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Committee on the Peaceful Uses of Outer Space

Information on research in the field of near-Earth objects carried out by member States, international organizations and other entities

Note by the Secretariat

Addendum

II. Replies received from member States

Czech Republic

[Original: English]

[6 January 2011]

Near-Earth object (NEO) research is an expanding field of astronomy, important both for solar system science and for protecting human society from asteroid and comet hazards. An integral part of NEO research is astrometric follow-up for precise orbit computation and for evaluating future close encounters with the Earth, including possible impact solutions. Two institutions in the Czech Republic are deeply involved in NEO-related activities.

The Klet Observatory in the South Bohemia region (www.klet.org) has maintained the observing programme devoted to near-Earth asteroids (NEAs) and comets since 1992. It has ranked among the world's most prolific professional NEO follow-up programmes. The KLENOT project of the Klet Observatory was started in 2002 to confirm and follow up fainter and fast-moving NEOs, as well as to watch and study the behaviour, outbursts, fragmentation or splitting of near-Earth comets. A 1.06-m KLENOT telescope was built for that purpose. Equipment, technology, software and an observing strategy have been developed for the project.

Results obtained during the first phase of the KLENOT project, from March 2002 to September 2008, during 346 observing nights, consisted of 13,342 positions of 1,369 NEAs, 222 of which were potentially hazardous asteroids (PHAs) and 157 of which were virtual impactors (VIs) at the time of observation. Thirty-four newly discovered comets were confirmed. A nucleus duplicity of comet C/2004 S1 (Van Ness) was detected, and astrometric measurements of fragments of comet 73P/Schwassmann-Wachmann 3 during its close approach to the Earth in 2006 were provided. As a by-product, several NEAs and other unusual objects were discovered.

A fundamental improvement of the KLENOT telescope was started in autumn 2008. The new computer-controlled mount will substantially increase telescope-time efficiency and the number, accuracy and limiting magnitude of observations. Special software has been upgraded for processing and developed for co-adding of multi-TIFF images. Future plans reflect also the role of astrometric follow-up in connection with the next-generation surveys all over the world. The first test images of this KLENOT telescope were obtained in July 2010, and the system (hardware and software) is now being adjusted. In the meantime, a 0.57-m reflector in the second dome at Klet has been used for selected astrometric observations.

Moreover, one of the most important duties of NEO scientists and research institutions is to maintain contact with the general public and the media. NEO-related issues have outstanding educational value and outreach potential. Both the results of the Klet Observatory and our educational activities play a role in providing clear, relevant and up-to-date information about NEO research and hazards, mainly in the Czech Republic and the Central European region.

Asteroid studies at the Astronomical Institute (www.asu.cas.cz/interplanetary-matter-department) of the Academy of Sciences of the Czech Republic are oriented to the physical study of asteroids, which is one of the most important research topics at the Institute. As the NEA population is highly dynamic and many NEA properties are derived from their sources in the main asteroid belt between Mars and Jupiter, scientists from the Institute study both of these related asteroid populations.

The main focus of the Institute is on deriving asteroid properties and investigating mechanisms of asteroid formation and evolution. In its studies it closely collaborates with a number of researchers around the world, so many of its findings are a result of teamwork involving collaborators from several countries.[1]

Using extensive photometric observational data, scientists from the Institute found that asteroids fission when they are spun up to critical rotation frequency and form asteroid pairs. Bound binary asteroid systems show similar characteristics, with angular momentum content close to the critical limit for a body in a gravity regime, suggesting that they have formed from the disintegration or mass shedding of parent bodies spinning at the critical rate. A mechanism to spin the asteroid up to

[1] For some of the most important recent findings, see Pravec, P., D. Vokrouhlický, D. Polishook, D. J. Scheeres, A. W. Harris, A. Galád, O. Vaduvescu, F. Pozo, A. Barr, P. Longa, F. Vachier, F. Colas, D. P. Pray, J. Pollock, D. Reichart, K. Ivarsen, J. Haislip, A. LaCluyze, P. Kušnirák, T. Henych, F. Marchis, B. Macomber, S. A. Jacobson, Yu. N. Krugly, A. V. Sergeev, A. Leroy, 2010, “Formation of asteroid pairs by rotational fission”, *Nature* 466, 1085-1088; Pravec, P., D. Vokrouhlický, 2009, “Significance analysis of asteroid pairs”, *Icarus* 204, 580-588; Scheirich, P., P. Pravec, 2009, “Modeling of lightcurves of binary asteroids”, *Icarus* 200, 531-547; Pravec, P., et al., 2008, “Spin rate distribution of small asteroids”, *Icarus* 197, 497-504.

its critical rotation frequency is provided by the non-gravitational Yarkovsky–O'Keefe–Radzievskii–Paddack (YORP) effect of re-radiaton of absorbed solar light energy from an irregular body. An important implication of the studies of asteroid pairs, both bound and separated, is that asteroids are predominantly weak structures that are composed of pieces held together by self-gravitation only, with zero or negligible global tensile strength.