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The period of V2976 Cyg = Fr196 Cyg

Moschner, Wolfgang - Lennestadt, Germany
email: wolfgang.moschner@gmx.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.

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Abstract: *V2976 Cyg = Fr196 Cyg was discovered by Peter Frank in 2012 and classified as an eclipsing binary. The authors present a phased light curve from ASAS-SN [1], 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
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 [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 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 EDR3 catalogue [4]. 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).

V2976 Cyg = Fr196 Cyg

Cross-IDs

= ASASSN-V J202907.17+511518.4
= ATO J307.2797+51.2549
= Gaia EDR3 2181067341627857920
= 2MASS J20290715+5115180
= GSC 03585-01758
= WISE J202907.1+511518
= ZTF J202907.15+511518.0

Gaia EDR3 Catalog:
Right ascension: 20h29m07.1368s at Epoch=J2000
Declination: +51° 15' 18.019" at Epoch=J2000
12.3090 mag G-band mean magnitude (350-1000 nm)
12.4542 mag Integrated BP mean magnitude (330-680 nm)
11.7575 mag Integrated RP mean magnitude (640-1000 nm)
0.6967 mag BP-RP

Periods known so far:

VSX [5]	0.72057 d
ASAS-SN [1]	0.7205735 d
ATLAS [6]	0.720561 d
WISE [7]	0.7205741 d
ZTF [8]	0.7205604 d

Results

After the discovery of the variable by Peter Frank in 2012, we systematically observed V2976 Cyg = Fr196 Cyg for a few years to check its period. The ASAS-SN database, the ATLAS database, the WISE database, the ZTF database and the VSX database also list the variable with different periods. There is no entry in the SIMBAD Astronomical database [9] yet. The presented elements were calculated by the method of least squares, taking into account all minima (see table below) and assuming that the true phase of Min II is exactly 0.5. Our ephemeris represents an improvement over the VSX, ASAS-SN, WISE and ATLAS periods. From the ASAS-SN data (Figure 1) we derive a variability approx. between 12.30 and 12.63 mag, with an amplitude for Min I given as 0.33 mag and for Min II as 0.05 mag (uncalibrated V). The period was constant in the observed period.

V2976 Cyg improved elements
Type = EB
Min. I = HJD 2456219.3259 + 0.7205755*E
±0.0016 ±0.0000005

Observer	HJD-Date Minimum	Type	Epoch	O-C (d)
P. Frank	2456219.3241	I	0	-0.0018
P. Frank	2457263.4392	I	1449	-0.0006
P. Frank	2457264.5224	II	1450.5	0.0017
W. Moschner	2458033.3767	II	2517.5	0.0020
W. Moschner	2458039.4972	I	2526	-0.0024
W. Moschner	2458051.3910	II	2542.5	0.0019
W. Moschner	2458073.3663	I	2573	-0.0004
P. Frank	2458402.3161	I	3029.5	0.0067
W. Moschner	2458694.5027	I	3435	0.0000
W. Moschner	2458724.4057	II	3476.5	-0.0009
W. Moschner	2458760.4372	II	3526.5	0.0018
W. Moschner	2459055.5115	I	3936	0.0004
W. Moschner	2459077.4846	II	3966.5	-0.0040
W. Moschner	2459780.4087	I	4942	-0.0013
W. Moschner	2459803.4660	I	4974	-0.0025
W. Moschner	2460181.4082	II	5498.5	-0.0021

Table 1: Minima of V2976 Cyg = Fr196 Cyg, O-C using the elements from the authors.
The O-C of the secondary minima were calculated assuming that the true phase is at exactly 0.5.

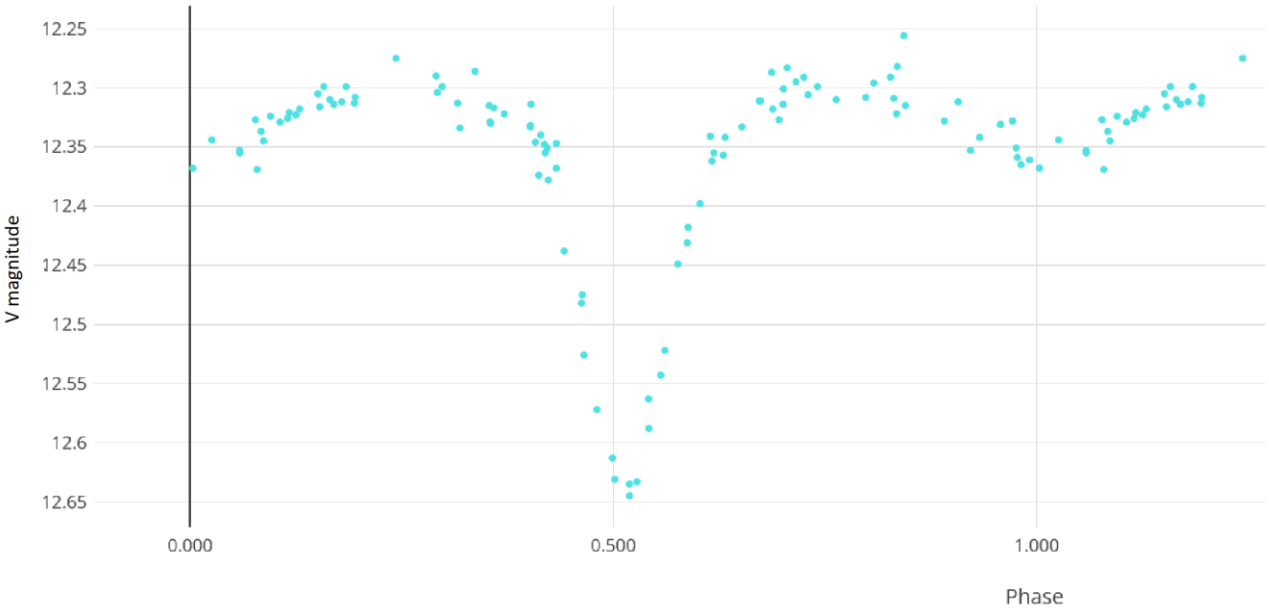

Figure 1: Phased light curve of V2976 Cyg = Fr196 Cyg using the period and data (V-Band) from ASAS-SN.
This graphic is taken from the ASAS-SN website.

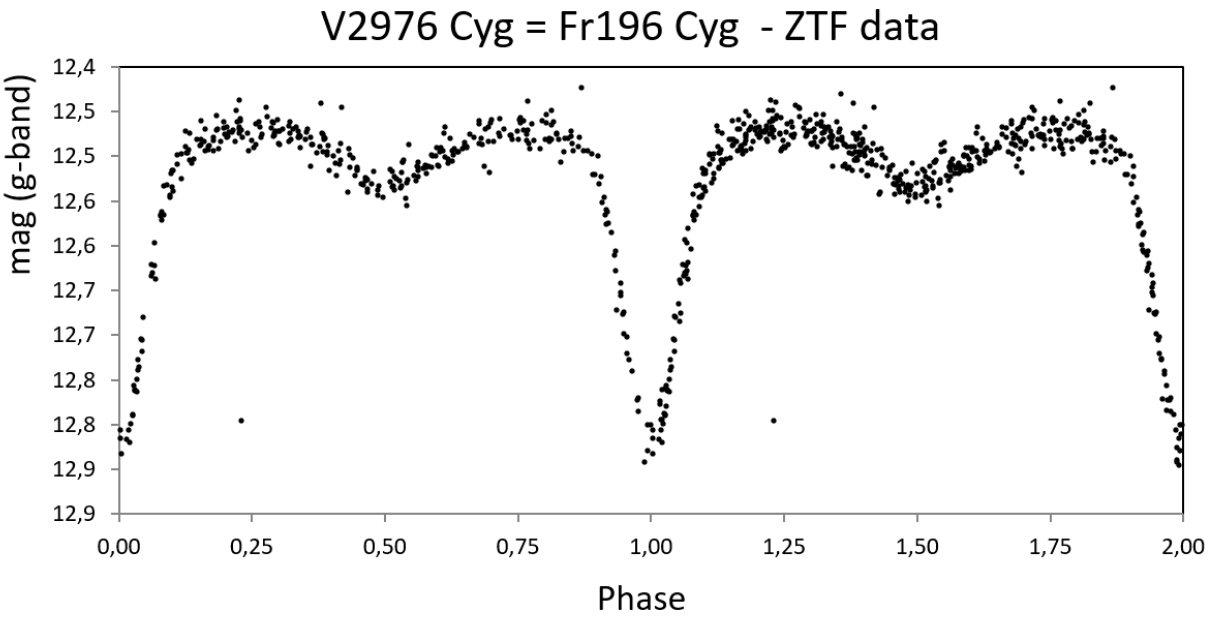

Figure 2: Phased light curve of V2976 Cyg = Fr196 Cyg using the improved elements and data from ZTF (g-band 420-550 nm).

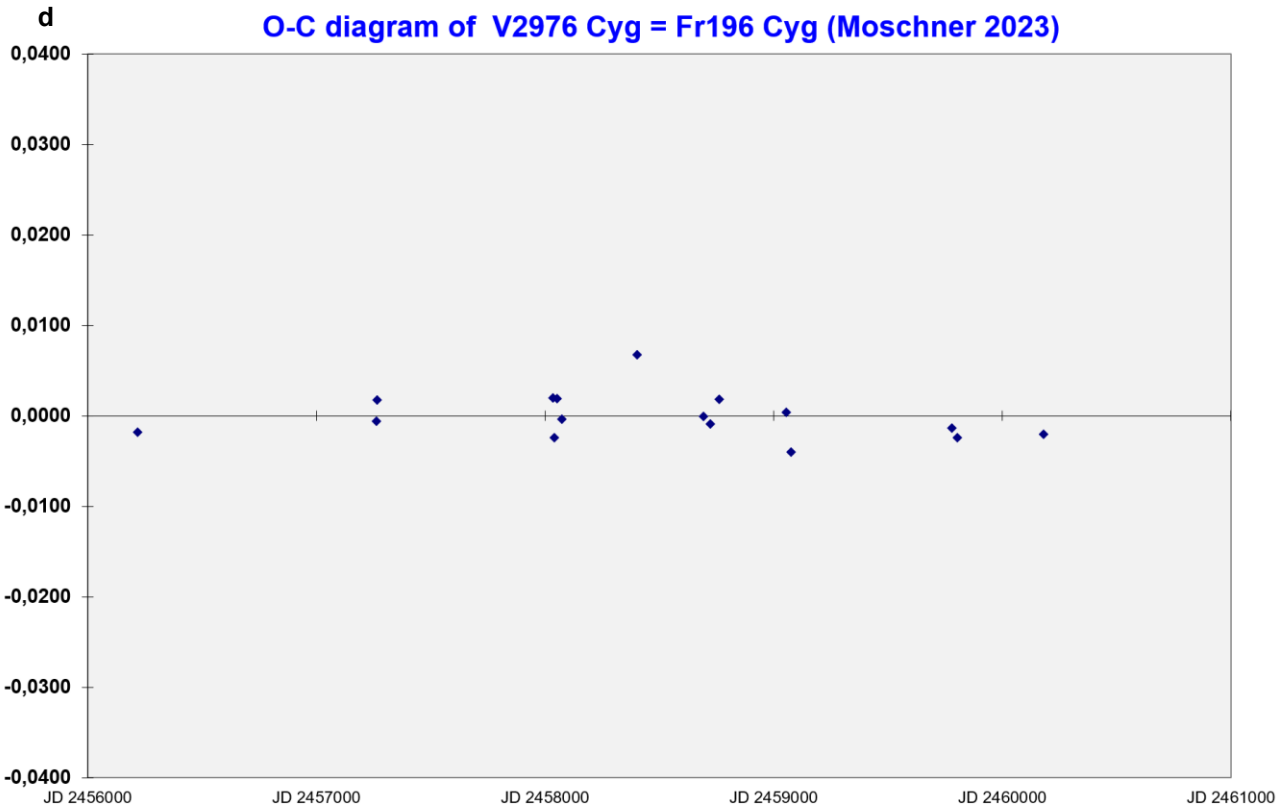

Figure 3: O-C-diagram of V2976 Cyg = Fr196 Cyg using the ephemeris given by the authors. The minima from Table 1 are shown in Figures 3,4 and 5.

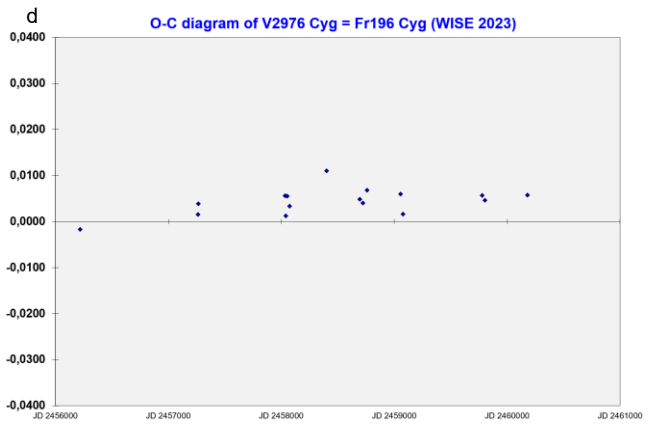

Figure 4

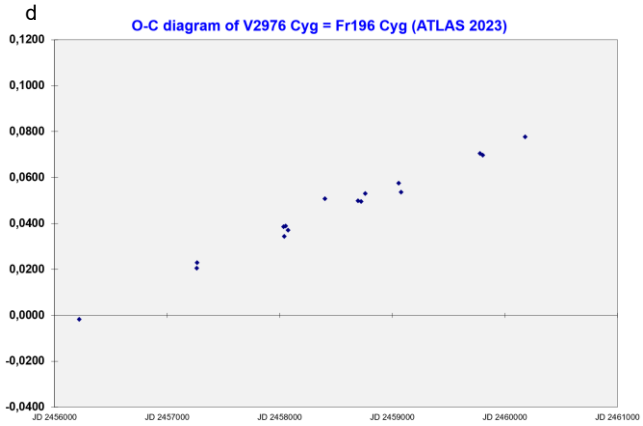

Figure 5

Figure 4: O-C-diagram of V2976 Cyg = Fr196 Cyg using the period from the WISE project (0.7205741 d).
Figure 5: O-C-diagram of V2976 Cyg = Fr196 Cyg using the period from the ATLAS project (0.720561 d).

Acknowledgements

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References

[1] All-Sky Automated Survey for Supernovae ASAS-SN
http://www.astronomy.ohio-state.edu/asassn/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:

[2] Motl, David: MuniWin
http://c-munipack.sourceforge.net

[3] Pagel, Lienhard: Starcurve
https://www.bav-astro.eu/index.php/weiterbildung/tutorials

[4] Gaia EDR3 (Gaia Collaboration. 2020)
European Space Agency.
http://vizier.u-strasbg.fr/viz-bin/VizieR?-source=I/350

[5] The International Variable Star Index (VSX)
https://www.aavso.org/vsx/index.php?view=search.top

[6] 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

[7] WISE catalog of periodic variable stars (Chen et al., 2018)
J/ApJS/237/28/table2

[8] ZTF Zwicky TransientFacility, Systematic Exloration of the Dynamic Sky
https://www.ztf.caltech.edu/
J/ApJS/249/18/table2

[9] SIMBAD Astronomical Database - CDS (Strasbourg),
http://simbad.u-strasbg.fr/simbad/sim-fid