Asteroids' Rotation Periods:
Contribution of The Mexican Asteroid Photometry Campaigns

L. Olguín[1]
The Mexican Photometry Campaign Coordinator

Participants:

P. A. Valdés-Sada[2], P.. A. Loera-González[1], J.C. Saucedo[1], S. A. Ayala-Goméz[3], W. Schuster[4], M. E. Contreras[1], S. A. R. Haro-Corzo[5], S. Navarro-Meza[4], J. Segura-Sosa[6], A. Avilés[3], E. Pérez-Tijerina[3], M. Reyes[4], R. Núñez-López[1], I. L. Fuentes-Carrera[7], C. Chávez-Pech[3], M. Rodríguez-Martínez[5], J.S. Silva[4], R. Vázquez[4], J.R. Valdés[8], J. Guichard[8], R. Mújica[8], J. Michimani-García[8]; R. López-González[8], G. Cerdán-Hernández[8], G. Dalle Mese[9], R. Domínguez-González[10]

(1) DIF,DFMI-Caborca – Universidad de Sonora, (2) DFM – Universidad de Monterrey, (3) FCFM - Universidad Autónoma de Nuevo León, (4) IA–Ensenada, Universidad Nacional Autónoma de México, (5) ENES-Morelia, Universidad Nacional Autónoma de México (6) FCFM – Universidad Autónoma de Coahuila (7) ESFM – Instituto Politécnico Nacional, (8) Instituto Nacional de Astrofísica, Óptica y Electrónica, (9) FACITE - Universidad Autónoma de Sinaloa, (10) Colegio de Bachilleres, Sonora.

Abstract

Currently we know about 600,000 numbered asteroids and between 3 to 4 hundred thousand unnumbered ones (1). Besides, many new objects are discovered every year. The rate of discovery is by far larger than the rate of their physical properties determination. In order to contribute to asteroid characterization, in 2015 a group of researchers and students of several Mexican institutions, have established The Mexican Asteroid Photometry Campaign, aiming to derive rotation period of asteroids based on optical photometric observations. This project was a first stage that allowed us to gain knwoledge about asteroids, to generate the capabilities to study them, and then to move into the stage of photometric characterization. The first campaign started in the second semester of 2015. Since then, five anual campaigns have been carried out. A total of 63 asteroids have been observed during a period of sixty months and 42 light curves and rotation periods have been published. The results obtained throughout the campaigns and a short description of our near future plans are presented.

Instrumentation

Observatories and telescopes involved in the campaigns are the following:

- 0.84 m telescope at the Observatorio Astronomico Nacional at Sierra San Pedro Martir (OAN-SPM), operated by Universidad Nacional Autónoma de Mexico, Baja California.
- 0.40 m telescope at Observatorio Astronómico Carl Sagan (OACS), Universidad de Sonora, Hermosillo city.
- 0.36 m telescope of the Universidad de Monterrey Astronomical Observatory, Monterrey city.
- 0.80m Tonatzintla Schmidt Camera, Tonantzintla, Puebla.

Figure 1. Buildings of telescopes used in the campaigns

0.84m at OAN-SPM
Long: 115˚ 27' 49'' W
Lat: 31˚ 02' 39'' N

Carl Sagan Stellar Observatory
Long: 111˚ 08' 09'' W
Lat: 29˚ 01' 15'' N

U. Monterrey Observatory
Long: 100˚ 22' 26'' W
Lat: 25˚ 38' 35'' N

Tonantzintla Schmidt Camera
Long: 98˚ 18' 59.5'' W
Lat: 19˚ 01' 57.7' N

Observations, data reduction and analysis

Typically to obtain complete light curves, five to ten nights of observation are dedicated to each asteroid. Due to instability issues of telescope mounts, exposure times for individual images are in the range of 30 to 240 seconds. This restriction has been a severe limitation for the follow-up of interesting faint objects. Basic steps in data reduction are performed using IRAF(16) or MaximDL software. For light curve extractions and period determinations, MPO Canopus software is used. Figure 2 shows examples of light curves derived using these procedures.

Observed objects and results

The asteroid sample has been obtained from the Collaborative Asteroids Lightcurve Link (CALL, 2). In general, asteroids with poorly or not known rotation period were choosen. Only those with declination $\delta > -30^{\circ}$ were observed. A total of 70 objects were scheduled for observations in five campaigns, 63 were actually observed, and reliable periods for 42 objects were obtained and published (3-15). Some data are still under analysis. A sample of derived rotation periods and relevant information are presented in the table below.

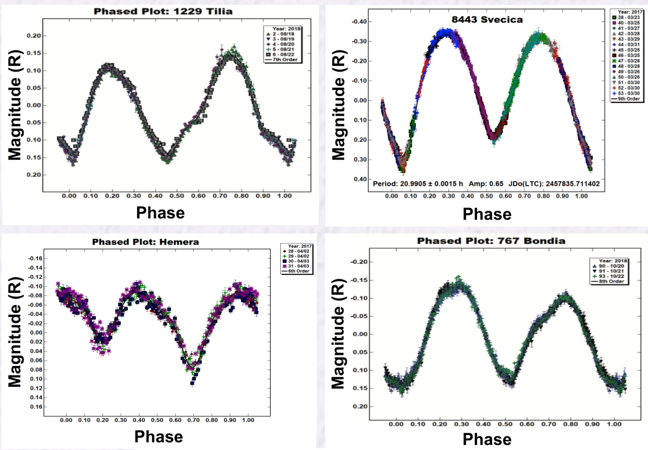

Figure 2. Examples of asteroids' phased light curves

Asteroids with reliable period determination						
Name		Period (h)	P. Error (h)	Amplitude (mag)	Nights	Classification[1]
767	Bondia	8.3402	0.0007	0.27	3	Main-belt
1084	Tamariwa	6.195	0.001	0.30	5	Main-belt
1218	Aster	3.1581	0.0002	0.35	7	Main-belt
1229	Tilia	7.0353	0.0005	0.29	5	Outer Main-belt
1239	Queteleta	10.278	0.003	0.03	15	Main-belt
1305	Pongola	4.349	0.0003	0.19	8	Main-belt
1475	Yalta	28.29	0.01	0.20	9	Main-belt
1491	Balduinus	15.3044	0.0057	0.45	4	Outer Main-belt
1579	Herrick	9.196	0.002	0.12	4	Outer Main-belt
1856	Ružena	5.957	0.001	0.68	11	Main-belt
1903	Adzhimushkaj	4.622	0.001	0.04	6	Main-belt
2022	West	14.1385	0.0031	0.54	7	Main-belt
2070	Humason	3.1885	0.0003	0.14	4	Main-belt
2162	Anhui	8.101	0.001	0.13	10	Main-belt
2171	Kiev	3.1714	0.0002	0.14	10	Main-belt
2535	Hameenlinna	3.2311	0.0001	0.11	10	Main-belt
2733	Hamina	93.23	0.02	0.36	13	Main-belt
2746	Hissao	3.1848	0.0015	0.41	6	Main-belt
3394	Banno	7.3249	0.0008	0.21	5	Main Belt
3877	Braes	5.81	0.01	0.60	6	Main Belt
4775	Hansen	3.1186	0.0001	0.15	8	Mars-crossing
8443	Svecica	20.9905	0.0015	0.65	10	Main-belt
18301	Konyukhov	2.6667	0.0003	0.15	6	Main-belt
21242	1995 WZ41	5.4534	0.0002	0.56	6	Main-belt

(1) Classification taken from JPL Small-body database

Concluding remarks and future work

After five years we have refined observational and analysis methods to derive reliable asteroids' light curves and rotation periods. In the next years, we plan to continue with this kind of work and to move to the more complex stage like the taxonomical classification of bright objects (V<15) and the theoretical study of asteroids' dynamical behaviour.

Note: Due to the COVID 19 pandemic, our data production has been severely reduced and unfortunately this situation seems that will continue for a few more months.

Acknowledgements:

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