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NEOSHIELD: FINDING SAFE HARBORS IN ASTEROID DEFLECTION MISSIONS

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ABSTRACT

Many strategies for deflecting potentially hazardous asteroids have been developed over the past decades. Depending on an asteroid's physical properties and the estimated time to collision, either impulsive deflection methods such as Kinetic Impacts or Nuclear Blast Deflection or slow push methods such as Gravity Tractors, Laser Ablation or Ion Beam Shepherds may be most suitable to avoid a disastrous impact. This has been shown, for instance, in the framework of the NEOShield project, an international initiative under European leadership aimed at developing a comprehensive picture of current asteroid deflection options. Constructing optimized end-to-end deflection mission designs is one of the topics addressed by the NEOShield consortium. Here we present results from a recent collaboration regarding the assessment and avoidance of post mitigation impact threats.
We argue that deflection mission designs should consider more than optimizing the miss distance between the Earth and the asteroid at the time of the potential impact. In fact, we propose to alter the orbit of a dangerous asteroid in such a way as to ensure that no encounter with the Earth over the next decades yields an unacceptable impact risk. Thus, scenarios where an emergency deflection action sets the asteroid on a trajectory that may lead to a later collision with the Earth can be avoided. To this end, we present a self consistent approach that integrates mission design and post mitigation impact risk assessment based on identifying so-called “safe harbors”. Those are regions in deflection phase space which guarantee that the mitigation mission will not only result in avoiding the primary impact, but also minimizes the collision probability with the Earth in the foreseeable future.
An example of such an optimal deflection shall serve to illustrate the proposed procedure.