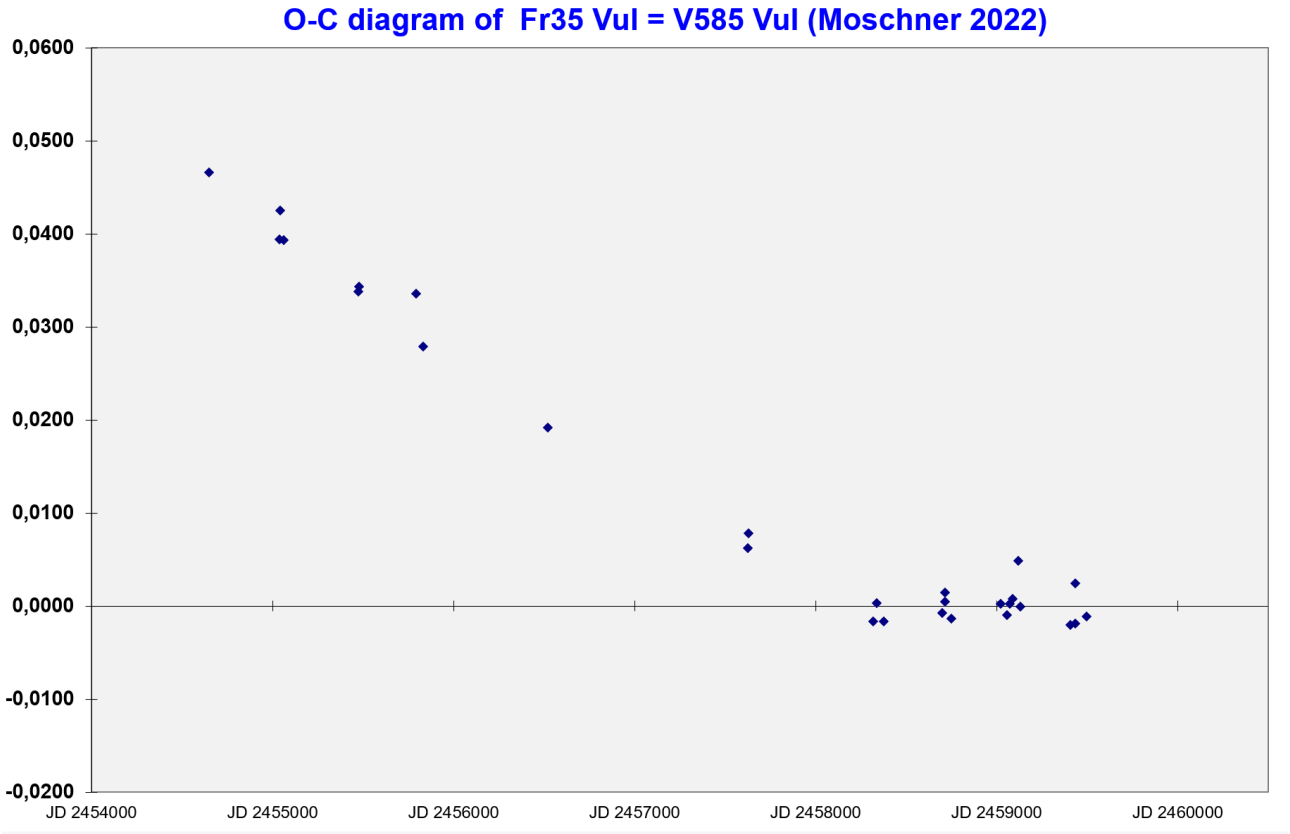

Figure 3: O-C-diagram of Fr35 = V585 Vul using the ephemeris after the period jump given by the authors.

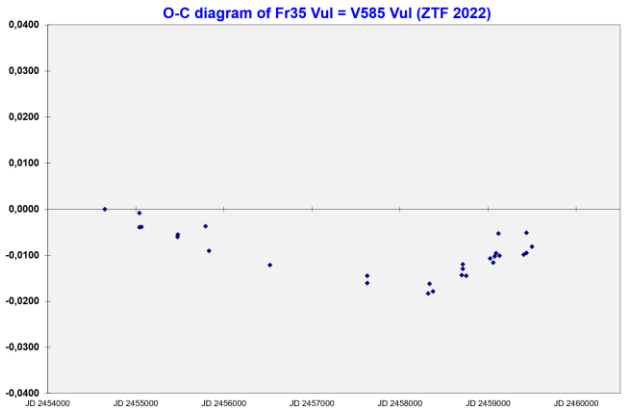

Figure 4

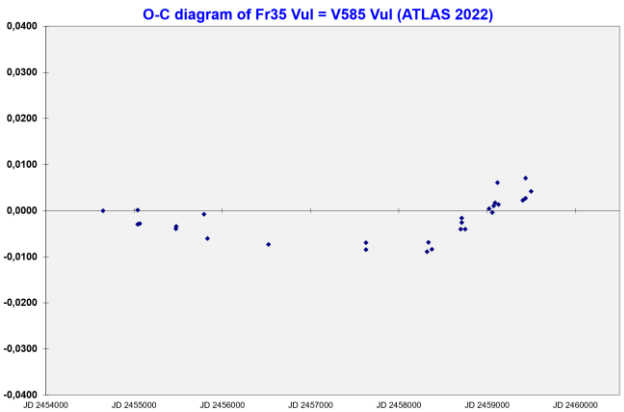

Figure 5

Figure 4: O-C-diagram of Fr35 = V585 Vul using the period from the ZTF project (0.3925570 d).

Figure 5: O-C-diagram of Fr35 = V585 Vul using the period from the ATLAS project (0.392556 d).

Acknowledgements

This research has made use of the SIMBAD database, operated at CDS, Strasbourg, France, the International Variable Star Index (VSX) database [8], operated at AAVSO, Cambridge, Massachusetts, the ATLAS project developed by the University of Hawaii and funded by NASA and the ZTF project, operations are conducted by COO, IPAC and University of Washington.

The authors thank David Motl [1] for providing his MuniWin photometry program, Franz Agerer (BAV) and Lienhard Pagel (BAV) [2] for providing their personal data analysis program.

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