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Item 12 of the provisional agenda*
Near-Earth objects

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

Note by the Secretariat

I. Introduction

1. In accordance with the multi-year workplan adopted by the Scientific and Technical Subcommittee of the Committee on the Peaceful Uses of Outer Space at its forty-fifth session, in 2008 (A/AC.105/911, annex III, para. 11), and extended by the Subcommittee at its forty-eighth session in 2011 (A/AC.105/987, annex III, para. 9), Member States, international organizations and other entities were invited to submit information on research in the field of near-Earth objects for the consideration of the Working Group on Near-Earth Objects, to be reconvened at the fiftieth session of the Subcommittee.

2. The present document contains information received from Germany and Japan, and the Committee on Space Research, the International Astronomical Union and the Secure World Foundation.

* A/AC.105/C.1/L.328.

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II. Replies received from Member States

Germany

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[29 October 2012]

The national activities listed below are based on the strong involvement of the Institute of Planetary Research of the German Aerospace Centre (DLR).

DLR uses the Spitzer SpaceTelescope of the National Aeronautics and Space Administration (NASA) for an infrared survey ("ExploreNEOs") of the physical properties of 750 near-Earth objects, as part of an international team.

A major contribution of DLR in the field of near-Earth object research is the development and verification of asteroid thermal models and analysis procedures, to facilitate the derivation of object sizes and albedos. Procedures developed at DLR are used in both the Spitzer ExploreNEOs and the NASA NEOWISE projects. An analysis of the Spitzer data, together with published results from the NEOWISE project of NASA, is currently under way to provide insight into the physical properties of potentially hazardous near-Earth objects for the purposes of the NEOShield project.

In cooperation with the Calar Alto Observatory (Spain), DLR has signed a contract to operate, for 100 nights per year for three years, the remotely controlled 1.2 m telescope for optical photometric and astrometric observations of near-Earth objects and other asteroids and comets. The first observing run started in April 2009. A second observing period, from 2012 to 2015, was successfully negotiated.

The NEOShield project (see www.neoshield.net), coordinated by DLR, was kicked off in January 2012. It is a major new international research initiative on near-Earth objects, funded by the European Commission within its Seventh Framework Programme (2007-2013). The main aim of NEOShield is to prepare the way for a space mission to test our ability to prevent the impact with the Earth of a threatening near-Earth object. The NEOShield Consortium consists of 13 partners and includes leading United States and Russian space organizations. Besides DLR, the Fraunhofer Ernst Mach Institute and Astrium GMBH are involved on the German side. While an actual mitigation demonstration mission is financially beyond the scope of the present NEOShield project, the goal is to provide the first detailed designs of appropriate demo missions for the kinetic impactor, gravity tractor and, possibly, other mitigation concepts, sufficiently detailed to facilitate the rapid development of actual demo missions in subsequent rounds of project funding within a European or international framework.

An online database of physical properties of near-Earth objects is maintained at DLR (see http://earn.dlr.de/nea). Physical data for near-Earth objects, such as size, albedo and rotation period, derived from appropriate publications, are entered into the database as they become available, on a daily basis. Work on the database is supported by the Space Situational Awareness programme of the European Space Agency (ESA). Close cooperation with the NEOShield Project has been established. As at September 2012, the database contains data on the physical properties of

about 10 per cent of the known near-Earth object population, and a literature dataset of more than 1,200 entries.

In cooperation with the Technical University of Braunschweig and the Observatoire de la Côte d'Azur in Nice, France, DLR is participating in a project to generate a new model for a synthetic near-Earth object population (NEO-POP) under an ESA contract, starting in July 2012.

DLR is involved in the operation of a network of all-sky cameras that record the tracks of large meteoroids colliding with the Earth. The European Fireball Network (see www.dlr.de/pf/desktopdefault.aspx/tabid-623) provides data for studies of the meteoroid mass flux near Earth and the probability of collisions with larger bodies. The cameras routinely monitor the night sky over Central Europe. The network comprises 11 camera stations in the Czech Republic, 2 in the Slovak Republic, 2 in Austria and 17 camera stations in Germany, France, Luxembourg and the Netherlands, deployed at approximately 100-km intervals to cover a total area of 106 km^2. In 2011, the German-supervised part of the network detected 59 fireballs, significantly above average.

As part of a German-French contribution to the Japanese asteroid sample-return mission Hayabusa-2, DLR provides the Mobile Asteroid Surface Scout (MASCOT), which is an asteroid hopping lander vehicle, and two of its four science payloads. Surface data generated by the MASCOT instrument suite will serve to provide information for the improvement of models characterizing the physical properties of potentially hazardous near-Earth objects, in particular regarding the development and verification of asteroid thermal models, porosity models and analysis procedures, to facilitate the derivation of object sizes and albedos, as well as density and mass estimates from remote observations. Detailed and sound knowledge of asteroid surface properties is vital to every kind of mitigation activity. More information on MASCOT is available from www.dlr.de/irs/en/desktopdefault.aspx/tabid-7902/13482_read-34316.

Japan

[Original: English]
[18 October 2012]

Project on near-Earth objects

Japanese near-Earth object activities started with the establishment of the Japan Spaceguard Association (JSGA) in 1996. JSGA constructed a 1-metre-wide field telescope for near-Earth object detection, which became operational in 2002 and was used mainly for follow-up observations. JSGA improved the telescope in 2006, and it is now able to detect near-Earth objects down to a magnitude of 20.5, which is comparable to detections by the Catalina Sky Survey and the Spacewatch programme in the United States of America. A list of near-Earth object follow-up observations is shown in the table below.

Near-Earth object observations by the Japan Spaceguard Association (as at August 2012)

	Near-Earth asteroid			*Comets*	
Year	*Number of observed objects*	*Number of position measurements*	*Sum of position measurements*	*Number of observed objects*	*Sum of position measurements*
2000	23	205	4 240	20	113
2001	29	560	5 907	16	275
2002	24	243	2 018	13	339
2003	54	567	4 938	18	165
2004	23	233	2 908	4	20
2005	8	42	2 431	0	0
2006	25	297	3 224	5	66
2007	34	408	7 219	15	108
2008	31	162	4 534	14	110
2009	26	138	5 796	7	37
2010	135	924	3 545	10	50
2011	248	1 740	3 229	23	229
2012	106	705	387	13	73
Total	**766**	**6 224**	**50 376**	**158**	**1 585**

JSGA has performed various research and educational activities over the past 10 years. Among them, light curve observations and multiband photometry for 107P/Wilson-Harrington of near-Earth objects were presented, and the results have shown the physical properties of candidate objects for future asteroid exploration. JSGA also presented a new Wi filter, which is optimized for the imaging of small solar system bodies.

In addition, for public outreach, JSGA has produced a practical educational package, which is available in Japanese, English and Spanish, on near-Earth object detection and has published two books, as well as many articles in journals and newspapers on the topic. A lecture was held to mark the first anniversary of the Hayabusa capsule returning to Earth. In 2012, the “Annular solar eclipse festival in Ebina” took place to promote further understanding of the importance of the Spaceguard programme among the public. JSGA organized lectures on the theme “Spaceguard 2012” in four different locations in Japan (in Kumamoto, Okayama, Nagoya and Ibaraki) and published the fifth issue of its bulletin, *Spaceguard Research*.

Hayabusa mission

Another important near-Earth object activity was the Hayabusa mission to the near-Earth object Itokawa. The scientific purpose of the mission was to acquire information on the mysteries behind the genesis of the solar system and on possible evidence of life; to achieve this, technology to bring back samples of asteroids was essential. Hayabusa reached Itokawa in 2005 and collected many images and other scientific data; it also attempted to touch down and collect surface material.

On 13 June 2010, the asteroid-sample capsule of the Hayabusa spacecraft returned to Earth containing the surface material of Itokawa. The material was analysed by the analysis team of the Hayabusa Science Team. The results of the mission are important not only for science but also for Spaceguard, as Itokawa is an asteroid of the type that may come close to the Earth and this mission is the first to have studied such an asteroid.

In January 2012, the Japan Aerospace Exploration Agency (JAXA) issued a worldwide announcement of opportunity concerning research on the sample. Out of 31 research proposals, 17 were selected. The involvement of experts throughout the world is expected to bring groundbreaking results.

JAXA is now developing another near-Earth object sample return mission, Hayabusa-2, which could provide information about another type of near-Earth object, the assumed C-type asteroid, which is a different type of near-Earth object from Itokawa. Hayabusa-2 is planned for launch in 2014, with an expected arrival at the target asteroid in 2018 and an expected return to Earth in 2020.

III. Replies received from international organizations and other entities

Committee on Space Research

[Original: English]
[18 October 2012]

Near-Earth objects are objects orbiting the Earth at perihelion distances of less than 1.3 astronomical units. The near-Earth object population is constantly evolving and being replenished from the main asteroid belt and cometary reservoirs. It consists of objects with a variety of compositions and internal structures. As at 18 October 2012, 9,196 near-Earth objects had been discovered. Among them, some 981 were asteroids with a diameter of approximately 1 km or more, and 1,335 had been classified as potentially hazardous asteroids, indicating a possibility that they might threaten the Earth. The number of near-Earth objects discovered per year is shown in the original document submitted by the Committee on Space Research, which can be found on the website of the Office for Outer Space Affairs of the Secretariat (www.unoosa.org).

Nowadays, near-Earth objects are discovered through automated, ground-based observational programmes. The Panoramic Survey Telescope and Rapid Response System (Pan-STARRS) is an astronomical survey that is continuously conducting astrometry and photometry of much of the sky to detect near-Earth objects that could threaten the Earth.

The NASA Wide-field Infrared Survey Explorer (WISE), although designed primarily for astrophysics science objectives, is providing a large amount of data on small objects. The WISE all-sky survey is also detecting most of the known main belt asteroids, providing accurate radii and albedos for over 100,000 objects and detecting many new ones. The NEOWISE programme, which is a supplementary analysis programme, is also discovering and characterizing many new near-Earth objects on a daily basis.

Space missions involving near-Earth objects

The Origins Spectral Interpretation Resource Identification Security Regolith Explorer project was among the three missions selected by NASA in 2010 for the second round of the next New Frontiers mission competition. It is designed to orbit a primitive near-Earth asteroid, 1999 RQ36, and bring a sample back to Earth for study.

The MarcoPolo-R mission has been selected for the assessment phase for the third medium-class mission of the European Space Agency. The primary objective of the MarcoPolo-R mission is to return a sample from a near-Earth asteroid.

Potentially hazardous asteroids

As at October 2012, two potentially hazardous asteroids, classified with level 1 (no unusual level of danger) under the Torino Impact Hazard Scale, are known and are being monitored: 2011 AG5 and 2007 VK184.

International Astronomical Union

[Original: English]
[11 November 2012]

Activities of the International Astronomical Union Minor Planet Center

In 2012, there were many activities at the Minor Planet Center (MPC). By November 2012, MPC had 95,800,000 observation lines on minor planets in its database. The orbits of over 595,000 objects have been determined. The optical ground-based near-Earth object surveys vigorously continued their operations. By 1 November 2012, the number of near-Earth objects in the MPC database was 9,254. The near-Earth object discovery rate is about 900 per year, of which about 2 per cent are larger than 1 km in diameter.

MPC web pages (see www.minorplanetcenter.org/iau/mpc.html) continue to be served by a high-powered LINUX cluster. This has reduced latency to nearly zero for the return of ephemerides, observations and orbits. MPC is currently capable of serving a few million page views per day with no delay. Its two blogs continue: one to assist the worldwide follow-up to discoveries of new near-Earth objects; and the other as the main blog for MPC. MPC continues improving operations, particularly in the area of short-term impact monitoring.

The Panoramic Survey Telescope and Rapid Response System (Pan-STARRS) survey project in Hawaii (United States) has been receiving more telescope time for observing near-Earth objects and, as such, the discovery rate of all objects is increasing (see http://pan-starrs.ifa.hawaii.edu/public).

The Catalina Sky Survey in California (United States) plans to have a new 1-m follow-up telescope online that should augment its capabilities (www.lpl.arizona.edu/css).

The Siding Spring Survey in Australia (www.mso.anu.edu.au/~rmn), which is one of the best near-Earth object surveys worldwide, might be out of funding for near-Earth object research and observations starting in calendar year 2013. The

Siding Spring Survey has been the only active near-Earth object survey in the southern hemisphere.

Twenty-eighth General Assembly of the International Astronomical Union

At the twenty-eighth General Assembly of the International Astronomical Union, held in Beijing from 20 to 31 August 2012, a special session on "The impact hazard: current activities and future plans" was organized by the IAU Division III Working Group on Near-Earth Objects, covering astronomical aspects of the hazards of near-Earth objects (see http://adams.dm.unipi.it/iausps7).

The twenty-eighth IAU General Assembly also adopted resolution B3, on the establishment of an international near-Earth object early warning system, as proposed by the Working Group, in which it recognized that there was now ample evidence that the probability of catastrophic impacts of near-Earth objects with the Earth, potentially highly destructive to life, and for humankind in particular, was not negligible and that appropriate actions were being developed to avoid such catastrophes; that, for the largest near-Earth objects, thanks to the efforts of the astronomical community and of several space agencies, the cataloguing of the potentially hazardous ones, the monitoring of their impact possibilities and the analysis of technologically feasible mitigations were reaching a satisfactory level; that even the impact of small- to moderate-sized objects represented a great threat to our civilizations and to the international community; and that knowledge of the number, size and orbital behaviour of smaller objects was still very limited, thus not allowing any reasonable anticipation of the likelihood of future impacts.

Also in resolution B3, the IAU General Assembly noted that near-Earth objects were a threat to all nations, and therefore that all nations should contribute to averting that threat. It recommended that IAU national members work with the United Nations Committee on the Peaceful Uses of Outer Space and the International Council for Science to coordinate and collaborate on the establishment of an international near-Earth object early warning system, relying on the scientific and technical advice of the relevant members of the astronomical community, the main purpose of which was the reliable identification of potential collisions of near-Earth objects with the Earth and the communication of the relevant parameters to suitable decision makers of the State(s) involved (see http://info.bao.ac.cn/download/astronomy/IAU2012/newspaper/IHissue09.pdf, p. 4).

Web page on near-Earth asteroids

The International Astronomical Union website continues to have a page on near-Earth asteroids (www.iau.org/public/nea/), which includes information on past and future approaches of near-Earth asteroids close to the Earth, milestones in NEA research and related conferences, as well as scientific literature.

Secure World Foundation

[Original: English]
[26 September 2012]

The Secure World Foundation (SWF) has been working to facilitate discussions on governance issues related to the deflection and mitigation of potentially threatening near-Earth objects. During the past year, SWF, in support of the Action Team on Near-Earth Objects of the Committee on the Peaceful Uses of Outer Space, hosted a workshop on near-Earth objects and the media, which examined how an information, analysis and warning network for near-Earth objects might best communicate with policymakers and with the general public. The report from that workshop was presented at the forty-ninth session of the Scientific and Technical Subcommittee, in 2012. The full report was distributed during the fifty-fifth session of the Committee on the Peaceful Uses of Outer Space, in June 2012, and is available on SWF website (http://swfound.org).

During 2012, SWF participated fully in the deliberations of the Action Team on Near-Earth Objects. It also presented the results of the workshop on near-Earth objects and the media at the 2012 International Astronautical Congress in Naples, Italy.