Young asteroid families: exploring the limits between collisional families and fission clusters

Valerio Carruba (São Paulo State University (UNESP), Guaratinguetá, SP, 12516-410, Brazil.)

Asteroid families are groups of objects that have similar orbits. They can be produced as the result of a collision between a projectile and the family parent body (collisional families), or because of the fission of a secondary body or of a low-energy impact on a rapidly rotating primary (fission clusters). Collisional families tend to be more dispersed in semi-major axis and they are usually identified in domains of proper elements. Fission clusters tend to be more compact and they are usually identified in mean-orbital elements domains.

Among asteroid families, those that were created less than $\simeq 7$ Myr ago can be dated using the Backward Integration Method (BIM), where the differences of the longitudes of nodes and pericenter of family members with respect to the parent body angles are tracked down in the past to check for mutual convergences. Recently, another approach based on close encounters between the alleged parent body and clones of family members drifting into the past has also been proposed to date young asteroid families. Four asteroid families, those of (3152) Jones, (7353) Kazuya, (108138) 2001 GB11, and (909) Ulla, were also recently identified as very young using BIM.

In this work we propose to use the method of family dating based on past close encounters to determine these four families ages and membership. Machine-learning technique will also be used on the results to objectively check for sub-families inside the larger group and for dating these sub-groups. Preliminary results for the (108138) 2001 GB11 family show that it is possible to find fission clusters inside collisional groups, and that this occurrence may appear in other asteroid families, such as that of Jones. “Mixed” asteroid families where fission and collisional event occurred in short time intervals may be, therefore, more common than previously thought.

Finantial support: CNPq, grant 301577/2017-0

References

Carruba V., De Oliveira E. R., Rodrigues B., and Requena I. 2018, MNRAS, 479, 4815