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Main Belt evolution in the context of adaptive-optics observations of large asteroids

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Abstract

According to the size-frequency distribution (SFD) of the Main Belt, there are approximately 4×10^5 small ($D = 2$–$3\,\mathrm{km}$) projectiles which determine the surface topography of large ($D > 100\,\mathrm{km}$) targets. Nowadays, the topography is accessible to adaptive-optics observations by the VLT/SPHERE/ZIMPOL instrument [2], which typically have a pixel scale $3\,\mathrm{km}$ and capability to resolve $D_\mathrm{c} \simeq 30$–$40\,\mathrm{km}$ craters in suitably illuminated areas. We used statistical collisional models (Monte-Carlo) to compute intrinsic collisional probabilities, impact velocities, expected number of catastrophic collisions, numbers of cratering events, taking into account not only mean numbers but also their dispersion. Even within the Main Belt, collisional environment can be very different from target to target.

Out of 140 known asteroid families [1, 3], three of them were recently studied in this context: (89) Julia, (2) Pallas, or (10) Hygiea. Apart from the SFD of the family and its velocity field, we discuss new observational constraints, namely relative/absolute numbers of craters, existence of large basins, and overall shapes of the largest remnants. We also provide a comparison to (1) Ceres, (4) Vesta, or so called "space truth". Finally, we discuss several bias factors, namely the partial visibility, the illumination bias, resurfacing, and the surface age. The latter can be addressed in selected cases with N-body models of orbital evolution

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