THE COLLISIONAL EVOLUTION OF THE MAIN BELT POPULATION. M. Yu. Kuzmitcheva[1] and B. A. Ivanov [1], [1]Institute for Dynamics of Geospheres, Russian Acad. Sci., Leninsky Prospect 38/1, Moscow, Russia 119334 (kuzm@idg.chph.ras.ru, baivanov@idg.chph.ras.ru).

Introduction: Numerical modeling of a disruptive-cascade of minor body populations leads to a new interpretation of the lunar impact crater size-frequency distribution (SFD) and the observed size distribution of the main-belt asteroids [1]. Within our model of a collisional evolution we adjust the best fit to the observed main-belt distribution size-strength scaling relations for asteroidal strength [2,3]. To compare with the lunar SFD we then average obtained distributions with a sliding time window of 2 Ma.

Our numerical model of a collisional evolution: This model in general is similar to others [2], but differs for large bodies. All collisions for asteroids with diameters greater than 8 km (this value may vary) are calculated by Monte-Carlo technique. In the fist place a vector of *n* random numbers is used to choose a time step *dt* and a "target" from *n* groops of impacted bodies, and then one more random number to select an "impactor" for the target. This procedure allows to distinguish properly disruptions of the biggest asteroids.

All calculations here are executed with the size-strength relations for critical energy of disruption for "strong" and "weak" bodies. The fist relation is a result of hydrocode predictions for basaltic targets and mean velocity of an impact of 5 km/s [3], the second is Fit 1, obtained from simulations of collisional evolution of the Main Belt [2]. In both cases a radius of the weakest body in population is almost the same (about 0.1 km), but minimal critical energy is less by 3 orders of magnitude for "weak" bodies. Fragments of disrupted asteroid are distributed by power law with exponent *p* determined from the fractional size of the largest fragment of the parent body [2]. So *p* depends on impact parameters and varies from one impact to the next. To test the model the traditional Dohnanyi equilibrium power law has been reproduced under conditions when the critical specific energy is independent of target size.

Size distributions obtained: The most interesting results are obtained for the case of "weak" asteroids, when for the whole period of the collisional evolution current size distributions, presented at close time moments differ significantly for bodies less than 0.3 km. But distribution smoothed with a sliding time window of 2 Ma look similar to each other. These results are drawn in Fig.1, where the curves 1, 2, 3, 4 are the current distributions for time moments of 0, 2, 3, 4.35 Ma of the collisional evolution, the curves *a* and *b* are results of averaging from 2 Ma and 4 Ma after the beginning to present day. Generally speaking, we can see the current distribution at the sky, and the curves *a*, *b* are recorded as the lunar SFD.

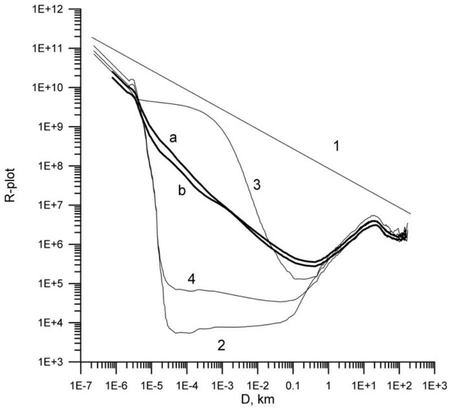

Fig.1 Size distributions, obtained for time moments of 0, 2, 3, 4.35 Ma of the collisional evolution (curves 1,2,3,4). Curves *a* ,*b* are results of averaging from 2 and 4 billion years after the beginning to present day.

Governing factors for the shape of the evolved size-distribution are characteristic lifetimes for populations of bodies of a given size. In Fig.2 we plot lifetimes for a start population (the curve 1), for a population of 0.1 million years of the evolution (the curve 2) and for the averaged distribution 4, drawn in Fig.1 (the curve 3).

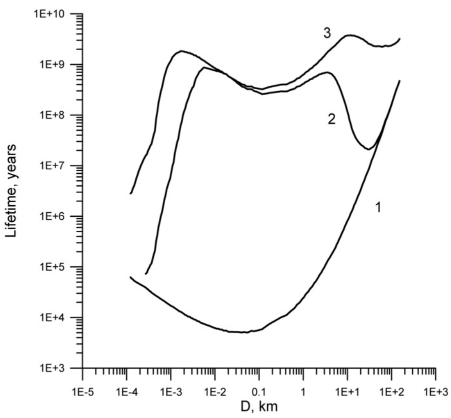

Fig.2 Lifetimes of the evolved population at successive time moments.

The ultimate shape of the size distribution is controled by a competition of the rate of disruption of ten-kms bodies, in which a power-law tail of debris is generated and the rate of "repairing" a depression, concerned with the "weakest" bodies.

Comparison of the Main Belt and the lunar SFD: We also have carried out simulations for a num-

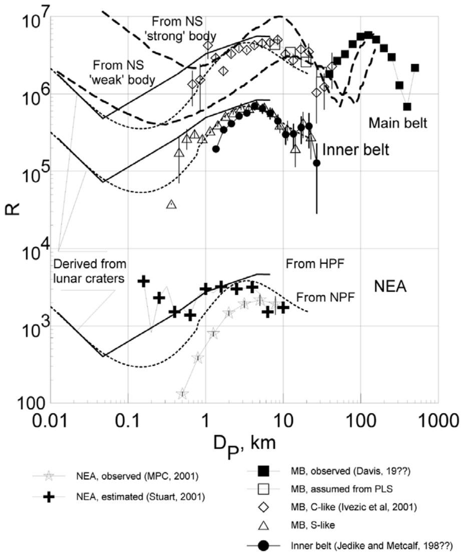

Fig.3 Comparison of the Main Belt, NEA populations, SFD and results of NS.

ber of mean velocities of mutual impacts with unchanged size-strength relations and mean probability of collisions. Though the last two admissions are not quit correct. R-plots, drawn here are more sensitive to deviations from a power law than cumulative curves, and results of numerical collisional modeling do not look as the best fits for the Main Belt population. In Fig.3 two thick dashed curves named as "From NS" (from numerical simulations) are shown, the upper is a resulting distribution for "strong" bodies and mean velocity of 5 km/s, the lower one is obtained for "weak" bodies and mean velocity of 3 km/s. These curves are chosen as the most acceptable.

Conclusions: Modern models (and described above too) explain well two humbs in the size distribution of the Main Belt asteroids, but fine features appears could not be described in the frame of a single evolved population with only one size-strength relation. In future we plan to use our model investigating some ancient populations, such as planetezimales in various feed zones, to clear possible sources of the Late Heavy Bombardment.

Acknowledgements: This work is supported by the RFBR grant #01-05-64564-a.

References:

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