



The elements of Fr133 Vul = USNO-A2.0 1125-16097188

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Abstract: *Fr133 Vul was discovered by Peter Frank and classified as RR-Lyrae star in 2009. The authors present a phased light curve from the ASAS-SN project, a list of own maxima, O-C diagrams and an improved period solution of the star.*

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 maxima

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

Fr133 Vul

Cross-ID's

= 2MASS J20283679+2456035

= ZTF J202836.78+245603.4

= ASASSN-V J202836.79+245603.6

= UCAC3 230-244355

= Gaia EDR3 1831684155963947904

= USNO-A2.0 1125-16097188

Gaia EDR3 Catalog:

Right ascension: 20h28m36.7992s at Epoch=J2000

Declination: +24° 56' 03.428" at Epoch=J2000

14.9830 mag G-band mean magnitude

15.4160 mag Integrated BP mean magnitude

14.3567 mag Integrated RP mean magnitude

1.0593 mag BP-RP

Periods known so far:

ZTF [4] 0.3465599 d

ASAS-SN [5] 0.3465564 d

ATLAS [6] no information

GEOS [7]
SIMBAD [8]

0.3468 d
0.346565 d

Results

After the discovery of the variable by Peter Frank in 2009, we systematically observed Fr133 Vul a few years later to determine its period. In our recent research, we found data on this variable in several sources. The ASAS-SN project provides a phased light curve and period, the ZTF project gives a period, the GEOS RR Lyrae database lists the variable under the catalogue designation UCAC3 255355 and provides a list of observed maxima together with the derived period. The period here is from Liakos et al., 2014. In the VSX database the variable is listed under the catalogue designation USNO-A2.0 1125-16097188 with a different period. Under the same catalogue designation, we find the variable in the SIMBAD database, also with a different period.

With our observations from the year 2009 to 2022 we present an improved period solution.

The presented elements were calculated by the method of least squares, taking into account all our maxima.

Fr133 Vul improved elements

Max. = HJD 2458718.6005 +0.3465590*E
±0.0012 ±0.0000002

Observer	HJD-Date Maximum	Epoch	O-C (d)
P. Frank	2455039.5370	-10616	0,0068
P. Frank	2455063.4400	-10547	-0,0027
P. Frank	2455473.4230	-9364	0,0010
P. Frank	2455830.3760	-8334	-0,0018
P. Frank	2456521.4160	-6340	-0,0004
F. Agerer	2457980.4270	-2130	-0,0028
W. Moschner	2458313.4704	-1169	-0,0026
W. Moschner	2458337.3808	-1100	-0,0049
W. Moschner	2458699.5355	-55	-0,0043
W. Moschner	2458718.6070	0	0,0065
W. Moschner	2459023.5743	880	0,0019
W. Moschner	2459068.6291	1010	0,0040
W. Moschner	2459092.5330	1079	-0,0047
W. Moschner	2459408.6038	1991	0,0043
W. Moschner	2459798.4748	3116	-0,0036
W. Moschner	2459867.4444	3315	0,0008

Table 1: Maxima Fr133 Vul, O-C using the improved elements.

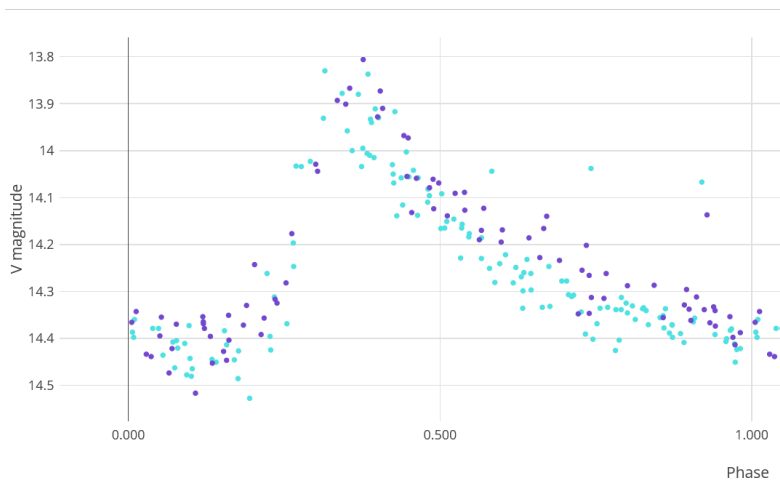


Figure 1: Phased lightcurve (V-Band) with the data of the ASAS-SN project (Blue dots: ba camera, Purple dots: bb camera) using the period from ASAS-SN.

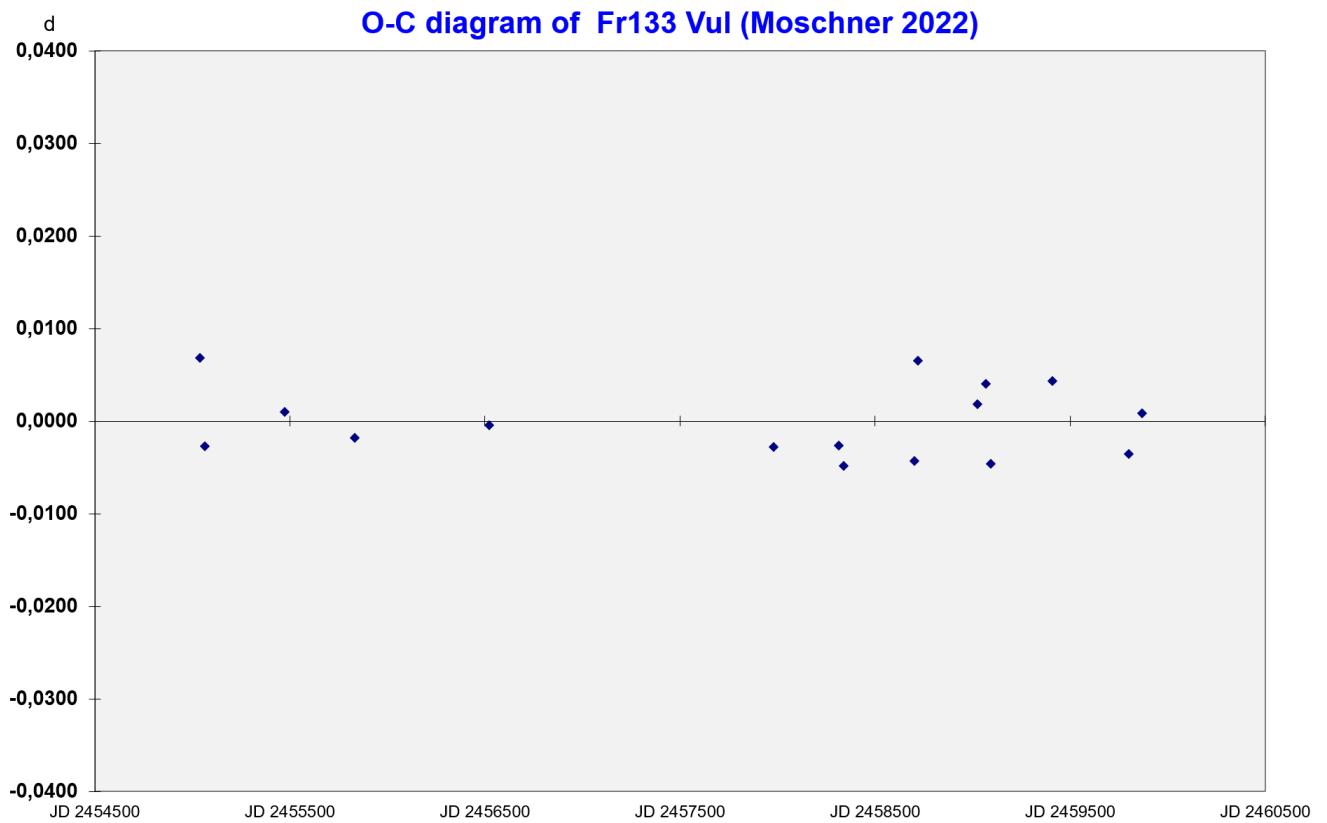


Figure 2: O-C-diagram of Fr133 Vul using the improved elements (period = 0.3465590 d).

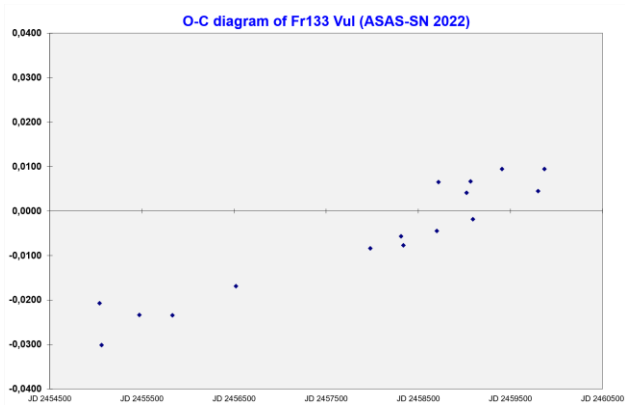


Figure 3

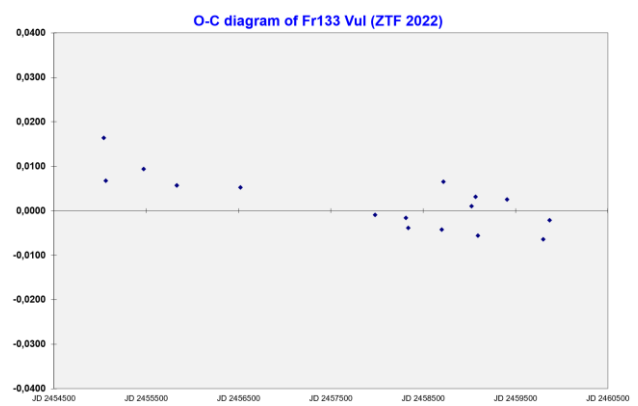


Figure 4

Figure 3: O-C-diagram of Fr133 Vul using the period from ASAS-SN project (0.3465564 d).

Figure 4: O-C-diagram of Fr133 Vul using the period from ZTF project (0.3465599 d).

Acknowledgements

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References

- [1] Motl, David: MuniWin
<http://c-munipack.sourceforge.net>
- [2] Pagel, Lienhard: Starcurve
<https://www.bav-astro.eu/index.php/weiterbildung/tutorials>
- [3] Gaia EDR3 (Gaia Collaboration. 2020)
European Space Agency.
<http://vizier.u-strasbg.fr/viz-bin/VizieR?-source=I/350>
- [4] Chen, X.; et al., 2020, The Zwicky Transient Facility Catalog of Periodic Variable Stars
<https://ui.adsabs.harvard.edu/abs/2020ApJS...249...18C/abstract>

[The ZTF catalog of periodic variable stars \(Chen+, 2020\)](#)

ZTF Zwicky Transient Facility, Systematic Exploration of the Dynamic Sky
<https://www.ztf.caltech.edu/>
- [5] 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>
- [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] GEOS RR Lyr database
http://rr-lyr.irap.omp.eu/dbrr/rrdb-V2.0_08.3.php?UCAC3+230-244355&en
- [8] SIMBAD database
<http://simbad.cds.unistra.fr/simbad/sim-id?Ident=USNO-A2.0+1125-16097188&NbIdent=1&Radius=2&Radius.unit=arcmin&submit=submit+id>