

THE 2019 MEXICAN ASTEROID PHOTOMETRY CAMPAIGN

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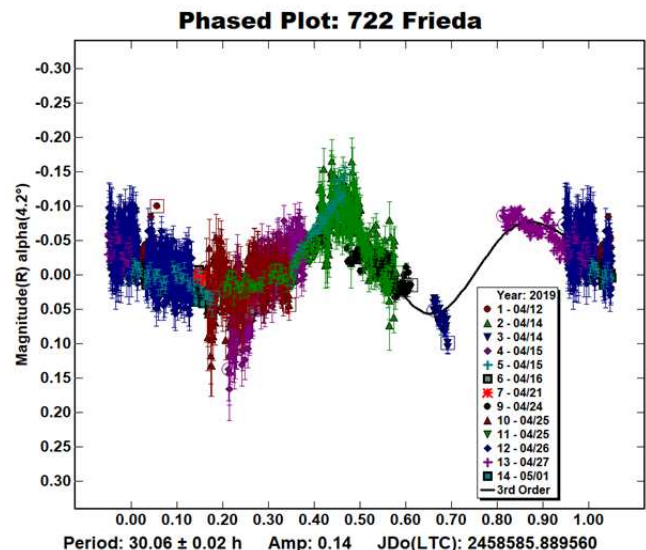
We present photometric optical lightcurves and derived rotation periods for a sample of five asteroids: 722 Frieda (30.06 ± 0.02 h), 1239 Queteleta (10.278 ± 0.003 h), 2162 Anhui (8.101 ± 0.001 h), 4148 McCartney (20.756 ± 0.0006 h), and 4408 Zlata Koruna (4.392 ± 0.001 h). These observations were carried out at the Observatorio Astronómico Nacional at Sierra San Pedro Mártir (OAN-SPM), Baja California, Mexico, the Carl Sagan Observatory (OCS) of the Universidad de Sonora, México, and at the INAOE Tonantzintla Observatory (TONA), Puebla, México.

During the first half of 2019, we have obtained photometric data of five asteroids: 722 Frieda, 1239 Queteleta, 2162 Anhui, 4148 McCartney, and 4408 Zlata Koruna as part of the Mexican Asteroid Photometry Campaign (CMFA in Spanish). Our observations were carried out at three observatories: the Observatorio Astronómico Nacional at San Pedro Mártir (OAN-SPM), Baja California, Mexico; the Carl Sagan Observatory (OCS) of the Universidad de Sonora, México; and the INAOE Tonantzintla Observatory (TONA), in Tonantzintla, Puebla, México. Observations at the OAN-SPM were carried out with the 0.84-m $f/15$ Ritchey-Chretien telescope and a 2048×2048 pix² E2V-4240 cryogenic CCD, operating at a temperature of -110 °C. Images were generally binned 2×2 with a final field of view of 9×9 arcmin². The equipment used at the OCS was a 3056×3056 -12 μ m Apogee Alta F9000 CCD camera mounted on a Meade LX-200GPS 0.41-m $f/10$ telescope. Images were trimmed to a subframe of 2000×2000 pixels and were generally 3×3 binned, yielding a final plate scale of 1.8 arcsec/pix and an effective

20×20 arcmin² FOV. Observations at TONA were made with a 0.77-m Schmidt Camera (TSC) equipped with a 3352×2532 pixel SBIG STF-8300 camera. Images were 2×2 binned with a final plate scale of 1.04 arcsec/pixel. Data reduction was made with *IRAF* or *MaximDL* following standard procedures to correct for bias, dark current and flat-field effects. Photometry and lightcurve analysis were made using the *MPO Canopus* (V.9.5.0.14, Warner, 2017) software package, which allowed us to obtain a synodic period for each object.

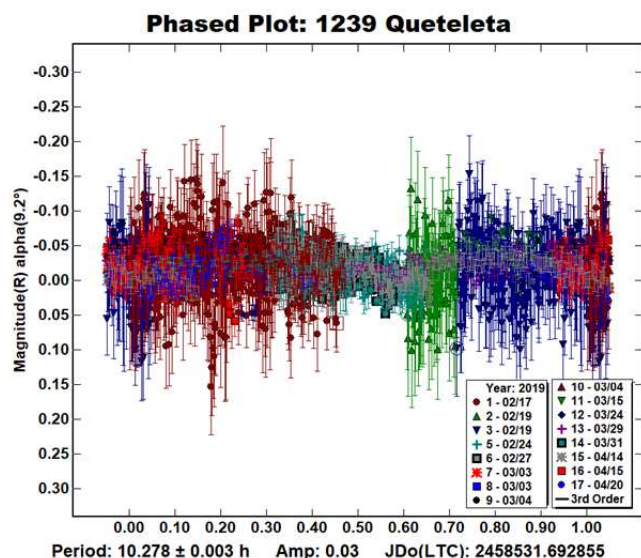
722 Frieda is a main-belt asteroid. It was discovered in 1911 by J. Palisa (Jet Propulsion Laboratory, Small-Body Database; Schmadel, 2003). The most recent values for its diameter, absolute magnitude H , and albedo are 10.51 km, 12.3, and 0.23, respectively. These data are reported at the Asteroid Lightcurve Database (LCDB) by Nugent et al. (2015). A synodic period value of 131.1 ± 0.2 h is reported by Polakis and Skiff (2019).

We have observed 722 Frieda during a total of 16 nights: eight nights at the OAN-SPM (2019 Apr 12-18, and Apr 21), three nights at the TONA observatory (2019 Apr 9, 14, and 15), and five nights at the OCS (2019 Apr 23-25, 27, and May 1st). Three nights were rejected based on their low data quality or photometric issues, and finally 13 nights and 2217 data points were used to derive a lightcurve. We obtained a period of 30.06 ± 0.02 h with an amplitude of 0.14 ± 0.05 mag. Our estimated synodic period is much lower than the previous value. However, due to the large data scatter and incomplete phase coverage in our data, the reason for this disagreement is not clear.

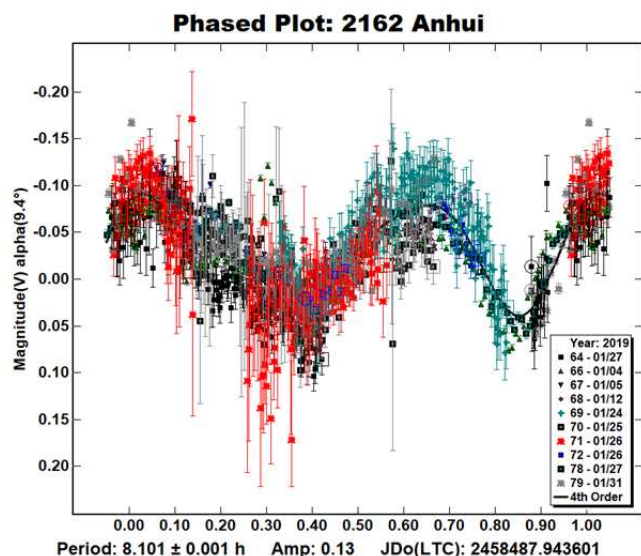


1239 Queteleta is a main-belt asteroid discovered in 1932 by E. Delporte (JPL Small-Body Database; Schmadel, 2003). It has an absolute magnitude of $H = 12.4$ (JPL Small-Body Database) with an albedo and a diameter of 0.051 and 18.681 km, respectively, reported by Masiero et al. (2011). Regarding its rotation period value, after a search of the Asteroid Lightcurve Database and the literature, no previously reported value was found. We observed this object for 17 nights: seven nights at TONA (2019 Feb 17, 19, 20, 24, 27, Mar 3, 4), six nights at the OCS (2019 Mar 3, 4, 15, 24, 29, 31), and four nights at the OAN-SPM (2019 Apr 14, 15, 18 and 20). Two nights were discarded due to low photometric data quality. Our derived lightcurve is rather flat, with only small features which are of the order of the observational data dispersion. Thus, we may conclude that Queteleta is a quite round

asteroid. Despite its possible round shape, we have attempted to estimate its rotation period using 2110 data points, obtaining a value of 10.278 ± 0.003 h with a peak-to-peak amplitude of 0.03 ± 0.03 mag. We are aware that this value might be not completely reliable, given the high data noise of some of our observations, but we consider it is a good first approximation.

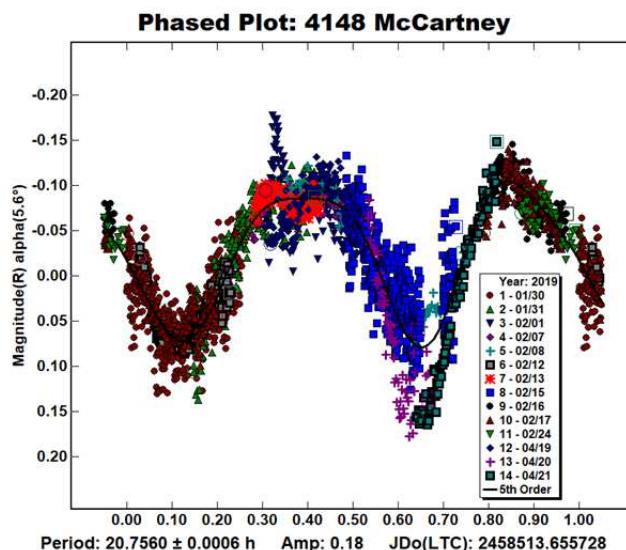


2162 Anhui This object is a main-belt asteroid discovered at the Purple Mountain Observatory (JPL Small-Body Database; Schmadel, 2003) in 1966. Its absolute magnitude $H = 12.82 \pm 0.25$ is reported by Veres et al. (2015) while its reported diameter and albedo are 7.494 ± 0.148 km, and 0.1988 ± 0.0324 (Masiero et al., 2011). Berhend et al. (2018) and Pravec et al. (2018) reported very similar rotation period values of 8.106 ± 0.001 h, and 8.1048 ± 0.0005 h, respectively. We have carried out observations during 11 nights: six at the OCS (2019 Jan 4, 5, 12, 26, 27, 31), and five at the TONA Observatory (2019 Jan 24, 25, 26, 27, 30). One night was discarded based on its low quality. We obtained a lightcurve with a total of 1258 data points and derived a rotation period of 8.101 ± 0.001 h with an amplitude of 0.13 ± 0.04 mag. We can see that our period value is consistent with the two previously reported values.

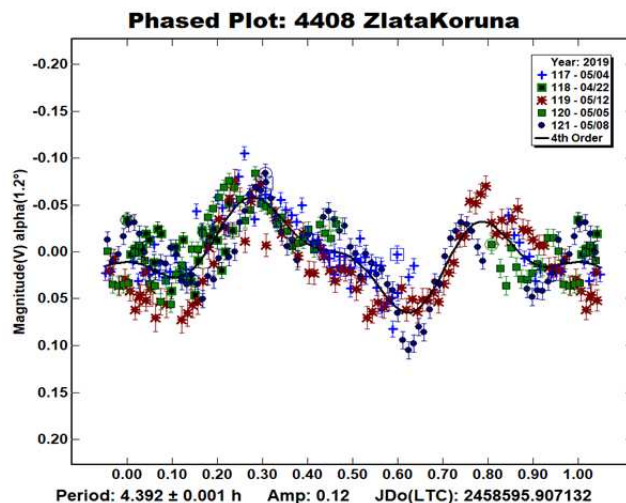


4148 McCartney is a main-belt asteroid. It was discovered in 1983 by E. Bowell at Flagstaff Observatory (JPL Small-Body Database; Schmadel, 2003). It has an absolute magnitude of $H=12.86 \pm 0.44$ (Veres et al., 2015). An albedo of 0.2795 ± 0.0573 and a diameter of 7.610 ± 0.066 km are reported by Masiero et al. (2011). This object has two reported period values, namely, 20.737 ± 0.002 h (Pravec et al., 2019) and 20.748 ± 0.003 h (Odden et al., 2019).

We have observed this object during 17 nights distributed as follow: four at the TONA Observatory (2019 Jan 30, 31, and Feb 1, 15), five at OCS (2019 Feb 7, 8, 24, 28, and Mar 20), and eight at OAN-SPM (2019 Feb 12, 13, 16, 17, 18, Apr 19, 20, and 21). Of all these, three nights were discarded due to their low quality. With these data we have derived a rotation period of 20.7560 ± 0.0006 h with an amplitude of 0.18 ± 0.03 mag, which is consistent with the previously reported values. A total of 2690 data points were used to build the lightcurve.



4408 Zlata Koruna is a main-belt asteroid discovered by A. Mrkos in 1988 that has an absolute magnitude of $H = 12.9$ (JPL Small-Body Database; Schmadel, 2003). To the best of our knowledge, there are no reported periods for this object. We have collected data for this object during 5 nights: one at the OAN-SPM (2019 Apr 22), and four at the OCS (2019 May 4, 5, 8, and 12), giving a total of 323 points. Based on our observations we have estimated a period of 4.392 ± 0.001 h with an amplitude of 0.12 ± 0.04 mag.



Number	Name	yyyy mm/dd	Phase	L _{PAB}	B _{PAB}	Period(h)	P.E.	Amp	A.E.	Grp
722	Frieda	2019 04/09-05/01	6.1, 7.0	208	+2	30.06	0.02	0.14	0.05	MB
1239	Queteleta	2019 02/17-04/20	9.3, 19.4	166	+2	10.278	0.003	0.03	0.03	MB
2162	Anhui	2019 01/04-01/31	4.7, 11.4	111	-1	8.101	0.001	0.13	0.04	MB
4148	McCartney	2019 01/30-04/21	5.7, 28.5	144	0	20.756	0.0006	0.18	0.03	MB
4408	Zlata Koruna	2019 04/22-05/12	5.6, 5.5	221	0	4.392	0.001	0.12	0.04	MB

Table I. Observing circumstances and results. The phase angle is given for the first and last date. If preceded by an asterisk, the phase angle reached an extrema during the period. L_{PAB} and B_{PAB} are the approximate phase angle bisector longitude/latitude at mid-date range (see Harris et al., 1984). Grp is the asteroid family/group (Warner et al., 2009).

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