

PAPER • OPEN ACCESS

Investigation of the potentially hazardous asteroids 276033 (2002 AJ129) and 2017 VR12 during their close approaches to the Earth

To cite this article: S N Petrova *et al* 2018 *J. Phys.: Conf. Ser.* **1135** 012011

View the [article online](#) for updates and enhancements.

You may also like

- [Asteroid Observations from the Transiting Exoplanet Survey Satellite: Detection Processing Pipeline and Results from Primary Mission Data](#)
Deborah F. Woods, Jessica D. Ruprecht, Michael C. Kotson et al.
- [CHARACTERIZING SUBPOPULATIONS WITHIN THE NEAR-EARTH OBJECTS WITH NEOWISE: PRELIMINARY RESULTS](#)
A. Mainzer, T. Grav, J. Masiero et al.
- [Peculiar Pair of Distant Periodic Comets C/2002 A1 and C/2002 A2 \(LINEAR\)](#)
Zdenek Sekanina, Paul W. Chodas, Miloš Tichý et al.



ECS
The
Electrochemical
Society
Advancing solid state &
electrochemical science & technology

DISCOVER
how sustainability
intersects with
electrochemistry & solid
state science research

Investigation of the potentially hazardous asteroids 276033 (2002 AJ129) and 2017 VR12 during their close approaches to the Earth

S N Petrova¹, A V Devyatkin¹, D L Gorshanov¹ and V N L'vov¹

¹The Central Astronomical Observatory of the Russian Academy of Sciences,
Pulkovskoe chaussee 65, Saint-Petersburg, 196140, Russia

E-mail: stalkered@yandex.ru

Abstract. Astrometric and photometric observations of asteroids 276033 (2002 AJ129) and 2017 VR12 (both classified as a "Potentially Hazardous Asteroids" by the Minor Planet Center) were made using two telescopes of the Pulkovo Observatory (CAO RAS). The data was processed and the lightcurves of the objects were obtained. Accuracy of the orbital elements of the asteroids was estimated on the basis of the data obtained and the data from the Minor Planet Center.

1. Introduction

In February and March 2018, as the part of the study of potentially hazardous asteroids at the Central (Pulkovo) Astronomical Observatory of the Russian Academy of Sciences (CAO RAS), observations of two near-Earth objects 276033 (2002 AJ129) and 2017 VR12 were made during their flybys.

The aim of this investigation was to make observations with two telescopes of the Pulkovo Observatory and then using the data obtained improve the orbital elements of the objects in question and also to obtain their lightcurves and determine their axial rotation periods.

2. Asteroid 276033 (2002 AJ129)

Asteroid 276033 (2002 AJ129) was discovered on January 15, 2002 at Haleakala Observatory, Hawaii. It belongs to Apollo group of the near-Earth objects and approaches within 0.1 AU of all four inner planets [1]. Its minimal orbit intersection distance (MOID) is estimated as 0.0573 AU. Diameter is estimated to lie in a range between 0.5-1.2 km [2].

On February 4, 2018 the object in question approached Earth within 0.0281 AU (10.9 lunar distances), and during its flyby on February 3-7, 2018 radar observations were made at the Goldstone and Arecibo observatories.

Asteroid 276033 (2002 AJ129) is classified as a "Potentially Hazardous Asteroid" by the Minor Planet Center, but the next notable future close encounter will occur only in 2172. The asteroid will approach Earth within 0.00458 AU (1.8 lunar distances) [1].



3. Asteroid 2017 VR12

Asteroid 2017 VR12 was first observed on November 10, 2017 at Haleakala Observatory, Hawaii. It belongs to Amor group of the near-Earth and its minimal orbit intersection distance (MOID) is estimated as 0.0077 AU [3].

On March 7, 2018 the asteroid in question made its closest currently known approach to Earth (0.0097 AU or 3.76 lunar distances) and on March 3-7, 2018, radar observations were made at the Goldstone, Green Bank and Arecibo observatories. The results of these observations showed that the asteroid has an elongated and angular shape with a size of approximately 250 meters [3].

2017 VR12 is classified as a "Potentially Hazardous Asteroid" by the Minor Planet Center [3].

4. Astrometric study

EPOS [5] and APEX-II [6] software systems were used to process the astrometric data and UCAC4 was used as the reference star catalog.

The results of the improvement of orbital elements of the objects are shown in table 1 and table 2.

Table 1. Improvement of 276033 (2002 AJ129) orbital elements for the epoch JD2458200.5.

Elements	MPC	Improved	Δ
M , ($^{\circ}$)	51.04693	51.04729	0.00036
ω , ($^{\circ}$)	211.00728	211.00713	-0.00015
Ω , ($^{\circ}$)	138.04181	138.04186	0.00005
i , ($^{\circ}$)	15.45478	15.45478	-0.00000
e	0.9148963	0.9148961	-0.0000002
a , (AU)	1.37044240	1.37043571	-0.00000669
q , (AU)	0.11662972	0.11662943	0.00000043

Table 2. Improvement of 2017 VR12 orbital elements for the epoch JD2458200.5

Elements	MPC	Improved	Δ
M , ($^{\circ}$)	8.89266	8.89240	-0.00026
ω , ($^{\circ}$)	180.74452	180.74481	0.00029
Ω , ($^{\circ}$)	347.31609	347.31610	-0.00001
i , ($^{\circ}$)	9.22473	9.22473	-0.00000
e	0.2695834	0.2695889	0.0000055
a , (AU)	1.36967590	1.36968628	0.00001038
q , (AU)	1.00043401	1.00043406	0.00000005

Where: M — the mean anomaly; ω — the argument of perihelion; Ω — the ascending node; i — the inclination; e — the eccentricity; a — the semi-major axis; q — the perihelion distance; Δ — the differences.

For the astrometric study of 276033 (2002 AJ129) the data was primarily obtained with the telescope MTM-500M (located near Kislovodsk, Russia) and the data from MPC was also used.

For the astrometric study 2017 VR12 the data was obtained with the telescope ZA-320M (located in Pulkovo).

5. Photometric study

APEX-II software package [5] was used to process the photometric data and 2MASS catalogue was used in the process of the photometrical reduction.

By this stage of the investigation, the axial rotation period of the asteroids 276033 (2002 AJ129) and 2017 VR12 have already been obtained by means of radar observations in the Goldstone and Arecibo observatories. It was estimated that the rotation period of 276033 (2002 AJ129) is approximately 3.9223 hours [4] and the rotation period of 2017 VR12 is 1.3775 hours [4].

The Scargle method [7] was used to determine the rotational periods and the results based on our data obtained and our calculations confirmed that the axial rotation period is approximately 3.9216 ± 0.02 hours for 276033 (2002 AJ129). For 2017 VR12 it is slightly different and is estimated to be 1.3004 ± 0.02 hours. But further investigations will be made. The phased lightcurves obtained from our longest observation series are shown on the figure 1 and figure 2.

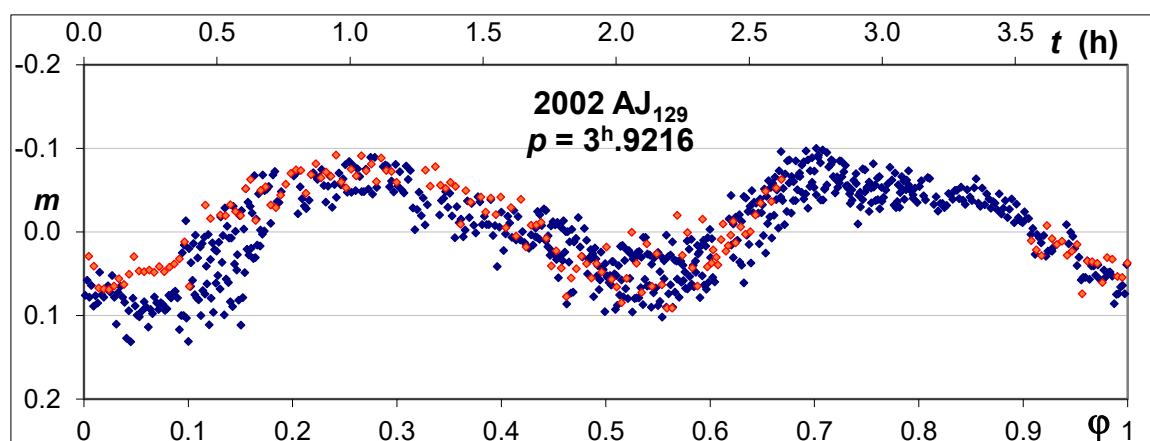


Figure 1. Lightcurve obtained by processing the observations made with MTM-500M.

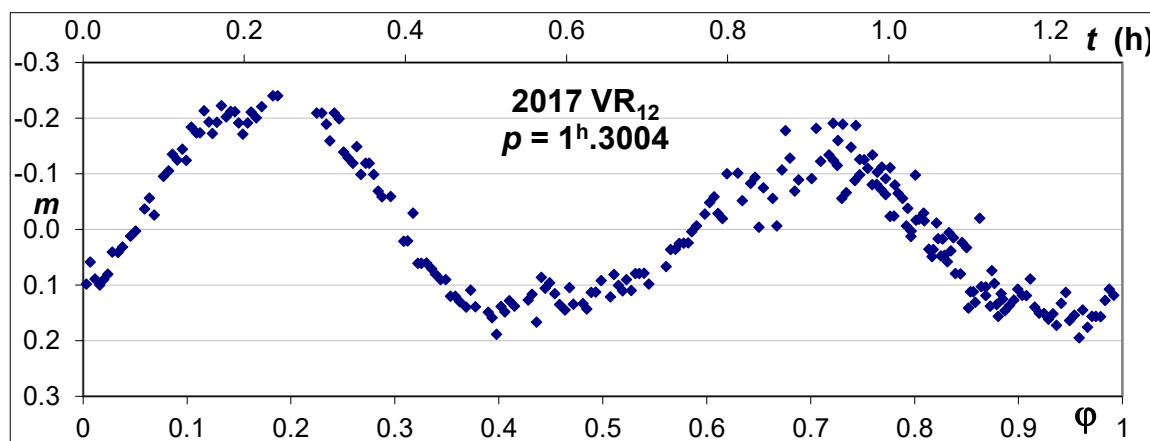


Figure 2. Lightcurve obtained by processing the observations made in.

6. Conclusion

In this study, observations of potentially hazardous asteroids during their close-Earth flybys were made with two telescopes of the Pulkovo Observatory. After processing the observational data, it was possible to obtain the lightcurves of both asteroids and their axial rotation periods were determined. For 276033 (2002 AJ129) it was confirmed that its rotation period is 3.9216 ± 0.02 hours. For 2017 VR12 we got a slightly different result from that has been determined before, and our result is 1.3004 ± 0.02 hours. The improvement of the orbital elements was also made. Further investigations of the given asteroids are planned.

References

- [1] https://echo.jpl.nasa.gov/asteroids/2002AJ129/2002AJ129_planning.2018.html
- [2] <http://earn.dlr.de/nea/276033.htm>
- [3] https://echo.jpl.nasa.gov/asteroids/2017VR12/2017VR12_planning.2018.html
- [4] <http://www.asu.cas.cz/~ppravec/newres.txt>
<https://ssd.jpl.nasa.gov/sbdb.cgi?sstr=276033>
- [5] <http://www.asu.cas.cz/~ppravec/newres.txt>
<https://ssd.jpl.nasa.gov/sbdb.cgi?sstr=3789225>
- [6] L'vov V N *et al* 2012 The use of the Epos software package for research of the Solar System objects *Solar System Research* **46** issue 2 pp 177-179
- [7] Gorshanov D L , Kouprianov V V *et al* 2010 Apex I and Apex II Software Packages for the Reduction of Astronomical CCD Observations *Solar System Research* **44** no 1 pp 68–80
- [8] Scargle J D 1982 Studies in Astronomical Time Series Analysis. II. Statistical Aspects of Spectral Analysis of Unevenly Spaced Data *Ap.J.* **263** pp 835-853