PERIOD DETERMINATION FOR THE SLOW ROTATOR 930 WESTPHALIA

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Lightcurve analysis for 930 Westphalia was performed using observations during its 2015 opposition. The synodic rotation period was found to be 100.66 ± 0.12 h and the lightcurve amplitude was 0.15 ± 0.02 mag.

Minor planet 930 Westphalia is a main-belt object discovered in 1920 by Walter Baade at Bergedorf (Germany) prior to moving to USA where his most known and notable research was done; it was named in honor of the region where the discoverer had been born 27 years earlier. It appeared on the CALL web site as an asteroid photometry opportunity due to it reaching a favorable apparition in 2015 and in the appealing short list of 3-digit asteroids still having no defined lightcurve parameters (Alvarez, 2015).

Unfiltered CCD photometric images were taken at Observatorio Los Algarrobos, Salto, Uruguay (OLASU; MPC Code I38) in 2015 from March 27 to April 14. The telescope was a 0.3-m Meade LX-200R reduced to *f*/6.9. The imager was a QSI 516wsg NABG (non-antiblooming gate) with a 1536x1024 array of 9-micron pixels and 23x16 arcminutes field-of-view. The exposure time was 120 seconds. 2x2 binning was used, yielding an image scale of 1.77 arcseconds per pixel. The camera was set to –10°C and off-axis guided by means of an SX Lodestar camera and *PHD2 Guiding* (Stark Labs) software. Image acquisition was done with *MaxIm DL5* (Diffraction Limited). The computer was synchronized with atomic clock time via Internet NTP servers at the beginning of each session.

All images were dark and flat-field corrected and then measured using *MPO Canopus* version 10.4.3.16 (Bdw Publishing) with a differential photometry technique. The data were light-time corrected. Night-to-night zero point calibration was accomplished by selecting up to five comparison stars with near solar colors according to recommendations by Warner (2007) and Stephens (2008). Period analysis was also done with *MPO Canopus*, which incorporates the Fourier analysis algorithm developed by Harris (Harris *et al*., 1989).

A total of 14 nights were devoted to observe this asteroid exclusively over a total span of 19 days. More than 75 hours of effective observation and about 2,200 data points were required in order to solve the essentially flat lightcurve (Figure 1). Over the span of observations, the phase angle varied from 7.6º to 6.0º to 6.8º, the phase angle bisector ecliptic longitude from 197.9º to 197.7º, and the phase angle bisector ecliptic latitude from –11.5º to –12.7º. The rotation period for 930 Westphalia was determined to be 100.66 ± 0.12 h with a lightcurve peak-to-peak amplitude of 0.15 ± 0.02 mag. No clear evidence of tumbling was seen in the lightcurve.

At the time of this study, 930 Westphalia was one of only 18 three-digit numbered asteroids for which no rotation parameters were found in the literature. However, not all of the already measured 982 rotation periods for the first 1000 asteroids are reliable (i.e., many still have U < 3; see Warner *et al*., 2009), so that ongoing investigations to verify, refine, or revise their values remains an important and pending endeavor.

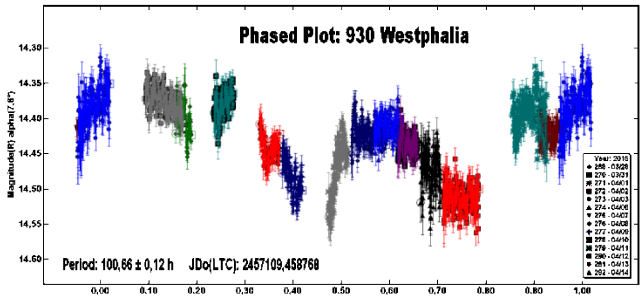

Figure 1. Composite lightcurve of 930 Westphalia.

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TARGET ASTEROIDS! OBSERVING CAMPAIGNS FOR JULY THROUGH SEPTEMBER 2015

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Asteroids campaigns to be conducted by the *Target Asteroids!* program during the July through September 2015 quarter are described. In addition to asteroids on the original *Target Asteroids!* list of easily accessible spacecraft targets, an effort has been made to identify other asteroids that are 1) brighter and easier to observe for small telescope users and 2) analogous to (101955) Bennu and (162173) 1999 JU3, targets of the OSIRIS-REx and Hayabusa-2 sample return missions.

Introduction

The *Target Asteroids!* program strives to engage telescope users of all skill levels and telescope apertures to observe asteroids that are viable targets for robotic sample return. The program also focuses on the study of asteroids that are analogous to (101955) Bennu and (162173) 1999 JU3, the target asteroids of the NASA OSIRIS-REx and JAXA Hayabusa-2 sample return missions respectively. Most target asteroids are near-Earth asteroids (NEA) though observations of relevant Main Belt asteroids (MBA) are also requested.

Even though many of the observable objects in this program are faint, acquiring a large number of low S/N observations allows many important parameters to be determined. For example, an asteroid's phase function can be measured by obtaining photometry taken over a wide range of phase angles. The albedo can be constrained from the phase angle observations, as there is a direct correlation between phase function and albedo (Belskaya and Shevchenko (2000). The absolute magnitude can be estimated by extrapolating the phase function to a phase angle of 0°. By combining the albedo and absolute magnitude, the size of the object can be estimated.

An overview of the *Target Asteroids!* program can be found at Hergenrother and Hill (2013).

Current Campaigns

Target Asteroids! plans to conduct a number of dedicated campaigns on select NEAs and analog carbonaceous MBAs during the quarter. These campaigns have a primary goal of conducting photometric measurements over a large range of phase angles.

Target Asteroids! objects brighter than V = 17.0 are presented in detail. A short summary of our knowledge of each asteroid and 10-day (shorter intervals for objects that warrant it) ephemerides are presented. The ephemerides include rough RA and Dec positions, distance from the Sun in AU (r), distance from Earth in AU (Δ), V magnitude, phase angle in degrees (PH) and elongation from the Sun in degrees (Elong).

We ask observers with access to large telescopes to attempt observations of spacecraft accessible asteroids that are between V magnitude ~17.0 and ~20.0 during the quarter (contained in the table below).

Asteroid Number	Name	Peak V Mag	Time of Peak Brightness
(7350)	1993 VA	17.4	late Aug
(52381)	1993 HA	18.2	late Nov
(65717)	1993 BX3	19.9	mid Sep
(89136)	2001 US16	19.6	late Jul
(163000)	2001 SW169	16.6	early Oct
(164221)	2004 QE20	19.0	early Jul
(341050)	2007 HZ	19.8	mid Sep
(350713)	2001 XP88	17.9	late Jul

The campaign targets are split up into two sections: carbonaceous MBAs that are analogous to Bennu and 1999 JU3; and NEAs analogous to the Bennu and 1999 JU3 or provide an opportunity to fill some of the gaps in our knowledge of spacecraft targets (examples include very low and high phase angle observations, phase functions in different filters and color changes with phase angle).

The ephemerides listed below are just for planning purposes. In order to produce ephemerides for your observing location, date and time, please use the Minor Planet Center's Minor Planet and Comet Ephemeris Service:

http://www.minorplanetcenter.net/iau/MPEph/MPEph.html

or the *Target Asteroids!* specific site created by Tomas Vorobjov and Sergio Foglia of the International Astronomical Search Collaboration (IASC) at

http://iasc.scibuff.com/osiris-rex.php

Analog Carbonaceous Main Belt Asteroid Campaigns

(442) Eichsfeldia (a=2.35 AU, e=0.07, i=6.1°, H = 10.0)
Not an obvious member of any of the major inner Main Belt carbonaceous asteroid families, (442) Eichsfeldia is an example of a carbonaceous (Ch-type) background object. Past studies suggested that it was a member of the Vesta family but its type and very low albedo (0.04) make that very unlikely.

This quarter Eichsfeldia covers a range of phase angles from 20° to an extremely low 0.2° at opposition on August 9. It is also at its brightest that day at V = 12.6. Lightcurve photometry found a period of 11.88 h and amplitude of 0.24-0.38 magnitudes. Filter photometry is especially requested to detect color changes at different phase angles.

DATE	RA	DEC	Δ	r	V	PH	Elong
07/01	21 40	-12 15	1.49	2.32	13.6	18	135
07/11	21 37	-12 56	1.42	2.33	13.4	14	146
07/21	21 31	-13 54	1.37	2.34	13.2	10	157
07/31	21 23	-15 04	1.34	2.35	12.9	5	169
08/10	21 14	-16 18	1.34	2.35	12.6	0	179
08/20	21 04	-17 29	1.36	2.36	13.0	6	167
08/30	20 57	-18 29	1.41	2.37	13.3	10	155
09/09	20 51	-19 16	1.49	2.38	13.6	14	144
09/19	20 49	-19 47	1.58	2.38	13.8	18	134
09/29	20 49	-20 02	1.68	2.39	14.1	20	124