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☐ **Key International and Political Developments**
☐ **Advancements and Progress in NEO Discovery**
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Asteroid Deflection via Neutral Beam Emitting Spacecraft

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ABSTRACT

Currently there are two major categories of asteroid deflection methodologies: high impulse and slow-push. Each technology has benefits and drawbacks when compared as they offer practical solutions for different warning timescales. High impulse solutions, such as kinetic impactors and nuclear devices, are preferred when warning times are short and deflecting an asteroid away from an impact is the only objective. Slow-push methods, such as the enhanced gravity tractor (EGT), provide a means for finer control of asteroid deflection with a shorter time than earlier iterations of the gravity tractor concept. However, the EGT requires the surface of an asteroid to have several boulders to increase the effectiveness and decrease the time required for deflection. We cannot be certain as to the composition of most Near-Earth asteroids (NEAs) and coupled with the high rotation rate of some asteroids, the multitude and size of boulders on the surface will vary greatly thus increasing the uncertainty in predictions of the time required for deflection. Propulsive methods, such as the Ion Beam Shepherd (IBS), also allow for fine control of asteroids, but rely on a charged beam or quasineutral plasma impinging on the surface leading to sputtered particles that could follow the field lines back to the spacecraft, deposit, and adversely affect the spacecraft. We propose using a neutral beam for asteroid control (NBAC). NBAC is a high efficiency, moderate power propulsive method that uses several spacecraft to stabilize the asteroid's rotation rate and deflect the asteroid from an Earth impact. NBAC is designed such that it does not require a precursor mission and can be used to deflect moderately-sized asteroids over the course of several years. The concept of NBAC is that it is a bridge in the gap between kinetic impactors and EGT for deflection timescales and mission flexibility. In this paper, we introduce the concept of a neutral beam and its inherit benefits. We then discuss the system level mass, power, and duration requirements for the NBAC concept as well as the sensitivity of NBAC performance to asteroid characteristics. The design of a scaled tech demonstration of a high efficiency, moderate power neutral beam is also presented. This paper also discusses on the performance of NBAC against 2017 PDC given its uncertainty in size and densities. We provide estimates on the rotation state of 2017 PDC based upon the moments of inertia and size of the asteroid and the time to slow or stop these rotation rates using NBAC. We also investigate the max deflection of the asteroid and provide data on the latest time that NBAC could be used to deflect 2017 PDC given the uncertainty in its size and density. Additionally, as NBAC provides fine control, we discuss its use for moving asteroids to orbits that can be visited later for resource acquisition. (464)