FOLLOW–UP CCD OBSERVATIONS OF NEAR–EARTH ASTEROIDS IN 1999

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INTRODUCTION

It is very important from the point of view of asteroid hazard problem both timely to discover "dangerous" body and to know its main physical properties. To a middle of 2000 the total amount of these objects with good known orbits exceeded 1000. However, study of physical properties of near-Earth asteroids (NEA) falls considerably behind from the speed of their discovering. Today the data of rotations and shapes have been obtained for less then 20% of known NEA.

In 1996 at Astronomical Observatory of Kharkiv University the regular CCD observations of NEA were started. The observations were carried out in collaboration with the DLR Institute for Planetary Exploration (Berlin) within the framework of European NEA discovery projects. The observation program includes obtaining both NEA lightcurves for a study of their rotation and shapes, and astrometric follow-up observations for newly discovered objects. For the observations we usually had 5–7 nights per month close to a new moon. Since these bodies have diameters about some kilometers or less the discovery occurs in a moment of their close approaching to Earth. This period of maximal visible brightness is most suitable to study physical properties, and we try to do our observations of asteroids just after their discoveries.

OBSERVATIONS

We discussed the results of follow-up photometric observations of NEA carried out in 1999. The 70-cm telescope equipped with a CCD camera SBIG ST-6 UV was used. Usually the observations were done through the R or V filters close to the standard Johnson-Cousins photometric system. The ASTPHOT package developed by S. Mottola (Mottola *et al.*, 1995) was used for reduction of CCD frames.

In 1999 we observed nine NEA and one Mars-crosser just after their discoveries. Namely they are listed in Table 1. It includes the asteroid orbit type, the calculated absolute magnitude H and the asteroid diameter. The absolute magnitude of each asteroid was calculated for its primary lightcurve maximum by using the HG-function (Bowell *et al.*, 1989) and assuming $G = 0.15$.

Table 1: Magnitudes and diameters of observed asteroids

Name of asteroid	Orbit type	H (mag)	Diameter (km)
1999 CV3	Apollo	15.0	3.0–5.5
1999 GU3	Amor	19.28	0.6
1999 HF1	Aten	14.54	3.7–6.8
1999 JM8	Aten	15.63	2.2–4.1
1999 JO8	Aten	16.77	1.3–2.4
1999 LF6	Apollo	18.02	0.7–1.4
1999 ND43	Amor	18.9	0.5–0.9
1999 RH27	Amor	16.83	1.3–2.4
1999 RQ36	Apollo	20.72	0.2–0.4
1999 US3	Mars-Crosser	13.61	5.7–10.4

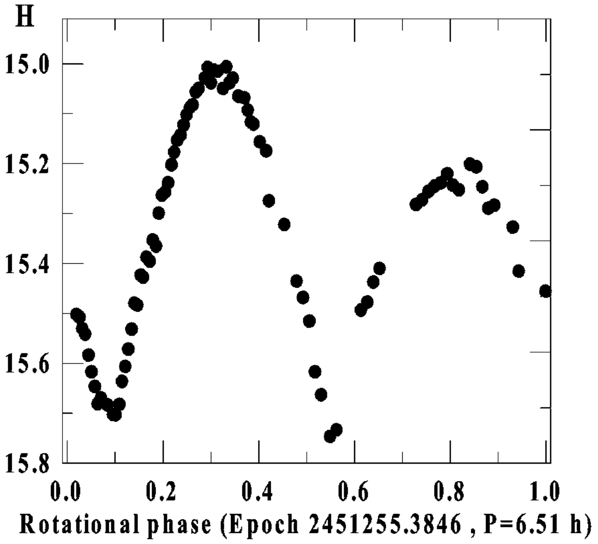

Figure 1: Composite lightcurve of asteroid 1999 CV3

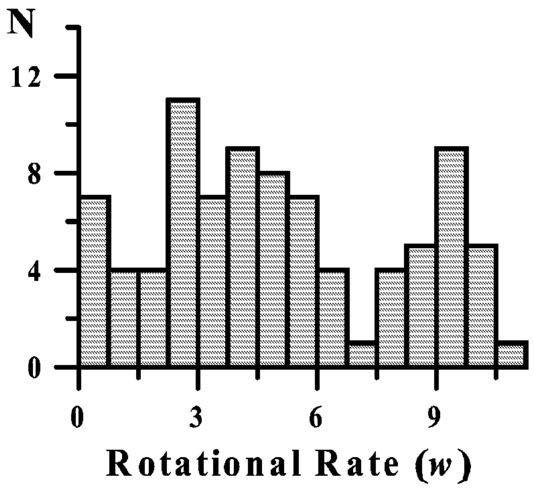

Figure 2: Distribution of NEA rotational rates

RESULTS

The composite lightcurve of asteroid **1999 CV3** observed during three nights in March 1999 is shown as an example in Fig. 1. The lightcurve is characterized by two pairs of extrema with unequal level of maxima and amplitude of 0.74 mag. Such large brightness variations give an evidence on a rather asymmetric elongated shape of the asteroid.

We determined unambiguously rotational periods for 6 of 10 asteroids. Three asteroids are characterized by fast rotation with periods less than 2.5 hours. One of these fast rotating asteroids, namely **1999 HF1**, is supposed to be a binary system (Pravec, 1999). Four observed NEA showed long-period brightness variations with periods more than 12 hours. Additional observations are needed to determine the accurate values of their rotational periods. Our data of the long-period asteroid **1999 GU3** were combined with the photometric data obtained at Ondrejov and Table Mountain Observatories and with the radar observations carried out using the Goldstone's radar system. As result the periodicity was thoroughly analysed and the period was determined (Pravec *et al.*, 2000). Lightcurves of asteroid **1999 ND43** did not show variations more than 0.1 mag and we did not find any period which could fit the data.

A distribution of NEA rotational rates is shown in Fig. 2. The sample includes 86 near-Earth asteroids with well-determined rotational periods. Asteroids can be divided into three groups according to their rotation: fast ($P < 3.5\,\mathrm{h}$), middle ($3.5 - 12\,\mathrm{h}$) and slow ($> 12\,\mathrm{h}$) rotation. Our observations presented here give a contribution into statistics for each group.

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