

**Observations of small-size and low-elongation NEAS in
RI Nikolaev astronomical observatory**
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Abstract:

Small-size NEAs can pose a threat to human settlements, which is confirmed by the example of the fall of the meteorite Chelyabinsk, in result many people were injured, buildings were damaged. Observation of low-elongation NEAs allows increasing the arc of observations, but they are hampered by the low intensity of the image NEAs.

Introduction

NEAs with diameter less than 140 m are the least studied minor bodies of Solar system and may be observed only at a distance less than 0.05 a.u. According to data of international astronomical union at October 2013 discovered [4]:

- 861 NEAs with diameter more then 1000 m, included 155 potential hazardous asteroids (PHA) (predicted number of this size NEAs- 966 ± 45);
- 5784 NEAs with diameter more then 140 m, included 1424 PHA (predicted number ~ 15000)
- 6448 NEAs with diameter more then 100m (predicted number ~ 20000)
- 8398 NEAs with diameter more than 40 m (predicted number ~ 300000)

Method and equipment

Considering the higt apparent motion of NEAs at the distance to the Earth less than 0.05 a.u., the combined method of observation is used in RI NAO [2]. Combined method consists in separation of processes of observation of reference stars and NEA and using of the short time delay and integration mode (TDI) [1]. The main condition of the TDI mode using is the fixing the column of CCD in the direction of NEA motion, for this goal the special device camera rotator was developed and applied. Camera rotator rotates the CCD camera around the optical axis of lens.

All observations in RI NAO were carried out with using of KT-50 telescope (D=0.5m, F=3.0m). The telescope equipped with CCD-camera Apogee Alta U9000 (3k×3k) and camera rotator. Field of view of the telescope is $0.7^\circ \times 0.7^\circ$ [3].

Results of observation

Since 2008, 4000 positions of 219 near earth asteroids have been obtained on KT-50 telescope. Using of the combined method allowed us to obtain observations of 12 NEAs with diameter less than 140 m (all observations obtained at the distance from the Earth less than 0.05 a.u.). In 2014

observations of 3 low-elongation NEAs with solar elongation less than 45° were obtained. 62 potentially hazardous asteroids were observed. The follow-up observation of 4 candidate NEAs with apparent motion higher than $5.6''/\text{min}$ were conducted in RI NAO.

The observations of NEAs 2014HQ124, 2013 TV135, 2002 GT, Apophis and 2005YU55 were obtained within the framework of the GAIA-FUN-SSO campaigns of observation.

Results of observation of 15 small size NEAs with diameter less than 140m are obtained in RI NAO. These objects very difficult observe because they become available for observation only during a close approach to the Earth. The physical parameters, number of position and accuracy of observation of small size NEAs in RI NAO are represented in the table 1. The magnitudes are in the range from 14.9 to 18.6, apparent motions are in the range from 4.7 to $306.3''/\text{min}$. The number of positions obtained in the all observatories showing in the third column, the number of position obtained in RI NAO in percentage are represented in the 4-rs column.

Table 1. The result of small size NEAs observation.

Provisional designation	Diameter, m	N	N2 %	Delta a.e.	Mag	App. motion $''/\text{мин}$	(O-C) $''$	
							RA	DEC
2000WL63	20 – 40	263	2.7	0.18	17.8	4.7	0.13	0.22
2011JY1	30 – 80	106	6.6	0.03	18.5	16.0	0.01	0.04
2012EO8	40 – 90	119	5.0	0.01	17.1	82.8	0.11	0.02
2012FQ35	50 – 120	170	4.7	0.04	18.3	15.5	0.21	0.19
2012HM	40 – 100	521	3.6	0.01	15.7	46.3	0.18	-0.1
2012HP13	40 – 90	195	10.3	0.01	15.8	174.7	0.33	0.24
2012LJ	20 – 50	53	13.2	0.005	18.2	306.3	-0.03	0.09
2012TC4	10 – 30	301	4.0	0.001	16.5	19.1	0.15	-0.05
2012XH112	10 – 20	48	41.7	0.01	17.2	90.4	0.00	0.05
2013GK69	50 – 110	65	4.6	0.04	18.1	20.5	0.15	-0.01
2013XY8	30 – 60	248	8.5	0.01	14.9	80.1	-0.35	0.28
2014FD	20 – 50	78	11.5	0.01	18.1	55.6	-0.33	-0.67
2014FO38	10 – 30	79	5.1	0.01	18.0	58.1	0.42	0.53
2014FR52	50 – 110	79	7.6	0.05	18.4	9.4	0.08	-0.3
2014HV2	10 – 40	70	12.9	0.02	18.6	8.1	-0.11	0.28
N – total numbers of positions, N2 – numbers of positions obtained in RI NAO (%)								

In 2014 in RI NAO was held an experiment to monitoring of low elongation NEOs. The conditions of observation (solar elongation, magnitude and apparent motion) are represented in the table 2. Observations of NEA 2014HQ124 were obtained within the framework of the GAIA-FUN-SSO campaigns of observation, results of observations were sent to institute of celestial mechanics and ephemerides computation.

Table 2. Condition of observation of low-elongation NEAs

Number	Solar elongation °	mag	App. motion "/min
3199	36	17.6	2.5
1999HF1	43	16.5	4.9
2014HQ124	45	17	18.6

The (O-C) of position of low elongation NEAs obtained in RI NAO and other observatory are represented in the figure 1. (O-C) of RI NAO positions are within $\pm 1''$.

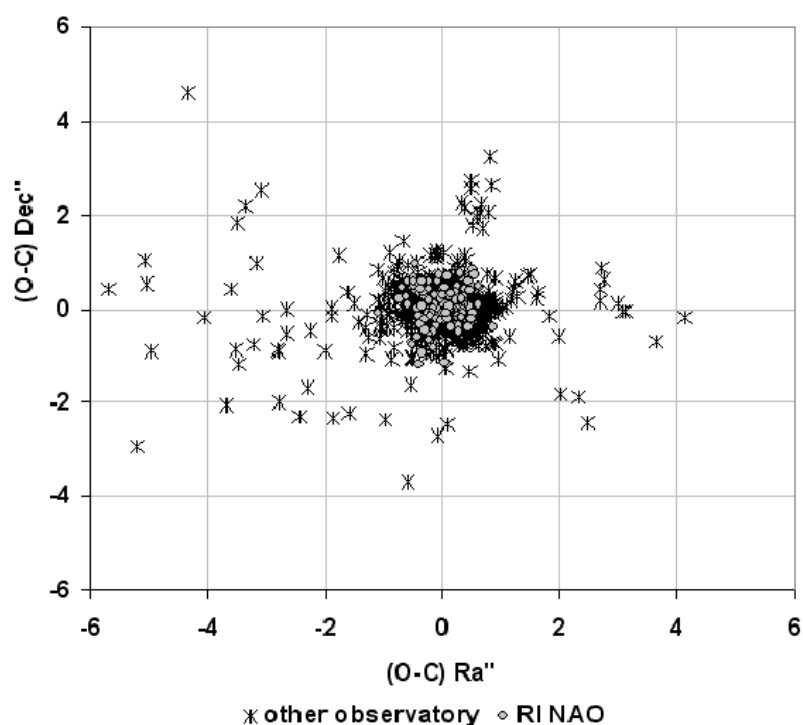


Fig. 1: (O-C) of position of low elongation NEAs

Observations of NEA 2014HQ124 were obtained within the framework of the GAIA-FUN-SSO campaigns of observation, results of observations were sent to institute of celestial mechanics and ephemerides computation.

Follow up observation of newly discovered NEAs

RI NAO has an experience in the follow –up observation NEAs. During 2012-2014 were obtained observation of 4 newly discovered NEAs. The previously and provisional designation, magnitude, apparent motion, distance to the Earth and diameter of NEA are represented in the table 3. For the observation of newly discovered NEA RI NAO obtained the thanks from Catalina sky survey.

Table 3. The observation condition of newly discovered NEAs

Previously designation	Provisional designation	mag	Apparent motion "/min	Delta a.e	Diameter m
TT2E495	2012 TG53	17.3	27.5	0.03	60-150
TT2ED76	2005JU1	17.3	10.8	0.08	140-320
VJA8CAE	2014JO25	17.5	7.6	0.2	410-920
S003564	2014 KP4	16.5	5.6	0.16	700-1600

Conclusion

Since 2008, 4000 positions of 219 near earth asteroids have been obtained on KT-50 telescope. The observation of 15 small size NEAs (less then 140 m) were received. Observation of 3 low-elongation NEA with solar elongation less then 45° were obtained, (O-C) of position are within $\pm 1''$. RI NAO has an experience in follow up observation of newly discovered NEAs.

References

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