PDC2017
Tokyo, Japan

IAA-PDC-17-03-P10

☐ **Key International and Political Developments**
☐ **Advancements and Progress in NEO Discovery**
☒ **NEO Characterization Results**
☐ **Deflection and Disruption Models & Testing**
☐ **Mission & Campaign Designs**
☐ **Impact Consequences**
☐ **Disaster Response**
☐ **Decision to Act**
☐ **Public Education & Communication**

DISTANT COMPOSITION DETECTION: DETERMINING NEO MAKEUP REMOTELY

Jonathan Madajian(1), Prashant Srinivasan(2), Gary B. Hughes(2), Philip Lubin(1), Sasha Cohen(1), Benton Miller(1), Daniel Brouwer(1), Jessie Su(1), Travis Brashears(3), and Qicheng Zhang(1)
(1)*University of California, Santa Barbara, CA, (805) 893-8418, lubin@deepspace.ucsb.edu*
(2)*California Polytechnic State University, San Luis Obispo, CA, gbhughes@calpoly.edu*
(3)*University of California, Berkeley, CA*

Keywords: *laser, ablation, standoff, composition, ftir,*

ABSTRACT

Understanding the composition of an incoming space object is crucial for potential defense efforts. This paper will discuss a method for standoff composition analysis of comets and asteroids and includes laboratory measurements that showcase this method's feasibility. With the use of a near-infrared (NIR) laser, a hot spot is generated on the surface of a near Earth object (NEO) of interest. The heated spot emits as a blackbody source, while at the same time evaporation and mass ejection are occurring at the spot. With laser energy in the range of ~10 MW/m^2, rocky materials in the target melt and evaporate to form an ablation plume over the laser spot; both molecular and atomic absorption of radiation emanating from the spot occur. The spot itself acts as an illuminating source, which can be viewed from a distant telescope equipped with a spectrometer; molecular spectroscopy can then be performed on the bulk composition of the NEO. This proposed technique is complementary to current methods for composition analysis, such as laser induced breakdown spectroscopy (LIBS), in that our system generates a backlight (the hot spot) behind the target of interest—the ablation plume. This blackbody source produces a much stronger signal than that of the ionized particles in LIBS, which allows greater distances between the detector and target. While LIBS analyzes the

particles ionized by the laser, our target cloud contains intact molecules that can be spectrally analyzed and identified. Furthermore, ablating the surface of a rotating NEO could potentially excavate a trench, enabling the analysis of shallow subsurface materials and molecules.
As a proof of concept, laboratory experiments were performed with a Fourier transform infrared spectrometer (FTIR). The FTIR passes a measurement beam through a cloud of particles, which is generated by a laser ablating a sample of asteroid regolith simulant.

****