Dynamical Evolution of Near-Earth Asteroid Families by Pan-STARRS

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An asteroid family is a population of asteroids that share similar orbital elements. D-criterion searches of the Near-Earth Asteroids (NEAs) population identifies no statistically significant family of objects (Fu et al. 2005; Pauls & Gladman 2005). We recently found that adding a constraint on the similarity of the mean anomaly as well allowed us to identify a single pair of NEAs with orbits. Based on our simulations with synthetic NEA populations there is >99% likelihood that these two objects are derived from the same parent body.

The existence of the NEA families would help to explain a nagging problem with the discovery of many NEAs that come surprisingly close to the Earth - e.g. the impact in Sudan of 2008 TC3 in 2008 and the discovery of asteroid Apophis that will approach within about 20,000 km of the Earth's surface in 2029. The best NEA models suggest that these events have a low probability of occurrence. Finding one is surprising. Finding two and more requires explanation. Perhaps NEA families can resolve the disparity.

The identification of NEA families is important for the increased risk of Earth impact. The NEA models from which the best impact rates are now calculated (Bottke et al., 2002) do not incorporate enhancements in the NEA orbit distributions corresponding to NEA families because, up till now, none were known to exist. If a family of NEAs does exist on Earth-orbit crossing trajectories then the impact rate at that time of year would increase dramatically. The existence of the NEA families would help to explain a nagging problem with the discovery of many NEAs that come surprisingly close to the Earth - e.g. the impact in Sudan of 2008 TC3 late last year and the discovery of asteroid Apophis that will approach within about 20,000 km of the Earth's surface in 2029. The best NEA models suggest that these events have a low probability of occurrence.

In order to search for more NEA families, preliminary results observed by Pan-STARRS PS1 (the Panoramic Survey Telescope and Rapid Response System, prototype telescope) will be presented.



Figure 1. Orbital evolution of asteroids discovered as the first statistical significant NEA family.

References

- H. Fu, et al., Icarus, **178**, 434, (2005).
 A. Pauls, and B. Gladman, Meteoritics & Planetary Science 40, 1241 (2005)
 W.F. Bottke, et al., Icarus, 156, 399 (2002)