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## LIGHTCURVE ANALYSIS OF EXTREMELY CLOSE NEAR-EARTH ASTEROID – 2012 DA14


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In this paper we present one of the first lightcurves of near-Earth asteroid 2012 DA14. This is a very interesting near-Earth asteroid, which approached the Earth at a very close distance on Feb. 15 2013. From our measurements we find a rotational period of 9.485 ± 0.144 h with an amplitude of 1.79 mag.


All observations reported here were carried out at Russian remote ISON-NM observatory (NM, USA) in visible light with 0.45-m astrograph f/2.8 and FLI ML09000-65 camera mounted in prime focus. The unbinned image scale is 1.95 arcsec/pixel. All images were dark and flat field corrected. Analysis of the images and results for the rotation period were carried out by the *MPO Canopus* package (Bdw Publishing).

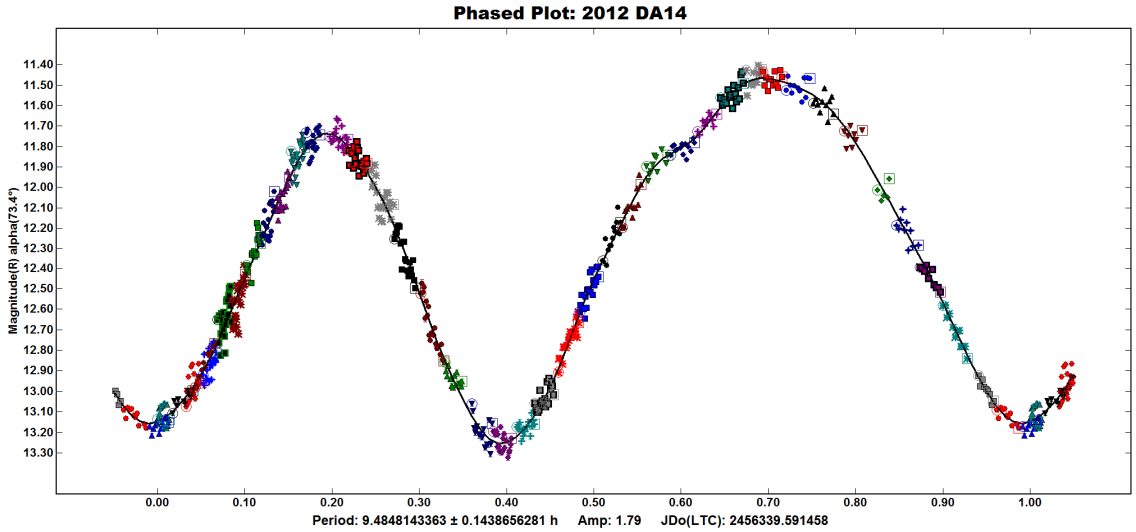
Asteroid 2012 DA14 is a near-Earth object (Aten category, $q$ = 0.8289, $a$ = 0.9103, $e$ = 0.0894, $i$ = 11.6081). Before the current close approach, 2012 DA14 had orbital elements within the Apollo category ($q$ = 0.8894, $a$ = 1.0018, $e$ = 0.1081, $i$ = 10.3372). Parameters of the orbit make this asteroid an interesting target for a possible space mission. Asteroid 202 DA14 was discovered on Feb 23 2012 by the La Sagra Sky Survey, LSSS (MPC code J75).

An extremely close approach to the Earth (0.00022 AU or ~34 000 km) occurred 2013 Feb 15.80903. We observed this asteroid after its close approach, 2013 Feb 16, from 02:11:35 UT to 12:17:43 UT (Table1). Our total observational interval was 10 h 16 min, i.e. ~108% of the rotation period.

| *UT* | *Δ* | *r* | *phase* | *mag* |
|---|---|---|---|---|
| 02:11:35 | 0.0011 | 0.988 | 73.5 | 11.8 |
| 12:18:43 | 0.0026 | 0.988 | 80.9 | 14.0 |

Table I. Photometric observations of 2012 DA14.

We found our data fit a rotation period that is relatively long for the objects with the same size: P = 9.485 ± 0.144 h with an extremely high lightcurve amplitude of 1.79 mag.



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***Editor's Note:** This manuscript was received on February 20, one of the earliest reported lightcurve results for 2012 DA14. Unfortunately due to an error by the Editor, this article was omitted from the processing for MPB 40-3. The Editor offers his apology for the delay in publishing these results.*

## LIGHTCURVE PHOTOMETRY, H-G PARAMETERS AND ESTIMATED DIAMETER FOR 1412 LAGRULA

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Photometric observations of main-belt asteroid 1412 Lagrula were made over ten nights during 2013 March and April, with filtered system. The resulting synodic period is 5.9176 ± 0.0001 h with an amplitude of 0.28 ± 0.05 mag. The color index V-R = 0.37 ± 0.05 mag. The measured absolute visual magnitude, Hv = 11.81 ± 0.04 mag. and the slope parameter, G = 0.135 ± 0.049, are consistent with a low albedo object, e.g., type C. The diameter is estimated to be D = 23 ± 3 km.

The main-belt asteroid 1412 Lagrula was reported as a lightcurve photometry opportunity, for 2013 March, in Minor Planet Call *http://www.minorplanet.info/PHP/call_OppLCDBQuery.php*. All the observations were carried out from C62 Eurac Observatory in Bolzano (Italy), during ten observing nights, using a 0.30m reflector telescope, reduced to f/4.0 and a QHY9 CCD camera. Before each session, the observers synchronized the computer's clock with atomic clock time, via Internet NTP servers. Differential photometry and period analysis was done using *MPO Canopus* (Warner, 2012). The derived synodic period was P = 5.9176 ± 0.0001 h (Fig.1) with a amplitude of A = 0.28 ± 0.05 mag.

All filtered images (V Johnson, R Cousins) were calibrated with dark and flat-field frames. The V and R band frames were acquired in sequence changing alternatively the filters (VR VR VR). This allowed us to find the color index of V-R = 0.37 ± 0.05 mag (mean of 40 values). This value is typical of a C-type asteroid (Shevchenko and Lupishko, 1998). Assuming C-type, the geometric albedo is Pv = 0.06 ± 0.02 (Shevchenko and Lupishko, 1998). The absolute magnitude (H) and slope parameter (G) ware found using the H-G Calculator function of MPO Canopus. Seven values obtained pre- and post-opposition of the asteroid, using the maximum values of the lightcurve. We obtained Hv = 11.810 ± 0.040 mag. and the slope parameter G = 0.135 ± 0.049 (Fig. 2).

From this, we can estimate a diameter of D = 23 ± 3 km using the expression (Pravec and Harris, 2007):

$$D_{(km)} = (1329/\sqrt{Pv})10^{-0.2Hv}$$

References

Minor Planet Call *http://www.minorplanet.info/PHP*

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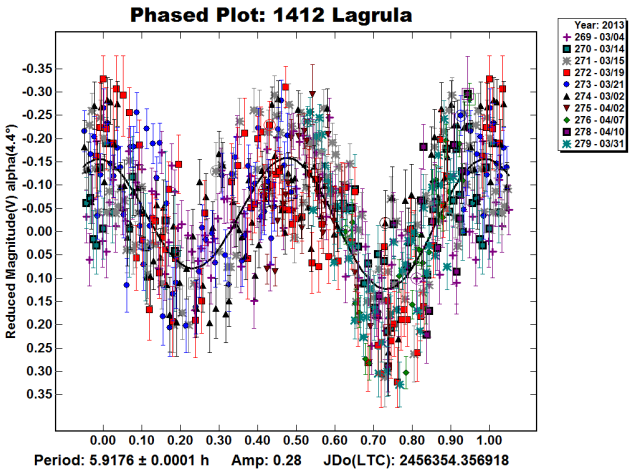


Figure 1. The lightcurve of 1412 Lagrula with a period of 5.9176 ± 0.0001 h and an amplitude of 0.28 ± 0.05 mag.

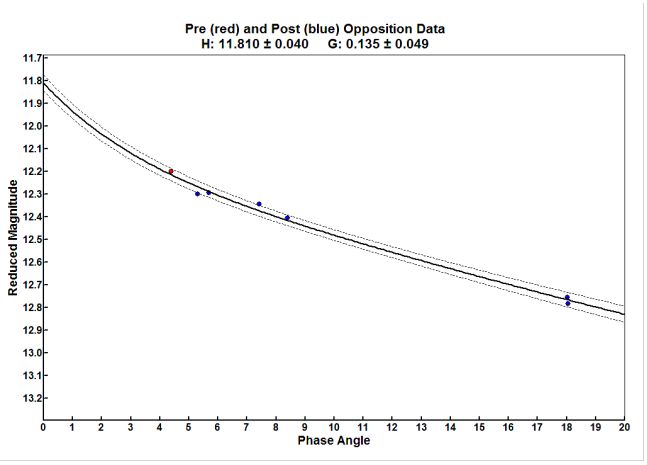


Figure 2. Visual reduced magnitude vs. phase angle for Hv = 11.810 ± 0.040 mag. and the slope parameter, G = 0.135 ± 0.049