PDC2023
Vienna, Austria

CREATING A CONTACT BINARY VIA SPACECRAFT IMPACT TO NEAR-EARTH BINARY ASTEROID (350751) 2002 AW

Colby C. Merrill[1], Carl J. Geiger[1], Abu T. M. Tahsin[1], Pruthvi Banginwar[2], Mason Peck[1], and Dmitry Savransky[1]
[1] *Sibley School of Mechanical and Aerospace Engineering, Cornell University, 124 Hoy Rd, Ithaca, NY 14853, USA, 1-607-255-3623, ccm242@cornell.edu, cjg275@cornell.edu, at664@cornell.edu, mp336@cornell.edu, ds264@cornell.edu*
[2] *School of Applied and Engineering Physics, Cornell University, 142 Sciences Dr, Ithaca, NY 14853, USA, 1-607-255-5198, pab272@cornell.edu*

Keywords: *planetary defense, binary asteroid, asteroid deflection, kinetic impactor, contact binary*

ABSTRACT

Contact binaries are ubiquitous in the solar system: the Kuiper belt, main belt, and near-Earth populations all house these complex aggregates. Though contact binaries account for approximately 10% of small bodies in the Solar System and can form in a number of ways, the formation of one has yet to be observed. We present a preliminary mission design to create a contact binary asteroid and observe its formation using a binary NEO system, a kinetic impactor, and an observer spacecraft. This mission serves both the planetary defense and planetary science communities; it will utilize planetary defense technology to provide unique observation opportunities. A binary system offers a convenient natural laboratory for this mission, as the ability to form a contact binary depends greatly on the size of the target and the proximity to its parent body. From a list of 80+ binary NEOs, binary asteroid system (350751) 2002 AW was chosen for this case study. A spacecraft can achieve rendezvous with this system from low-Earth orbit with a total $\Delta V < 4.5$ km/s and the system houses a 50 meter secondary (the lower bound of asteroid size for which a kinetic impactor might target). A pair of spacecraft will launch on the same launch vehicle and separate before asteroid impact. The two spacecraft are (1) an impactor that is virtually a build-to-print DART spacecraft and (2) an observer spacecraft that will rendezvous with the binary system and document the creation of the contact binary. The spacecraft impact must be designed such that it redirects the secondary into a collision course with the primary while not catastrophically disrupting the target asteroid. Impact parameters such as angle of impact, catastrophic disruption limit, and the β factor have all been considered. Among other design decisions, we present our target-selection methodology, launch-vehicle considerations, and launch window opportunities.