How Collisional and Dynamical Evolution Shape the Main Belt and NEA Size Distributions

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The two main processes which govern the size distribution of main-belt asteroids are collisional evolution and dynamical removal from the main-belt. Collisional evolution refers to the breakup of large bodies by smaller bodies and the resulting production of smaller bodies from the breakup. Dynamical removal is due to the interaction of gravitational perturbations from the planets (resonances) with non-conservative forces such as the Yarkovsky effect which can push bodies into these resonances. Bodies are driven out of the main belt and into NEA space by the resonances. Both the strength vs. size scaling law which governs collisional evolution and the non-conservative forces which drive bodies into resonances are size-dependent. Thus, the size distribution of asteroids which results from the combined effect of collisional evolution and dynamical elimination will deviate from a simple power-law. In addition, the NEA population made of the bodies driven from the main belt will have a different slope than the main-belt population.

We have developed a numerical model to study the combined effect of collisional evolution and dynamical elimination on the main-belt and NEA populations. Preliminary results indicate that our model should be able to match the observed NEA and main-belt size distributions for plausible values of the strength vs. size scaling law and the size-dependent removal rate from the main-belt. We will present and summarize our most recent results.