IMPACT ORIGIN OF ASTEROID FAMILIES. J. Leliwa-Kopystynski[1,2], M. J Burchell[3], I. Włodarczyk[4], [1]University of Warsaw, Institute of Geophysics, Pasteura 7, 02-093 Warszawa, Poland, jkopyst@mimuw.edu.pl [2]Space Research Centre of PAS, Bartycka 18A, 00-716 Warszawa, Poland, [3]Centre for Astrophysics and Planetary Sciences, University of Kent Canterbury, Kent, CT2 7NH, UK, M.J.Burchell@kent.ac.uk [4]Chorzów Astronomical Observatory, 41-500 Chorzów, Poland, Al. Planetarium 4, astrobit@ka.onet.pl
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Introduction: The aim of this work is to find relationships between the size distribution of asteroid family members and the impactor parameters (namely impactor size and density as well as the impact velocity) required to create the family via a catastrophic impact. Calculations are based: (i) On a set of data concerning the population of the family under consideration, and (ii) On an empirical relation related to the threshold of catastrophic disruption of impacted targets.

Eunomia Family: The Eunomia family is considered as an example. Eunomia, the largest member has a diameter $2R$ = 272 km. The family contains approximately as many as 2300 ± 300 asteroids within the size range from 5 to 12 km (the total number of the known asteroids supposed to be the family members is about 4700). The size distribution in the size range 5 to 12 km is $\lg N = -3.106 \lg(2R) + 4.501$, (regr. coeff. = 0.935) where N is the number of asteroids in the diameter bin equal to 0.2 km around the diameter $2R$, expressed in kilometers. (The figures above are according to calculations of Leliwa-Kopystynski and Wlodarczyk, presented on the Catastrophic Disruption Workshop, Alicante, 2007; submitted to PSS). From these data the size of the parent body of the family can be estimated.

Size Distribution Versus Impactor Parameters: Studies of the largest craters on 21 small objects (on satellites and on asteroids) have been performed [1]. Here 'small' denotes from R = 0.7 km (Dactyl, the Ida satellite) to R = 265 km (Vesta). The data aided in establishing the following ratio: (The largest crater diameter D observed on the target) / (The target radius R). For the rocky bodies – some satellites and all the asteroids – there is $D_{\text{largest}} = 1.6R$. This means that if the impact is so energetic that it is able to form a crater with diameter larger than $1.6R$ therefore instead of cratering catastrophic disruption happens: Such impacts led to formation of the asteroid families. In the asteroid belt both the targets and impactors are taken as rocky bodies. In the belt the mean impact velocities are typically (5.81 ± 1.88) km s^{-1} [2]; for asteroids larger than 50 km they are typically 5.3 km s^{-1} [3]. In the following, for the purpose of numerical calculations, we assume that the impact velocity is equal 5.5 km s^{-1}. There are few data available concerning density of Eunomia, an S-class asteroid. Here we assume that both the target and the impactor belong to asteroids of the class S and their density is 1500 kg m^{-3}. With the parameters fixed as above the radius of impactor remains the only one unknown value that should be determined and correlated with the size distribution of the family members. The size distribution of the impact originated fragments depends on the amount of energy used for crushing of the target: Production of small number of the large fragments is less energetic than crumbling of the target into a large number of small fragments. So, a mutual relationship between the impactor energy and the parameters of the size distribution of the family members would allow a determine of the impactor size (providing the impactor density and impact velocity are fixed parameters). Such a relationship is presented here.

In the literature, laboratory, impact disruption experiments have been carried out and fragment size distributions obtained for hydrous and anhydrous targets [4, 5] for example. However, a range of such experiments as a function of impact energy density (and target type) are required, along with a scaling relationship to large size bodies. Equivalently, hydrocode simulations can produce data at the right size scale, but need verification. If the resulting fragment size distributions can be shown to be sensitive to the degree of disruption (catastrophic, extreme catastrophic etc.) then it will permit the necessary relations to be verified, validating models such as that presented here.

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