

Families Among High-Inclination Asteroids. Bojan Novaković¹, Alberto Cellino² and Zoran Knežević³,
¹Department of Astronomy, Faculty of Mathematics, University of Belgrade, Studentski trg 16, 11000 Belgrade, Serbia (bojan@matf.bg.ac.rs), ²INAF: Osservatorio Astronomico di Torino, Via Osservatorio 20 (cellino@oato.inaf.it), I-10025 Pino Torinese, Italy, and ³Astronomical Observatory, Volgina 7, 11060 Belgrade 38, Serbia (zoran@aob.rs).

Introduction: Dynamical asteroid families are identified as concentrations of objects with similar orbital elements. These families are believed to have formed through the collisional disruptions of large parent bodies. Families are usually identified in the space of proper elements: proper semi-major axis (a_p), proper eccentricity (e_p), and proper inclination (i_p). To date, several tens of families have been discovered across the asteroid main belt [6, 3].

Most of these families are located at lower proper inclinations. The situation is more difficult at higher inclinations, mainly due to the small number of known asteroids in this region. Until recently the only systematic search for asteroid families at high- i was performed using only 3697 objects [1]. Situation has changed recently with a work of [5] who present a new classification of families identified among the population of high- i asteroids. Here we review these results but also give more details on some of the individual cases including very interesting small cluster around the asteroid (5438) Lorre.

New classification: The classification is performed using newly computed set of synthetic proper elements for 18,560 numbered and multi-opposition objects having sine of proper inclination greater than 0.295. We considered three different zones of the main belt (inner, intermediate and outer) and used the standard approach based on the Hierarchical Clustering Method (HCM) to identify families in each zone. Our approach slightly differs with respect to previously published methodologies. These changes are made to achieve a more reliable and robust classification. We also used available SDSS color data to improve membership and estimate fraction of interlopers in each family. In total 38 families are identified, many of them for the first time. In addition, a significant number of clumps and clusters deserving further investigation is found as well.

Lorre cluster: One of the most interesting asteroid groups identified by [5] is definitely Lorre cluster. This cluster is located at $a_p \approx 2.745 AU$, $e_p \approx 0.263$ and $i_p \approx 28^\circ$. Ten¹ asteroids are identified as likely members of the group. Our preliminary result suggests it is formed by an impact that produced a crater on the about 30 km in diameter large asteroid (5438) Lorre.

¹Database as of October 2011.

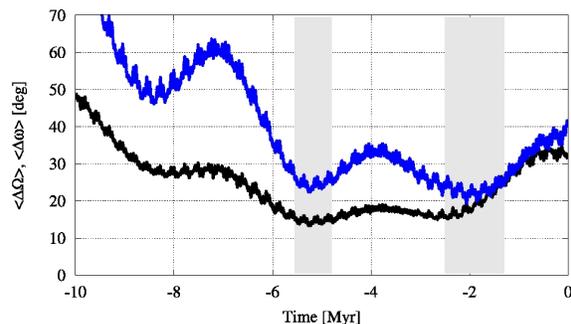


Figure 1: The average differences of the longitudes of the ascending nodes $\langle \Delta\Omega \rangle$ (black) and arguments of pericenters $\langle \Delta\omega \rangle$ (blue) for members of the Lorre cluster. The most interesting (and very deep) clusterings occur at about 1.9 ± 0.6 and 5.2 ± 0.4 Myr in the past (marked by gray regions).

Very tight spread of the family members, in the space of proper elements, immediately suggests that group is a young. For instance, the average differences in proper semi-major axis and eccentricity are 0.0017 AU and 0.0003 respectively. As all currently known members are on the stable orbits we employ backward integration method (BIM; [2]) to estimate age of the cluster. Obtained results (see Fig. 1) indicate that Lorre cluster is only a few Myr old.

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