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ADDRESSING IMMINENT IMPACTORS THREAT FROM DISTANT RETROGRADE ORBITS (DRO).

Abstract

Planetary Defence is gaining momentum after the launching toward the Didymos binary system of NASA DART, the first asteroid deflection mission, foreseeing also the deployment of ASI's LICIAcube. Moreover, the ESA Hera spacecraft, which will contribute to assessing the DART impact momentum transfer, is in full realization phase and the European Union has included the NEO hazard in its recently approved Space Programme. The aim of the EU is to complement the already established ESA Planetary Defence initiatives i.e. the NEO Coordination centre operations at ESRIN and the wide-field high-sensitivity Flyeye telescope realization. Finally, the ever-growing NEO discovery rate moves toward increasingly smaller objects passing close to our planet, thus posing new challenges in performing follow-up observations for determining their orbital and physical properties.

Within this framework, addressing the so called "imminent impactors" threat, posed by objects in the 10-40 m range in route of collision with the Earth, has become a key issue for planetary defence. Deflection capabilities are useless if a celestial body large enough to produce significant damage can *sneak up* on the Earth undetected, as could asteroids hiding by the Sun, lurking in the well-known blind spot that ground-based observations can never peer into. In this respect the significant increase in the warning time obtained by a telescope placed on a stable Distant Retrograde Obit (DRO) around the Earth has already been proven, and is now well established in the literature.

In this work the feasibility of a mission scenario foreseeing a constellation of four spacecraft in DRO is analysed, comparing several target orbits and different transfer strategies (including lunar swingbys). The more efficient orbital configurations in terms of accessibility and detection capabilities are then investigated and validated using case studies of historic asteroid undetected close encounters. Results prove that a DRO constellation would have been able to detect and refine the trajectory of the incoming objects with a substantial increase in warning time, by far exceeding the performances of the ground-based detection systems currently in place. The possibility of contributing to the physical characterization of an imminent impactor is also discussed, which is essential for building up an efficient rapid response system for civil protection purposes.