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NEOShield: Working towards an international near-Earth object mitigation demonstration mission

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1. Overview of the NEOShield project

NEOShield is a European-Union funded project to address impact hazard mitigation issues, coordinated by the German Aerospace Center, DLR. The NEOShield consortium consists of 13 research institutes, universities, and industrial partners from 6 countries and includes leading US and Russian space organizations. The primary aim of the project is to investigate in detail promising mitigation techniques, such as the kinetic impactor, blast deflection, and the gravity tractor, and devise feasible demonstration missions. Options for an international strategy for implementation when an actual impact threat arises will also be investigated.

The motivation for NEOShield arose partly from consistent statements made in recent years by organizations such as The National Research Council of the US (2010) and the International Academy of Astronautics (2009), urging governments and relevant agencies to fund research and conduct experiments leading to a space mission to test our ability to deflect a threatening NEO.

The NEOShield project is structured to enable the results of scientific investigations into the physical properties of near-Earth objects (NEOs) to flow into a subsequent technical phase, in which mitigation demonstration missions will be designed in sufficient detail to facilitate rapid development and launch by international partners in a later phase of funding.

2. Scientific work within the NEOShield Project

At the current early stage in the project, work is focused on examining the mitigation-relevant physical properties of the NEO population by means of statistical analyses of observational data, and laboratory experiments on asteroid surface analog materials. An important aim is to estimate the most likely properties of a future potential impactor that could trigger a mitigation action, and predict how such an object would respond to a mitigation attempt. While the properties of the next seriously hazardous object may turn out to be completely different to those we would expect on the basis of our statistical knowledge of the NEO population, we will attempt to narrow the range of the "expected properties" to provide a rational basis for the choice of objects to serve as targets in mitigation demonstration missions.

3. Mitigation demonstration mission

An important issue is whether the population of objects that are most likely to impact and trigger the first mitigation attempt differs in some way from the overall population of NEOs. One obvious question is that of size: NEOs discovered to date have diameters between a few meters and about 40 km. For objects with diameters below D = 50 m it seems likely, given current knowledge of terrestrial impacts, that an

atmospheric explosion would result (cf. the Tunguska event in 1908) and the decision taken by the authorities concerned would most likely be to tolerate it, with any mitigation effort being limited to evacuation of the predicted impact region. NEOs with D > 200 m have a statistical likelihood of impact of less than one per 10,000 years, rendering the necessity of a mitigation campaign against an object with D > 200 m in the foreseeable future highly unlikely. Therefore, the size of the object that will trigger the first space-borne mitigation action will probably be in the range 50 m - 200 m, much smaller than the sizes of NEOs for which most results on physical properties have been obtained to date.

In order for a mitigation demonstration to be convincing, the target object should be as realistic as possible, i.e. typical of the size and type of NEO we are likely to be faced with in the first space-borne mitigation campaign.

Note that the decision to mount a mitigation campaign will have to be taken years in advance of the predicted date of impact on the basis of a probability of impact. Decision makers will never have the luxury of absolute certainty. Even a moderate probability of a serious impact (1%, 10%, 30%?) may be considered justification for a mitigation action, which would greatly increase the frequency of mitigation missions above that expected from a naïve inspection of current impact probabilities.

The NEOShield project is funded with a total of 5.8 million euros for a period of 3.5 years. The kick-off meeting took place at the DLR Institute of Planetary Research, Berlin, in January 2012. We present a brief overview of the history and planned scope of the project, and results obtained to date.

References

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