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Directed Energy Deflection Laboratory Measurements

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ABSTRACT

We report on laboratory studies of the effectiveness of directed energy planetary defense as a part of the DE-STAR (**D**irected **E**nergy **S**ystem for **T**argeting of **A**steroids and exploRation) program. DE-STAR (Lubin *et al*., 2014) and DE-STARLITE (Kosmo *et al*., 2014) are directed energy "stand-off" and "stand-on" programs, respectively. These systems consist of a modular array of kilowatt-class lasers powered by photovoltaics, and are capable of heating a spot on the surface of an asteroid to the point of vaporization. Mass ejection, as a plume of evaporated material, creates a reactionary thrust capable of diverting the asteroid's orbit. In a series of papers, we have developed a theoretical basis and described numerical simulations for determining the thrust produced by material evaporating from the surface of an asteroid (Lubin *et al*., 2014; Kosmo *et al*., 2014; Hughes *et al*., 2014; Johansson *et al*., 2014). In the DE-STAR concept, the asteroid itself is used as the deflection "propellant". We compare this approach to other proposed techniques. This study presents results of experiments designed to measure the thrust created by evaporation from a laser directed energy spot. We constructed a vacuum chamber to simulate space conditions, and installed a torsion balance that holds an "asteroid" sample. The sample is illumination with a fiber array laser with flux levels up to 60 MW/m^2 which allows us to simulate a mission level flux but on a small scale. We use a separate laser as well as a strain gauge torque sensor to readout the angular motion and can thus determine the thrust. We compare the measured thrust to the models will discuss scaling issues associated with small scale lab testing vs full scale missions.

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