KLENOT – PRACTICAL USE OF SOLAR SYSTEM DYNAMICS IN FOLLOW-UP ASTROMETRY OBSERVATIONS OF SMALL SOLAR SYSTEM BODIES

M. KOČER, J. TICHÁ, M. TICHÝ
Kleť Observatory
Zátkovo nábřeží 4, 370 01 České Budějovice, Czech Republic
e-mail: kocer@klet.cz, www: http://www.klet.cz/

ABSTRACT. The KLENOT project is a project of the Kleť Observatory, Czech Republic, devoted to astrometric observations of Near Earth objects, distant objects and comets.

The improved effort of the large NEO surveys resulting in an increasing number of newly discovered NEOs calls for continuous follow-up astrometry to secure an accurate orbit determination of discovered bodies first in discovery opposition and then during next apparitions. Considering this urgent need of astrometric follow-up, the fact that many of these targets are fainter then magnitude $m_V = 20.0^m$ and our results and experience in minor planet and comet CCD astrometry done at Kleť since 1993, we decided to bring into operation a new 1-m class facility working on a permanent basis - the KLENOT telescope. The regular observing of the telescope started in March 2002 (the MPC code 246).

We discuss here methods and techniques we use for follow-up astrometry. Some of the practical results are also mentioned.

1. KLENOT PROJECT

Kleť Observatory Near Earth and Other Unusual Objects Observations Team (and Telescope) project goals:

- Confirmatory observations of newly discovered fainter NEO candidates
  Some of new search facilities produce discoveries fainter than $m_V = 20^m$ (for example 1.8-m Spacewatch II, 1.2-m Palomar/NEAT) which need a larger telescope for confirmation and early follow-up. A 1-m class telescope is also very suitable for confirmation of very fast moving objects and our larger FOV enables to search for NEO candidates having a larger ephemeris uncertainty.

- Follow-up astrometry of poorly observed NEOs
  It is necessary to observe newly discovered NEOs in a longer arc during the discovery opposition when they get fainter. Special attention is given to "virtual Impactors" and PHAs, target of future space missions or radar observations. On the other hand, it is necessary to find and use an optimal observing strategy to maximize orbit improvement of each asteroid.

- Recoveries of NEOs in the second opposition
  For the determination of reliable orbits it is required to observe asteroids in more then one

opposition. If the observed arc in a discovery apparition is long enough, the chance for a recovery in the next apparition is good. If the observed arc at single opposition is not so good, we plan to search along the line of variation. For this purpose a larger field of view is an advantage.

- Follow-up astrometry of other unusual objects (Centaurs and transneptunian objects)
- Detection of cometary features of a newly discovered objects
- Search for new asteroids
- Follow-up of Gamma-ray burst (GRB) optical counterparts

2. KLENOT TELESCOPE

The KLENOT telescope (1.06-m f/3) was built using an existing dome and infrastructure of the Kleť Observatory. The original mounting was upgraded and the optoelectronical control system was added. The telescope is equipped by CCD camera Photometrics Series 30 (chip SITe 003B 1024×1024 pixels, pixel size 24 microns, liquid nitrogen cooling) so that the final field of view of the telescope is 33 x 33 arcminutes. The limiting magnitude is $m_V = 22^m$ for 180-sec exposure time in standard weather condition.

3. TECHNOLOGY

A special software package has been developed for the KLENOT project at the Kleť Observatory using a combination of programs running both on Linux and Windows platforms. The system consists of web-based observation planing tools (program `ephem`), data-acquisition, CCD camera control and data processing tools (programs `blink`, `astrometry`, `residua` and `orbit`).

4. RESULTS

The regular observations of the KLENOT project started in March 2002. By September 2003 14.720 astrometric positions of Solar System objects has been obtained (and published to MPC); 4303 of them have been observations of NEAs (412 Atens, 2420 Apollos, 1471 Amors) and 755 have been observations of comets. Other important results of the KLENOT project are recoveries of 12 NEAs, recoveries of comets `C/2003 A1`, `C/2003 A2` and `100P` as well as the discovery of Apollo-type asteroid `2002 LK`.

Acknowledgments. This work has been sponsored by The Grant Agency of the Czech Republic Reg. No. 205/98/0266, The 2000 NEO Shoemaker Grant of The Planetary Society, and The Grant Agency of the Czech Republic Reg. No. 205/02/P114.

5. REFERENCES

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