Selection effects in the discovery of near-Earth asteroids

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We consider the known population of near-Earth asteroids (NEAs), in particular the faint objects with absolute magnitude $H \geq 22$, roughly corresponding to a diameter smaller than 200 m. One of the purposes of next generation surveys is to substantially increase the discovery of NEAs with diameters between 100 m and 1 km, whose catalog today is by far incomplete.

The distribution of the orbital elements of the known NEAs, projected onto the plane (q, ω), where q is the perihelion distance and ω is the argument of perihelion, clearly shows some patterns (see Figure). These patterns reflect the occurrence of selection effects in the detection of faint NEAs.

In this talk we show that, among several effects involved in the detection of an asteroid, the geometry of its orbit seems to play a very relevant role to explain the existence of such patterns.

For this purpose, we consider the possible values of the minimum orbital intersection distance (MOID) between a generic asteroid orbit with perihelion distance ≤ 1.3 au and the Earth, assumed on a circular trajectory with radius 1 au. We characterize the extremal values of the MOID as explicit functions of (q, ω), and also of other pairs of orbital elements. Then we show that these results yield an explanation for the distribution of the known population of faint NEAs.

These results can also be used in a predictive way, therefore are relevant for planning a NEA survey both with ground-based and space- based observations.

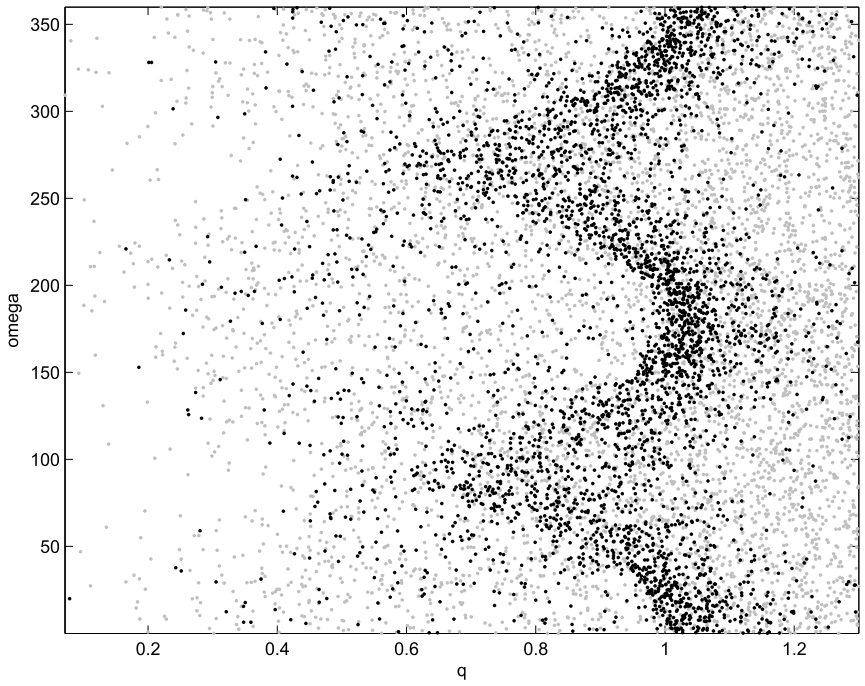

Figure: Orbital distribution of the known NEAs in the plane (q, ω). The black dots correspond to the fainter asteroids, that have absolute magnitude $H > 22$. The gray dots represent all the others.

References: Gronchi, G.F., Valsecchi, G.B. : 2013 'On the possible values of the orbit distance between a near-Earth asteroid and the Earth', MNRAS, 429/3, 2687–2699.