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MISSION ANALYSIS FOR THE ION BEAM DEFLECTION OF FICTITIOUS ASTEROID 2015PDC

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ABSTRACT

A realistic mission scenario for the deflection of fictitious asteroid 2015PDC is investigated that makes use of the ion beam shepherd concept as primary deflection technique with a possible synergy with a kinetic impactor or nuclear deflection device.
The proposed mission involves, first and foremost, the launch of a medium-size rendevous spacecraft equipped with at least two ionic thrusters that can serve as propulsion means for the interplanetary trajectory up to rendezvous with the asteroid and as contactless actuators for a possible follow-up deflection mission.
The asteroid, whose uncertainty ellipsoid is initially too large to establish whether (and how) it should be deflected, is reached by the rendezvous spacecraft after a low-thrust interplanetary trajectory of reasonable duration. Following rendezvous the spacecraft is placed in an orbit around the asteroid to estimate its mass, study its structure and composition and, crucially, reduce its uncertainty ellipsoid by ground tracking to confirm or rule out an impact.
Assuming that an impact is confirmed several deflection scenarios are considered based on the actual asteroid size. Ion beam deflection is considered for a small to medium size asteroid with the possibility of full deflection (the asteroid misses the Earth by a safe margin) or impact location adjustment (the impact footprint is diplaced to the nearest unpopulated region). For a larger asteroid the launch of a kinetic impactor mission or a nuclear device is considered with the employment of the rendezvous spaceraft to measure the deflection outcome and possibly to refine the deflection in case it is needed.

Critical technological aspects of the mission, including the design of the interplanetary rendezvous trajectory and the assessment of the ion beam deflection capability for different asteroid masses, are carefully investigated and discussed. Preliminary power and propulsion requirements for the deflecting spacecraft are also derived.

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