EPSC Abstracts
Vol. 13, EPSC-DPS2019-2076, 2019
EPSC-DPS Joint Meeting 2019

EPSC
EPSC-DPS Joint Meeting 2019
15–20 September 2019 | Geneva, Switzerland

Broken asteroids – analysis of asteroids' families

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Abstract

Potentially Hazardous Objects (PHAs) are the subset of Near-Earth Objects (NEOs) that present a risk of collision with our planet he Earth. They are a real threat to Earth, since if an object is attracted during the intersection of its orbit with the Earth, it may cause damage of continental magnitude. Stopping these objects or *Deflecting theme is* an embryonic science. In this work, we interested to know what could happen if an *PHA* breaks due to an implosion/explosion. For that purpose, we first checked the possible distribution function to consider for a size-distribution of the fragments. The Fréchet distribution that dominated the fragments distribution of the asteroid families in our solar system could be suitable to use. Our next step will be to perform simulations in which fictitious fragments generated with efferent ejection speeds.

1. Introduction

An asteroid impact on Earth could be catastrophic if the event brings together factors culminating in enough energy to cause significant damage. In 1993, one year after the Shoemaker-Levy disintegration, the observation data indicated 23 objects with descending obits that would probably impact on Jupiter. In fact, one of those fragments left an Earth's size impact signature [1], luckily Shoemaker-Levy was around Jupiter, but the consequences after its disruption might be taken as the picture of what an uncontrolled fragmentation could bring if happened around Earth.

One possibility action of planetary defense for potentially hazard asteroid near Earth would be maneuvering the object using space tether, which depends on material type. Another action to avoid the hazard body would implode/explode it. Already considering the object having not enough strength to support the stress due to the attachment of the tether, and taking imploding/exploding as a valid alternative, the raised question is what may happen after the asteroid breakage. The answer may imply in two questions beforehand, what fragments size would the object turns out and which trajectories would these fragments assume. The answers are important to distinguish the danger we can go through.

2. Methodology

The idea is to build an asteroid using the appropriated size distribution and mimic different energies for breaking up.

2.1 Asteroid's families

We analyzed 119 asteroid dynamical families classified by David Nesvorny [3], in order to define a possible size-distribution of the fragments. Our results are presented in Figure1. We found that the Fréchet distribution dominated the fragments distribution of the asteroid families in our solar system.

2.2 Asteroid's building

The BPCA (Ballistic particle cluster aggregate) code was adjusted to consider a previously chosen asteroid density [2], and indeed the referred size-distribution function has been used. The families' analyses have shown that largest fragment of an asteroid after breaking tends to be half-size of the parent body as in

Figure 2 – this is the maximum constituent size used to build the aggregate.

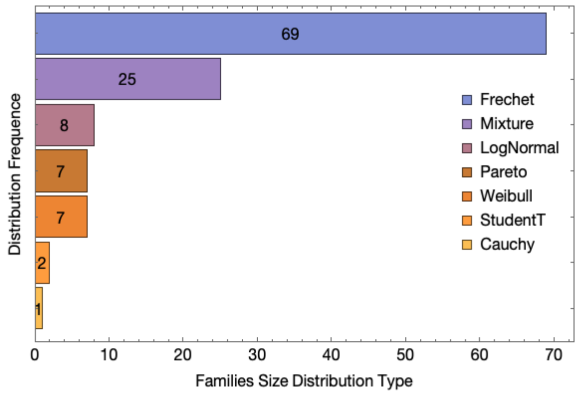

Figure 1: Size distribution frequency after analyzing 119 asteroids' families.

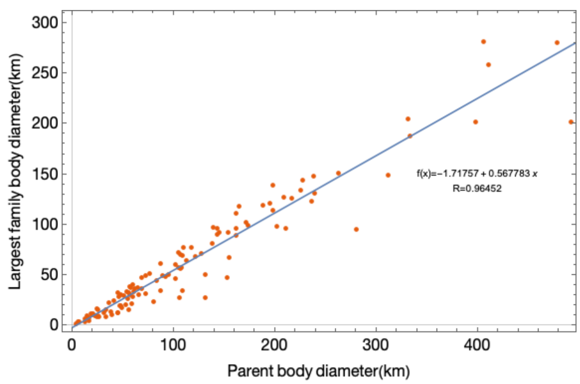

Figure 2: Asteroid largest fragment tendency – half-size of parent body.

2.2 Asteroid's fragments trajectories

In order to break-up our target, we will consider the physics of asteroid break-up events as presented in e.g. [3-5] and others. That will allow us to generate fictitious fragments from the assumed breakup site following a Maxwellian distribution with the specified mean ejection velocity parameter. We will perform simulations in which fictitious fragments were generated with different ejection velocity.

3. Summary and Conclusions

After considered 119 asteroids' families to find an appropriate distribution function, we 're-built' an asteroid to mimic the breakage and we will attribute dispersion velocities to each fragment. This will allow us to study the trajectories described by those fragments. This is an ongoing work; the next stage will be analyzed different energies inputs for the fragmentation.

Acknowledgements

The A.H.F.G. thanks FAPESP under the process grant 2018/11659-7. S.A. thanks CNPq grant 153683/2018-0. All authors thank to CAPES.

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