COLLISION LIFETIMES AND IMPACT STATISTICS OF NEAR-EARTH ASTEROIDS;
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We have examined the lifetimes of Near-Earth asteroids (NEAs) by directly computing the collision probabilities with other asteroids and with the terrestrial planets. We compare these to the dynamical lifetimes, and to collisional lifetimes assumed by other workers. We discuss the implications of the differences.

The lifetimes of NEAs are important because, along with the statistics of craters on the Earth and Moon, they help us to compute the number of NEAs and the rate at which new NEAs are brought to the vicinity of the Earth. Assuming that the NEA population is in steady-state, the lifetimes determine the flux of new bodies needed to replenish the population. Earlier estimates of the lifetimes ignored (or incompletely accounted for) the differences in the velocities of asteroids as they move in their orbits, so our results differ from (for example) Greenberg and Chapman (1983, _Icarus_ 55, 455) and Wetherill (1988, _Icarus_ 76, 1) by factors of 2 to10.

We have computed the collision rates and relative velocities of NEAs with a) each other, b) the main-belt asteroids, and c) the terrestrial planets, using the corrected method described by Bottke et. al. (1992, _GRL_, in press). The many recent discoveries of NEAs provide a more complete sample than was previously available, which presumably gives a better representation of the orbital distribution of NEAs.

We find that NEAs typically have shorter collisional lifetimes than do main-belt asteroids of the same size, due to their high eccentricities, which typically give them aphelia in the main belt. Consequently, they spend a great deal of time in the main belt, and are moving much slower than the bodies around them, making them "sitting ducks" for impacts with other asteroids. They cross the paths of many objects, and their typical collision velocities are much higher (10-15 km/s) than the collision velocities (~ 5 km/s) among objects within the main belt. These factors combine to give them substantially shorter lifetimes than had been previously estimated.

These short lifetimes imply one or more of the following: a) there are sources of NEAs other than those we understand, b) the known source mechanisms are more effective than has been suggested, possibly because there are more small objects in or near resonances than we can observe, or c) that earlier suggestions that many NEAs are extinct comets may be correct.

All these possibilities have implications for the impact rate of bodies onto the Earth. If the source mechanisms are more effective than believed, then the orbital distribution of NEAs will be dynamically "young", implying that Earth impacts are most likely at the asteroid's perihelion, _observable as PM falls_.

We have also computed the probability distributions for impact velocities between the Earth and observed NEAs, using the technique of Bottke and Greenberg (1993, _BAAS_ 24, 960). Unlike previous methods, each possible orbital geometry for collision between pairs of bodies is included in the distribution according to its probability, rather than simply an average velocity for each NEA as in previously published velocity histograms. NEAs have a wide range of eccentricities, so that impacts can occur over a wide range of velocities. This method is important because it gives a compete representation of the probability of extreme (high and low) impact velocities, which can affect impact energy at the Earth.

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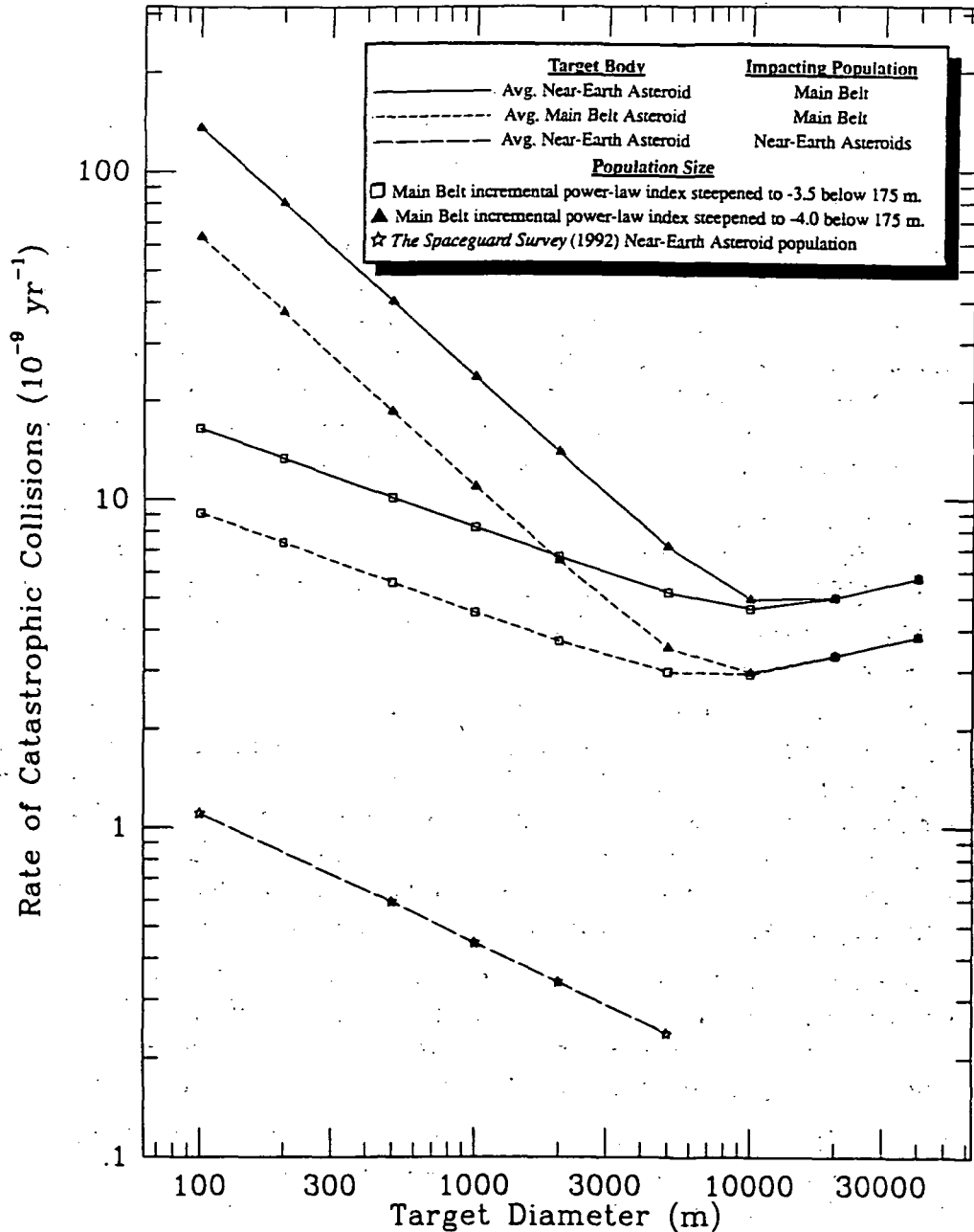
For a target asteroid, which is an average member of a given orbital class, we show (as a function of its size) the frequency of catastrophic disruption events due to impacts from another class. Note that:

1. **Near-Earth asteroids** passing through the **Main Belt** are <u>disrupted twice as often</u> as **Main Belt** asteroids of the same size, due to their higher impact velocities. This result is <u>independent</u> of the size distribution of **Main Belt asteroids**.

2. Disruptions between **average Near-Earth asteroids** and the **Near-Earth asteroid population** occur at least <u>1-2 orders of magnitude less frequently</u> than collisions with the **Main Belt population**. Therefore, they are not significant and can be neglected (except for the **Atens**, where few **Main Belt** crossings occur).