The achievements of the NEOShield project and the promise of NEOShield-2

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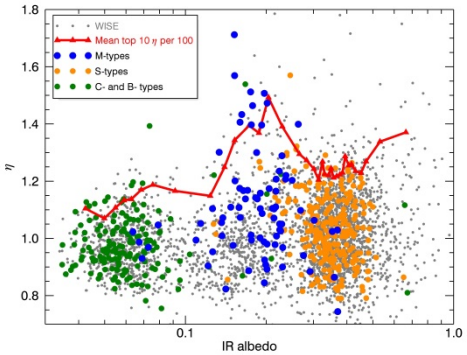
NEOShield

- November 2010: Proposal submitted in response to the European Commission's FP7-Space-2011 call for research proposals. Category:

"Prevention of impacts from near-Earth objects (NEOs) on our planet"

- March 2011: After assessment, NEOShield topped the list of 6 proposals submitted in the category.
- November 2011: Negotiations with the European Commission were successfully concluded with the signing by the EC of the NEOShield Grant Agreement.
- January 2012: Kick off meeting
- June 2015: End of funding period. Duration: 3.5 years.
- Funds provided by the European Commission = 4.0 million euro.
- Total volume of NEOShield funding = 5.8 million euro.

The NEOShield Project



Main themes/results of the project:

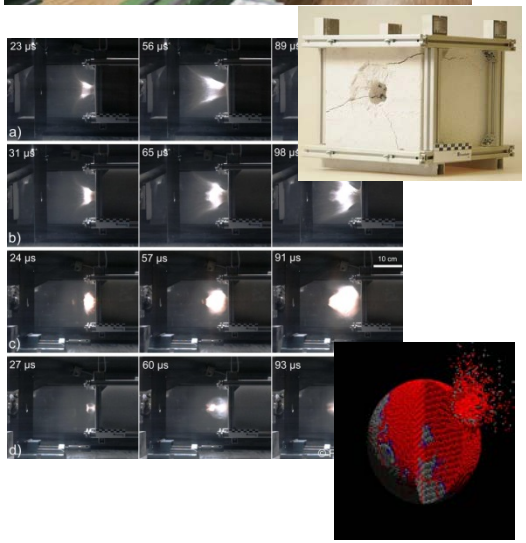
Science

- **Physical properties of NEOs have been analyzed from the point of view of mitigation requirements.**
  See Perna et al. (O, Tues.)

- **Lab. experiments on impacts into asteroid surface analogue materials, and measurements of material properties, have been carried out, enabling impact modeling at small scales to be validated.**
  See Hupfer et al. (P)

- **Numerical simulations have enabled impact and momentum-transfer modeling to be scaled to realistic NEO sizes.**
  See Jutzi et al. (P); Schwartz et al. (O, Wed.)

- **Mitigation precursor reconnaissance requirements, strategy, instrumentation, for ground-based facilities and space missions, have been determined.**



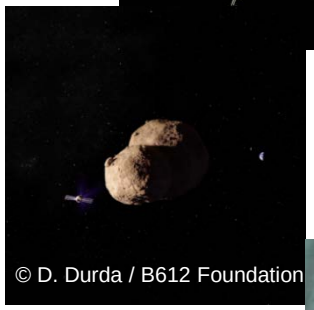
The NEOShield Project

Main themes/results of the project (continued):

2. NEO deflection demonstration missions

- **Potential NEO targets for deflection test missions have been identified and, as far as possible, characterized.**

- **Detailed mission designs of technically and financially realistic missions to demonstrate the effectiveness of deflection methods have been provided for the kinetic impactor, gravity tractor, and blast deflection techniques.**
  See Kersten et al. (O, Thurs.); Drube et al. (P); Faber et al. (O, Wed.); Afanasieva (P); Kolyuka et al. (P)



3. Global response campaign roadmap

- **Impact threat response strategy: Software tools to aid in response planning and a global response strategy have been developed.**
  See Eggl et al. (O, Wed.); Eggl et al. (P); Cano et al. (O, Wed.)

The NEOShield Consortium

Participant organisation	Leading personnel	Country
German Aerospace Center (DLR), Berlin (*coordinating partner*)	A. W. Harris, L. Drube	Germany
Observatoire de Paris	LESIA: M. A. Barucci, M. Fulchignoni IMCCE: D. Hestroffer, W. Thuillot	France
Centre National de la Recherche Scientifique (Observatoire de la Côte d′Azur, Nice)	P. Michel	France
Open University	S. F. Green	UK
Fraunhofer – Ernst-Mach-Institute, Freiburg	F. Schäfer, T. Hoerth	Germany
Queen′s University Belfast	A. Fitzsimmons	UK
Astrium (Airbus D&S) (*supervisory interface for technical work packages*)	A. Falke, U. Johann M. Chapuy, E. Kervendal M. Trichas	Germany France UK
Elecnor Deimos, Madrid	J. L. Cano	Spain
Carl Sagan Center, SETI Institute	D. Morrison	USA
TsNIIMash, Roscosmos	Y. Lipnitsky, S. Meshcheryakov,	Russia
University of Surrey	V. Lappas, N. Ummen	UK

www.neoshield.net

See Hermsen et al. (O, Thurs.)

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THE TEAM
The Partners in the NEOShield Project

The NEOShield consortium consists of a number of world-leading European research institutes, the most NEO-experienced European space industry, and leading US and Russian space research institutes. The project benefits from a broad combination of scientific/technical expertise and experience, and the management competence of major international players in the space field. The NEOShield project is coordinated by the German Aerospace Center's Institute of Planetary Research.

Click to learn more about any of the Partners, or scroll down to read about them all.

- DLR Institute of Planetary Research
- Observatoire de Paris
- Centre National de la Recherche Scientifique
- The Open University
- Fraunhofer Institute for High-Speed Dynamics, Ernst-Mach-Institut (EMI)
- Queen's University Belfast
- Astrium
- Deimos Space
- SETI Institute Corporation, Carl Sagan Center
- Russian Federal Space Agency, Central Research Institute of Machine Building (TsNIImash)
- Surrey Space Centre, University Of Surrey

DLR Institute of Planetary Research
http://www.dlr.de/pf/en

NEOShield Coordinator.

The DLR Institute of Planetary Research (Institut für Planetenforschung) studies planets, the planets' moons, asteroids and comets, researching their internal structure, formation and evolution. The research programs of the institute are based on both ground and space based remote sensing, as well as in-situ measurements using instruments carried on spacecraft. The institute also undertakes theoretical modelling and laboratory experiments.

The work of the institute covers concept studies, the instrument development and calibration, instrument operation on spacecraft, observations with ground-based and orbiting telescopes, and the acquisition, reduction, analysis, archiving and distribution of scientific data.

DLR (Deutsches Zentrum für Luft- und Raumfahrt e.V., German Aerospace Center) is Germany's national research centre for aeronautics and space. Its extensive research and development work in aeronautics, space, transportation and energy is integrated into national and international cooperative ventures. As Germany's Space Agency, the German federal government has given DLR responsibility for the forward planning and implementation of the German space programme as well as international representation of Germany's interests.

THE NEOSHIELD PROJECT
- Project Overview
- The Team
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- Publications

NEXT CLOSE APPROACH

NEXT NEO CLOSE APPROACH:
1998 QE2 (1332m-2979m)
31 May 2013, 20:59 UTC
10.85 million km
(15.2 Lunar Distances)

MORE CLOSE APPROACHES

NEO BACKGROUND INFO

Want more information about Near Earth Objects?

NEO BACKGROUND INFO

QUICK LINKS

NEOShield

Some NEOShield Peer-Reviewed Publications (see www.neoshield.net)

- NEOShield - A global approach to near-Earth object impact threat mitigation. L. Drube, A. W. Harris, P. Michel, T. Hoerth, F. Schäfer, and D. Perna: 2015, In Handbook of Cosmic Hazards and Planetary Defence, Pelton, J. N. and Allahdadi, F (eds.), Springer-Verlag, Berlin, Heidelberg.
- How to find metal-rich asteroids. A. W. Harris, L. Drube: 2014, Astrophys. Journal Letters, 785, L4.
- Low delta-V near-Earth asteroids: A survey of suitable targets for space missions. S. Ieva, E. Dotto, D. Perna, M. A. Barucci, F. Bernardi, S. Fornasier, F. De Luise, E. Perozzi, A. Rossi and J. R. Brucato: 2014, Astronomy and Astrophysics, 569, A59.
- Hypervelocity impacts on asteroids and momentum transfer I. Numerical simulations using porous targets. M. Jutzi, P. Michel: 2014, Icarus, 229, pp. 247-253.
- Estimated efficiency of the deflection of a dangerous space object using an explosion or impact. S. A. Meshcheryakov, Y. M. Lipnitskii: 2015, Technical Physics, 60, 26-30.
- The near-Earth objects and their potential threat to our planet. D. Perna, A. Barucci, M. Fulchignoni: 2013, Astronomy and Astrophysics Review, 21, Issue 1, article 65.
- The triple near-Earth asteroid (153591) 2001 SN263: an ultra-blue, primitive target for the Aster space mission. D. Perna, A. Alvarez-Candal, S. Fornasier, Z. Kaňuchová, S. M. Giuliatti Winter, E. Vieira Neto and O. C. Winter: 2014, Astronomy and Astrophysics, 568, L6.
- Polyhedron tracking and gravity tractor asteroid deflection. N. Ummen, V. Lappas: 2014, Acta Astronautica, 104, Issue , pp. 106-124.

…….. more to come!

NEOShield-2

- **March 2014: Proposal submitted in response to the European Commission's Horizon 2020 PROTEC-2 call for research proposals. Category:**

"Access technologies and characterization for near-Earth objects"

- **August 2014: After assessment, NEOShield-2 topped the list of 11 proposals submitted in the category.**
- **November 2014: Negotiations with the European Commission were successfully concluded with the signing by the EC of the NEOShield-2 Grant Agreement.**
- **March 2015: Kick off meeting (telecon).**
- **September 2017: End of funding period. Duration: 2.5 years.**
- **Funds provided by the European Commission = 4.2 million euro.**
- **Total volume of NEOShield-2 funding ~ 6 million euro.**

The NEOShield-2 Project

Main themes/tasks of the project:

1. Science

- **Mitigation-relevant physical and compositional characterization of small NEOs (D = 50–300 m):** **Population of 200,000 objects remains largely unexplored. NEOShield-2 will carry out new observations and analyses of published data.**
  See Barucci et al. (P)

2. Technology

- **Development of guidance, navigation, control systems:** **for accurate targeting of a kinetic impactor into a small NEO.**
- **Orbiting, hovering, manoeuvring close to a small asteroid:** **NEOs have very weak gravity fields - appropriate autonomous control systems will be developed.**
- **Development of techniques for robotic exploration:** **surface material sampling and collection, sample return to Earth, etc.**

The NEOShield-2 Consortium

Participant organisation	Leading personnel	Country
Astrium (Airbus D&S) (*coordinating partner*)	A. Falke, U. Johann	Germany
German Aerospace Center (DLR), Berlin (*supervisory interface for scientific work packages*)	A. W. Harris, L. Drube	Germany
Astrium (Airbus D&S)	M. Chapuy, E. Kervendal, M. Trichas	France UK
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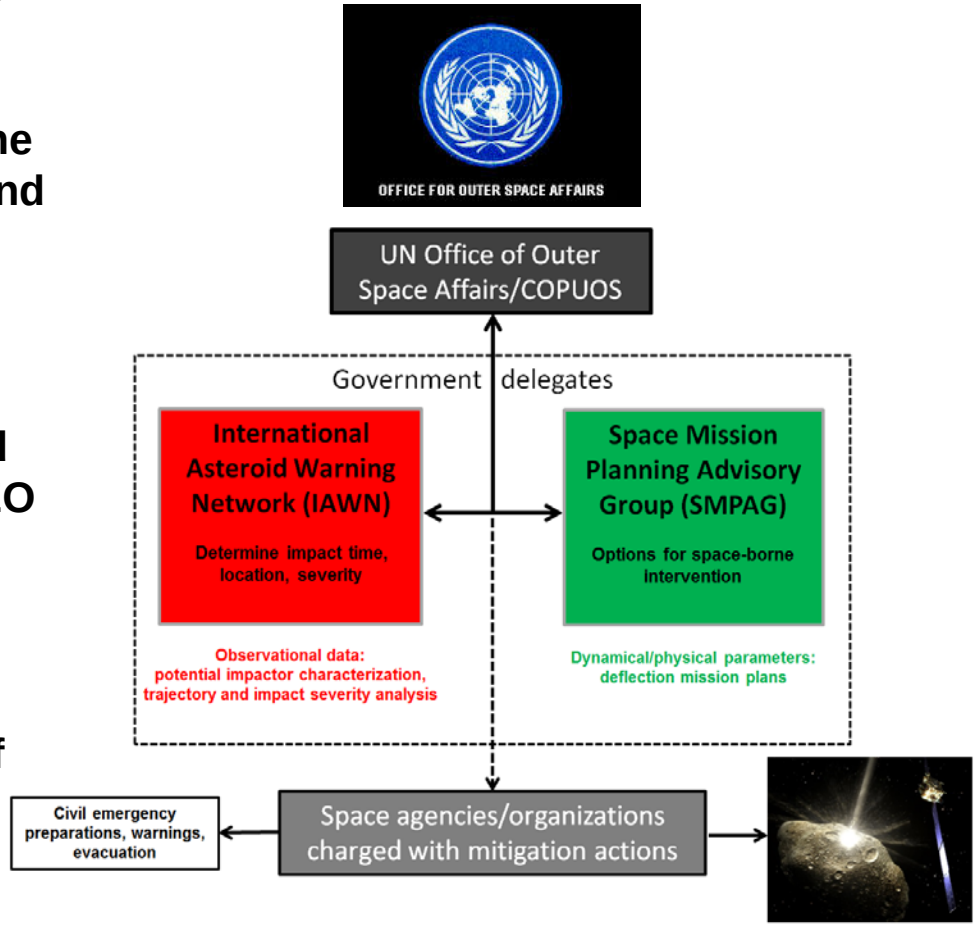
Fraunhofer – Ernst-Mach-Institute, Freiburg	F. Schäfer, T. Hoerth	Germany
GMV Aerospace and Defence SA, Madrid	M. Graziano, V. Barrena-Perez, J. Gil-Fernández	Spain
Istituto Nazionale di Astrofisica, Rome	E. Dotto, M. Lazzarin	Italy
Observatoire de Paris	LESIA: M. A. Barucci, M. Fulchignon, D. Perna IMCCE: D. Hestroffer, W. Thuillot	France
Queen′s University Belfast	A. Fitzsimmons	UK

UN-Sanctioned Impact-Hazard Activities

- **Partners in both NEOShield projects are members of IAWN and SMPAG.**
- **The interface of NEOShield-2 with the activities of ESA on the one hand, and the IAWN and SMPAG on the other, represents a unique coordinated strategy for NEO impact mitigation.**
- **An example for a global coordinated network of partners to tackle the NEO impact hazard?**
- **The recommendations of SMPAG concerning future space-mission-related work could form the basis of calls for research proposals by funding agencies, such as the EU.**



The NEOShield Projects

Concluding remark

EU funding facilitates collaboration of large interdisciplinary consortia

The NEOShield projects benefit from the close contact between:

- **scientists investigating the properties of NEOs, selecting targets for deflection test missions and studying post-deflection orbit evolution, and**
- **engineers developing spacecraft systems for NEO deflection techniques and designing realistic test missions.**