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The unusual period behavior of MoFr22 Cyg

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Abstract: *MoFr22 Cyg was discovered by Peter Frank and classified as EW type eclipsing binary in 2009. The discovery was published with first elements in BAV Journal 11 in 2016. Supplementary observations up to the year 2021 show an unusual period behavior in the O-C diagram.*

Observations

320 mm RC-Telescope f/5.9 - f = 1900 mm, SBIG ST-9XE CCD-Camera – without filter - t = 30 sec.
Wolfgang Moschner, Lennestadt, 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

MoFr22 Cyg

Cross-ID's

= GSC 03937-02349
= ASASSN-V J201701.19+525241.3
= WISE J201701.1+525240
= ATOID J304.2549+52.8780
= Gaia EDR3 2184668620157510272

Gaia EDR3 Catalog:
Right ascension: 20h17m01.1981s at Epoch=J2000
Declination: +52° 52' 40.917" at Epoch=J2000
13.2343 mag G-band mean magnitude
13.5764 mag Integrated BP mean magnitude
12.6985 mag Integrated RP mean magnitude
0.877919 mag BP-RP

Periods known so far:

VSX (AAVSO) [4]	0.2875006 d	(BAVJ11) [5]
ASAS-SN [6]	0.2874987 d	
ATLAS [7]	0.287500 d	
ZTF [8]	no information	
WISE [9]	0.2875012 d	

Results

The observations over the entire interval between 2009 and 2021 show an unusual period behavior of MoFr22 Cyg. The period remains constant for about two years and changes then abruptly. This process can be observed several times in the O-C diagram. The new linear elements describe the average period over the entire interval. A physical interpretation of the phenomenon cannot be made here. But it seems possible that the effects are caused by a third partner in the system with a long orbital period and high orbital eccentricity. In this case, further period changes at regular intervals should occur in the future. Another possibility would be a sporadic mass ejection (no continuous mass flow, but a one-time change in mass). Generating spectra could be helpful to solving the problem. The variable should be observed further in the future, since the period behavior cannot be predicted. The presented elements were calculated by the method of least squares, taking into account all our minima (see table below). Data from this star were also recently processed by the ATLAS project [7], the ASAS-SN project [6] and the WISE project [9].

MoFr22 Cyg linear elements

These linear elements are to be used for the years 2009 to 2021.

Min. = HJD 2457605.40790 + 0.2875031*E
±0.00120 ±0.0000003

Observer	HJD-Date Minimum	Type	Epoch	O-C (d)
Moschner/Frank	**2455333,4252**	**II**	**-7902,5**	**0,0105**
W. Moschner	**2457574,4973**	**II**	**-107,5**	**-0,0040**
W. Moschner	**2457574,6398**	**I**	**-107**	**-0,0053**
W. Moschner	**2457576,5085**	**II**	**-100,5**	**-0,0053**
W. Moschner	**2457581,5385**	**I**	**-83**	**-0,0066**
W. Moschner	**2457605,4016**	**I**	**0**	**-0,0063**
W. Moschner	**2457605,5462**	**II**	**0,5**	**-0,0055**
W. Moschner	**2457623,3711**	**II**	**62,5**	**-0,0057**
W. Moschner	**2457623,5131**	**I**	**63**	**-0,0075**
W. Moschner	**2457691,3642**	**I**	**299**	**-0,0071**
W. Moschner	**2457916,6287**	**II**	**1082,5**	**-0,0013**
W. Moschner	**2457955,4415**	**II**	**1217,5**	**-0,0014**
W. Moschner	**2457955,5872**	**I**	**1218**	**0,0005**
W. Moschner	**2457963,4934**	**II**	**1245,5**	**0,0004**
W. Moschner	**2457963,6378**	**I**	**1246**	**0,0010**
W. Moschner	**2457979,4504**	**I**	**1301**	**0,0010**
W. Moschner	**2457979,5937**	**II**	**1301,5**	**0,0005**
W. Moschner	**2458004,4622**	**I**	**1388**	**0,0000**
W. Moschner	**2458010,3578**	**II**	**1408,5**	**0,0018**
W. Moschner	**2458010,5024**	**I**	**1409**	**0,0026**
W. Moschner	**2458015,3893**	**I**	**1426**	**0,0019**
W. Moschner	**2458015,5323**	**II**	**1426,5**	**0,0012**
W. Moschner	**2458329,4960**	**II**	**2518,5**	**0,0115**
W. Moschner	**2458329,6360**	**I**	**2519**	**0,0078**
W. Moschner	**2458330,5003**	**I**	**2522**	**0,0096**
W. Moschner	**2458330,6436**	**II**	**2522,5**	**0,0091**
W. Moschner	**2458352,3499**	**I**	**2598**	**0,0089**
W. Moschner	**2458352,4926**	**II**	**2598,5**	**0,0079**
W. Moschner	**2458397,3444**	**II**	**2754,5**	**0,0092**
W. Moschner	**2458397,4874**	**I**	**2755**	**0,0085**
W. Moschner	**2458720,3466**	**I**	**3878**	**0,0016**
W. Moschner	**2458720,4905**	**II**	**3878,5**	**0,0018**

W. Moschner	2458720,6327	I	3879	0,0002
W. Moschner	2458755,4201	I	4000	-0,0003
W. Moschner	2459053,4100	II	5036,5	-0,0072
W. Moschner	2459053,5540	I	5037	-0,0070
W. Moschner	2459069,3666	I	5092	-0,0071
W. Moschner	2459069,5104	II	5092,5	-0,0071
W. Moschner	2459069,6530	I	5093	-0,0082
W. Moschner	2459102,4283	I	5207	-0,0083
W. Moschner	2459102,5734	II	5207,5	-0,0069
W. Moschner	2459140,3805	I	5339	-0,0064
W. Moschner	2459403,5949	II	6254,5	-0,0012
W. Moschner	2459426,4534	I	6334	0,0009
W. Moschner	2459426,5985	II	6334,5	0,0022
W. Moschner	2459469,4357	II	6483,5	0,0015

Table 1: Minima from MoFr22 Cyg using the linear elements above (period 0.2875031 d).

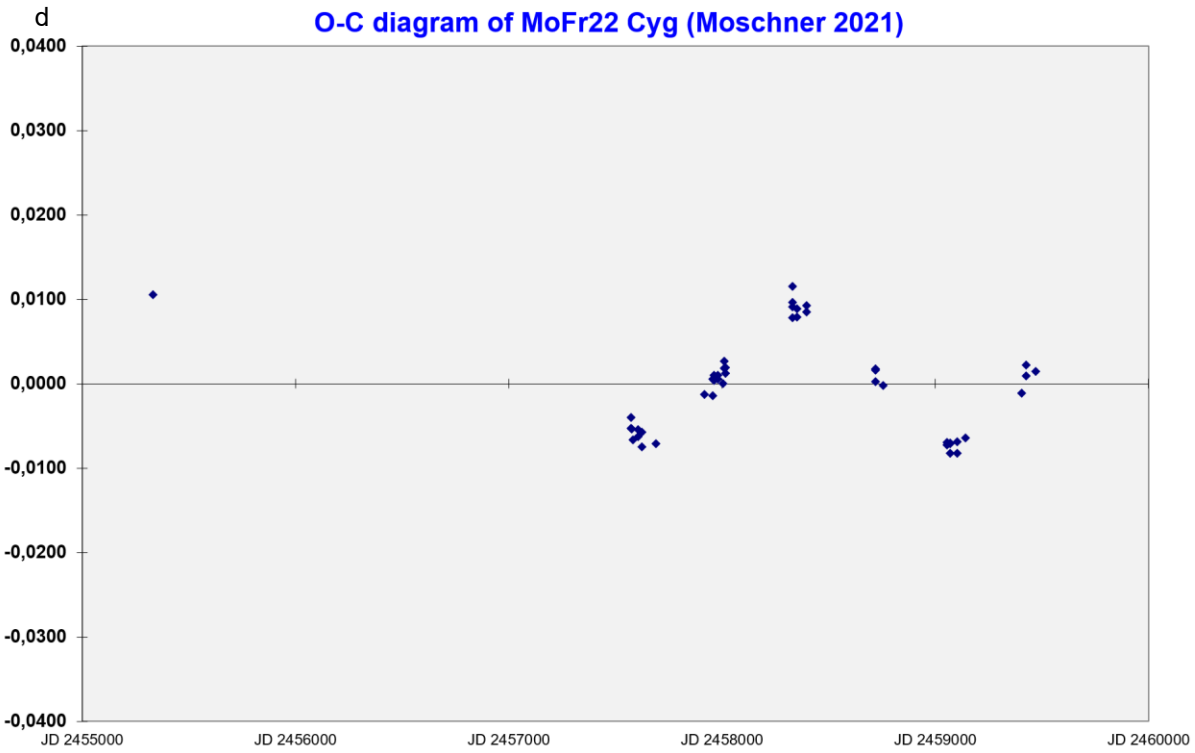

Figure 1: O-C-diagram from MoFr22 Cyg using the linear elements above (period 0.2875031 d).

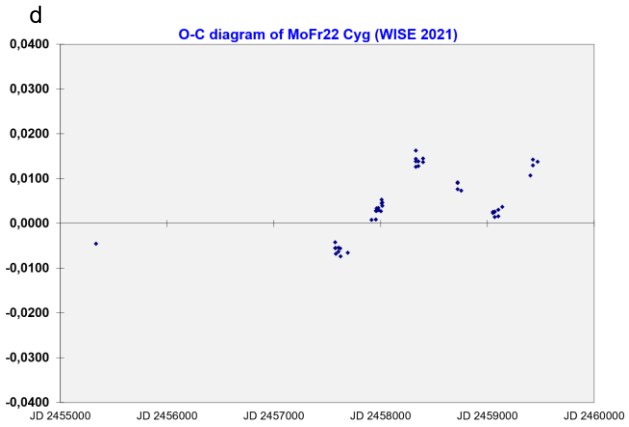

Figure 2

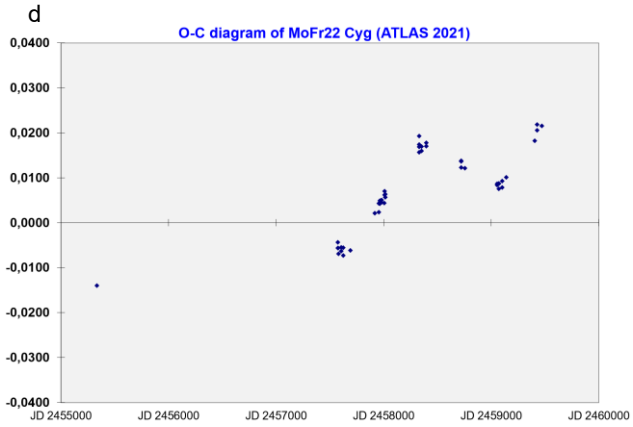

Figure 3

Figure 2: O-C-diagram from MoFr22 Cyg using the period from WISE (0.2875012 d).
Figure 3: O-C-diagram from MoFr22 Cyg using the period from ATLAS (0.287500 d).

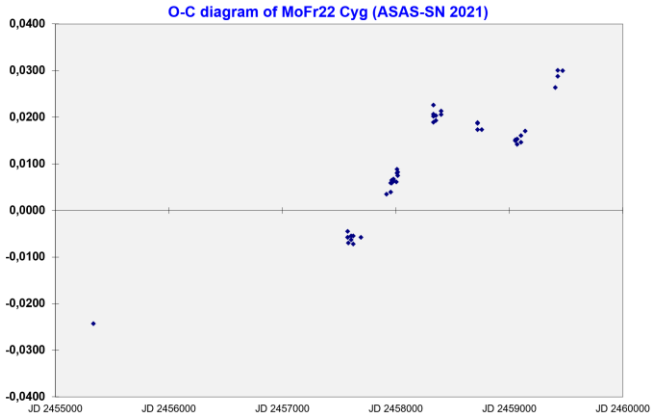

Figure 4: O-C-diagram from MoFr22 Cyg using the period from ASAS-SN (0.2874987 d).

Acknowledgements

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