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NEO Characterization

CHARACTERIZATION OF NEAR-EARTH OBJECTS USING PLANETARY RADAR OBSERVATIONS AND NUMERICAL MODELING

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ABSTRACT

Planetary radar observations provide a powerful tool for the post-discovery characterisation of the physical and dynamical properties of asteroids, comets, the Moon, and terrestrial planets. I will present recent results of radar observations of near-Earth asteroids observed at the Arecibo Observatory [1], which have increased our understanding of the diversity of potentially hazardous asteroids in terms of sizes, shapes, binarity, and composition. These characteristics are crucial to planetary defense as they play a role in the selection of the optimal mitigation technique. Planetary radar systems can measure the asteroid's radar cross section in two opposite or orthogonal polarization states and the Doppler broadening, which provide information on the asteroid's size, rotation rate, and the composition. They can also be used for range-Doppler imaging by mapping the reflected power as a function of the Doppler frequency and the range (based on the signal's round-trip time), which allows imaging resolutions finer than 10 meters at best, and thus direct observations of morphologic features and possible moons.

Due to the penetration depths of several wavelengths and the wide parameter space in scattering inversion problems, understanding the physical characteristics of NEOs based on their radar scattering profiles requires extensive numerical modeling. Traditionally, circular polarization ratio has been used as a first-order gauge to the surface roughness, but more recent advances in numerical modeling demonstrate that better measures exist (e.g., [2]). I will discuss how these recent advances in the numerical modeling of radar scattering can help us to understand better the physical characteristics of near-Earth asteroids in light of planetary defense.

[1] Virkki, A. K. et al. Arecibo planetary radar observations of near-Earth asteroids: 2017 December – 2019 December, Planetary Science Journal 3:222 (2022)

[2] Virkki, A. K. and Bhiravarasu, S. S. Modeling Radar Albedos of Laboratory-Characterized Particles: Application to the Lunar Surface, Journal of Geophysical Research: Planets, Volume 124:11 (2019)

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Comments:

Oral presentation preferred, no time slot preferences