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ASTEROID LIGHTCURVES FROM ETSCORN OBSERVATORY

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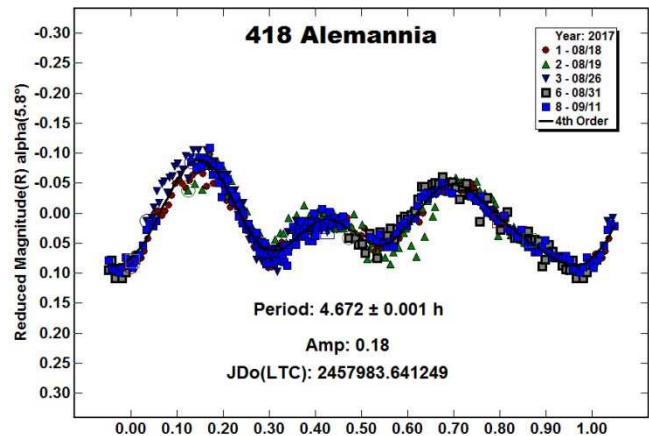
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During 2017 August and September, we observed five spin-shape asteroids: 418 Alemannia, 1095 Tulipa, 2648 Owa, 3122 Florence, and 5040 Rabinowitz. The selections were by listed by Warner et al. (2017) in their regular *MPB* paper featuring photometric opportunities for the upcoming quarter.

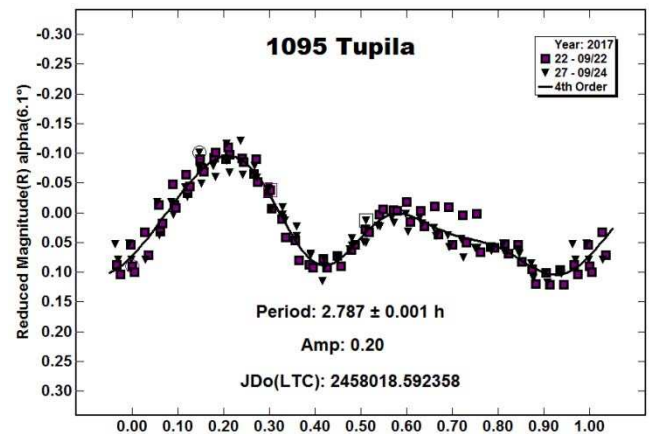
Our observations of five minor planets were obtained with two Celestron 0.35-m telescopes and SBIG CCD cameras at Etsorn Campus Observatory (Klinglesmith and Franco, 2016). The images were processed and calibrated using *MPO Canopus* 10.7.2.0 (Warner, 2016). Exposures were between 60 and 360 seconds through clear filters depending on the brightness of the asteroids. The multi-night data sets for each asteroid were combined with the FALC algorithm (Harris et al., 1989) within *MPO Canopus* to provide synodic periods for each asteroid.

Discovery information was obtained from the JPL Small Bodies Node (JPL, 2017). The five asteroids were suggested as possible targets in order to derive their spin/shape models (Warner et al. 2017). Table I contains the observation circumstances and results. Table II is a compilation of the previously obtained lightcurves with their references.

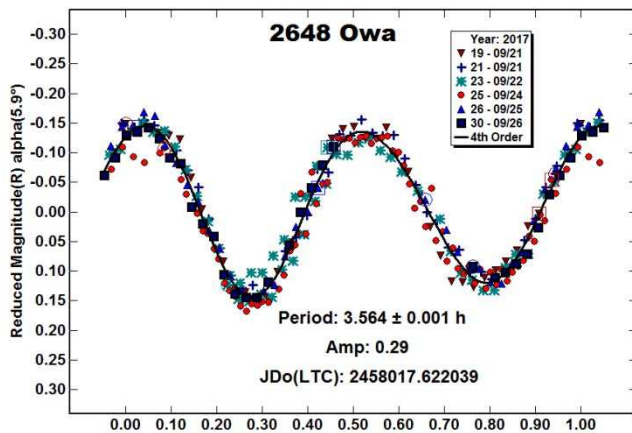
418 Alemannia is a main-belt asteroid discovered by M. Wolf at Heidelberg on 1896 Sep 7. It is also known as 1896 CV. We observed it on five nights between 2017 Aug 18 and Sep 11. We obtained a synodic period of 4.672 ± 0.001 h and amplitude of 0.18 mag.



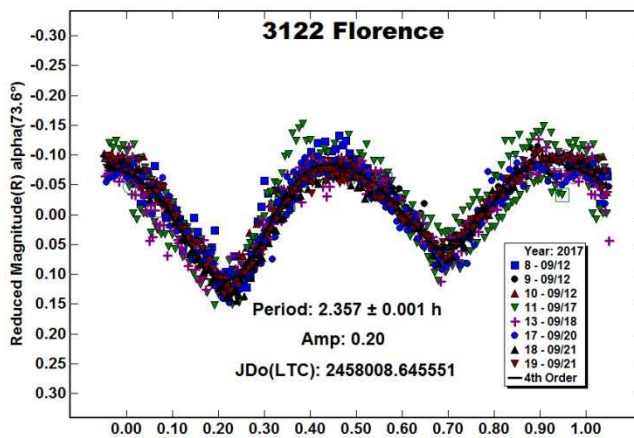
1095 Tulipa is a main-belt asteroid discovered by K. Reinmuth at Heidelberg on 1926 Apr 14. It is also known as 1926 GS. We observed it on 2017 Sep 22 and 24. We obtained a synodic period of 2.787 ± 0.001 h and amplitude of 0.20 mag.



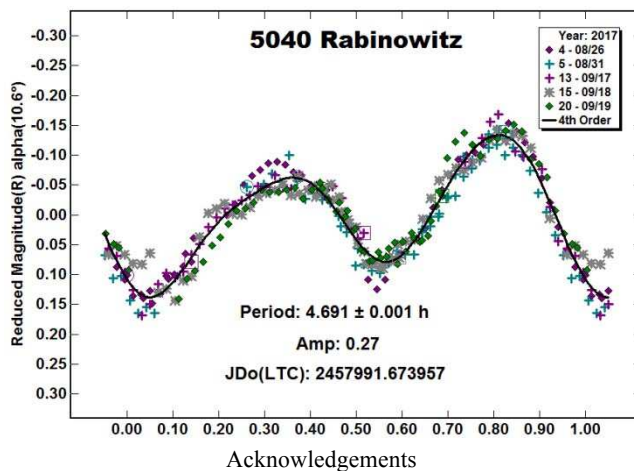
2648 Owa is a main-belt asteroid discovered by E. Bowell at Flagstaff, Anderson Mesa Station, on 1980 Nov 8. It is also known as 1980 VJ, 1926 VD, and 1953 TJ. We observed Owa on five nights between 2017 Sep 21-26. We obtained a synodic period of 3.564 ± 0.001 h and amplitude of 0.29 mag.



3122 Florence is classified as an Amor (NEO, PHA) asteroid. It was discovered by S.J. Bus at Siding Spring on 1981 Mar 2. We observed it on five nights between 2017 Sep 12-21. We obtained a synodic period of 2.357 ± 0.001 h and amplitude of 0.20 mag. We did not see any evidence of the binary nature of 3122 Florence.



5040 Rabinowitz is a main-belt asteroid discovered by T. Gehrels at Palomar. It is also known as 1972 RF and 1987 QE. We observed it on five nights between 2017 Aug 28 and Sep 19. We obtained a synodic period of 4.691 ± 0.001 h and amplitude of 0.27 mag.



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Number	Name	2017 mm/dd	Pts	Phase	L _{PAB}	B _{PAB}	Period(h)	P.E.	Amp	A.E.	Grp
418	Alemannia	08/18-09/11	525	5.8, 9.6	331	9	4.672	0.001	0.18	0.03	MB-I
1095	Tulipa	09/22-09/24	148	6.0, 6.7	343	3	2.787	0.001	0.20	0.04	EOS
2648	Owa	06/21-09/26	267	5.8, 8.0	242	7	3.564	0.001	0.29	0.03	FLOR
3122	Florence	09/12-09/21	1267	73.3, 79.4	346	42	2.357	0.001	0.20	0.05	NEA
5040	Rabinowitz	08/26-09/19	287	10.8, 13.7	336	13	4.692	0.001	0.27	0.05	PHO

Table I. Observing circumstances and results. Pts is the number of data points. The phase angle is given for the first and last date. L_{PAB} and B_{PAB} are the approximate phase angle bisector longitude and latitude at mid-date range (see Harris *et al.*, 1984). Grp is the asteroid family/group (Warner *et al.*, 2009). MB-I = Main-belt, inner; FLOR = Flora; PHO = Phocaea.

Number	Name	References	Date	L _{PAB}	B _{PAB}	Phase	Period	Amp
418	Alemannia	This paper	2017 Sep 01	331	9	9.0	4.672	0.18
		Wetterer 1999	1998 Jan 27	100	-5	12.2	4.680	0.27
		Behrend 2001	2001 Dec 26	78	-2	8.2	4.6714	0.23
		Behrend 2005	2005 Sep 22	49	4	22.4	4.67	0.33
		Behrend 2007	2007 Apr 12	165	-8	13.8	4.6727	0.20
1095	Tulipa	This paper	2017 Sep 23	343	3	6.3	2.787	0.20
		Binzel 1987	1985 Feb 10	137	-8	3.6	2.77	0.21
		Behrend 2005	2005 May 15	220	9	6.7	2.78721	0.21
		Benishek 2008	2006 Jul 20	306	10	5.3	2.7879	0.17
		Husarik 2011	2003 Jul 19				2.787	0.20
		Waszczak 2015	2012 Aug 18	5	0	10.8	2.787	0.14
		Benishek 2015	2013 Sec 18	86	-12	4.8	2.7873	0.23
		Klinglesmith 2017	2016 Jul 17	262	12	12.7	2.787	0.19
		Durech 2017					2.787153	
2648	Owa	This paper	2017 Sep 23	353	7	6.9	3.564	0.29
		Behrend 2007	2007 Nov 02	24	7	11.9	3.567	0.24
		Pravec 2007	2007 Oct 26	23	7	8.2	3.5641	0.23
		Johnson 2008	2007 Oct 19	22	7	5.6	3.563	0.20
		Brinsfield 2008	2007 dec 07	30	5	26.5	3.56	0.32
		Higgins 2012	2012 Feb 23	156	-6	3.3	3.563	0.35
3122	Florence	This paper	2017 Sep 17	346	42	76.3	2.357	0.20
		Pravec 1998					2.3581	0.18
		Pravec 2002	2003 Mar 12	164	-5	4.6	2.3581	0.15
		Pravec 2003	2003 Oct 31	105	29	49.4	2.3581	0.22
		Pravec 2004	2004 Jan 24	123	20	14.4		0.16
		Behrend 2010	2010 Dec 18	107	33	33.8	2.3582	0.18
		Elenin 2012	2010 Oct 28	87	38	57.9	2.359	0.27
		Linder 2013	2011 Jan 03	108	30	25.7	2.359	0.15
		Warner 2016	2016 Jan 21	156	5	17.5	2.3580	0.12
		Warner 2018	2017 Sep 02	329	12	29.9	2.386	0.21
		Warner 2018	2017 Sep 01	328	7	23.8	2.362	0.16
5040	Rabinowitz	This paper	2017 Sep 08	336	13	12.3	4.692	0.27
		Stephens 2013	2016 Jun 15	272	34	20.9	4.691	0.35
		Pravec 2013	2013 Jul 01	273	34	21.3	4.6901	0.33
		Clark 2014	2103 Jul 27	277	32	24.7	4.472	0.31

Table II: Summation of solar bisector angles, phase angles, periods and amplitudes for the asteroids discussed in this paper.