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The peculiar albedos of near-Earth and Mars-crossing asteroids: implications for the near-Earth object impact prevention and the NEOShield2 project

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Abstract

Here we show that the albedo distributions of near-Earth and Mars-crossing asteroids are different. We explain these difference in terms of origin and fate of the near-Earth asteroids.

1. Introduction

The understanding of the origin, sizes, composition, internal structure of sub-kilometre-sized near-Earth asteroids (NEAs) is an important goals of planetary sciences. This is also one of the central questions that the projects NEO-Shield [1] and NEO-Shield2, funded by the H2020 program of the European Union, want to address. This knowledge will lead to better estimates of physical quantities of the NEA population, which are required to better assess the impact risk that NEAs pose to our planet [2]. In addition, this information is required to develop techniques to mitigate the potential damage produced by an asteroid, in case a collision with an NEA is deemed probable.

2. Origin of near-Earth asteroids

It is well understood that NEAs are on orbits which are unstable for periods longer than about 10My. Yet, NEAs existed over the age of the Solar System. Members of the NEA population must be thus constantly resupplied by the so-called NEA source regions [3]. Most of these regions are located in the Main asteroid Belt, but an additional important source is the population of Mars-crossing asteroids.

3. Mars- & Earth-crossing asteroid albedos

We recently determined the diameters and albedos of more than 1500 Mars-crossing asteroids (MCs) [4] from thermal modelling (using the NEATM; [5]) of infrared observations obtained by the WISE/NEOWISE mission [6, 7], including those taken for +300 objects during the fully cryogenic phase that had not been modelled before.

4. Results

The albedo (p_V) distribution of MCs shows the classical double peak: one peak centred at $p_V \sim 0.05$ and a second at $p_V \sim 0.25$ corresponding to the bulk of the asteroids belonging to the C- and the S- spectroscopic complexes respectively [8, 9] (Fig. 1).

On the other hand, the p_V-distribution of NEAs (which albedos were obtained from the literature) does not show this double peak (Fig. 1). An excess of asteroids with $0.1 < p_V < 0.2$ and a deficit of low-albedo objects is visible in the NEA population compared to that of the MCs. In this work we study the origin of these differences and their implications for the origin of NEAs.

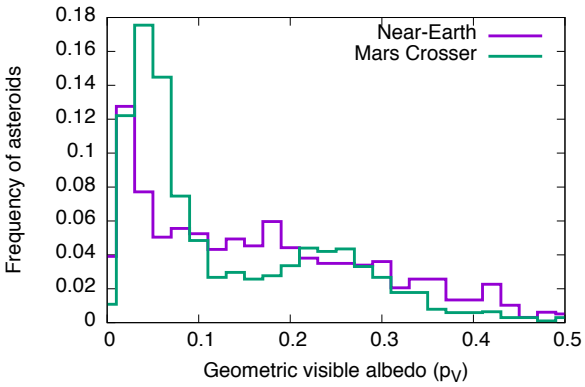

Figure 1: The albedo distributions of Mars-crosser and near-Earth asteroids

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