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A SWARM OF LASER SAILCRAFT TO OBSERVE
THE APOPHIS CLOSE APPROACH IN 2029

Abstract

Most potentially hazardous asteroids (PHA) are first detected immediately before a close approach to the Earth, and for many PHA basic parameters such as the size and rotation of the PHA and the existence any satellites are unknown. This lack of basic information would considerably complicate the planetary defense response to a possible impactor. While of course a dedicated spacecraft flyby could resolve these uncertainties, it would be expensive to keep a rocket system on standby for a dedicated launch to a newly discovered PHA.

We propose the development of gram-mass laser sailcraft for quick deployment to newly discovered PHA and other planetary defense targets, using MegaWatt (MW) IR lasers and 4 meter class optical telescopes. We also that this new technology be tested on April 13, 2029, when asteroid (99942) Apophis, a near-Earth asteroid more than 300 meters in diameter will pass close to the Earth. A mission to intercept Apophis would serve as an excellent precursor exercise for intercepting potentially hazardous asteroids. We want to intercept such asteroids well before their closest approach in order to acquire precise trajectory data, in order to accurately determine the orbit and rotation state of the body, and acquire images and other data to determine its makeup of the body - whether iron, stony, chondrite, or ice - and other data required to accurately plan potential courses of action in the case of a potential impactor.

We will describe a precursor mission to Apophis based on Breakthrough Starshot sailcraft developments which would use available technology to launch a set of laser-accelerated sail-craft to flyby and even intercept Apophis during its approach to Earth, returning imagery and trajectory data and possibly planting an RF beacon for Very Long Baseline Interferometry. This effort would demonstrate that launcher-launched light-sail craft are feasible and capable of fast-reaction missions and would demonstrate that they could be successfully used to intercept an Earth-approaching asteroid. Because a laser system could loft several sailcraft to reach apogee and dwell near the Apophis rendezvous regions for relatively extended periods (100's of seconds), it would be possible to have Apophis fly through a sailcraft swarm, providing a full view of this asteroid.

Once demonstrated, such sail-craft could be used for other missions as well, such as intercepting passing interstellar bodies, such as 1/I'Oumuamua, passing through the Solar System.