ON THE STATISTICS OF NEAS

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Introduction: An analysis of the statistics of near-Earth asteroids of more than 10 m in diameter is carried out. The statistic of the small NEAs (from 10 to 50 meters in diameter) is of a great importance for the problem of asteroid hazards and for fundamental issues of the Solar system researches. However, the population of small NEAs is almost completely undiscovered due to the small size and other physical properties. In our work we use theoretical model to provide a statistical analysis of the NEAs population and dynamics.

Methods: The statistics of asteroids approaching the Earth is made using a program written in C ++. The program calculates positions of asteroids and the Earth in the space on the interval of 10 years with a step of 1 day (starting from January 1, 2016). The position of the asteroid is determined from the Keplerian elements of the asteroid's orbit (obtained with the NEOPOP package reference). An unperturbed motion is considered. The position of the Earth is taken from the file DE405, taken from the JPL website (http://ssd.jpl.nasa.gov/?planet_eph_export link). Then the distances between the Earth and the asteroid are calculated. We considered two areas around the Earth – the sphere with radius R = 400 000 km (approximate radius of the Moon's orbit) and the spere of R = 1 000000 km. If the distance is less than or equal to the given R, then this event is taken into account in the statistics.

A Near-Earth Object Population Observation Program (NEOPOP) was used to simulate the population and obtain the orbital elements of model asteroids. The NEOPOP package is based on the Bottke-Morbidelli-Gravnik Near Earth Asteroids model [1].

Results: The Figure 1 shows the dependence of the average number of near-Earth asteroids for the year (during the calculation period) crossing the near-Earth sphere with radius R from the size of the asteroid. The results for two values of R are given: 1 million km, and 0.4 million km. In the Bottke-Morbidelli-Gravnik model, not the dimensions but absolute asteroid magnitude H are given. The size of the asteroid for the given H was determined from the formula log(D = 3,122-0,5 log(ρ-0,2H)), where D is the diameter of the asteroid expressed in km, ρ is the geometric albedo of the asteroid, H is the absolute stellar magnitude of the asteroid in rays V (visual band of the spectrum of the photometric system UBV).

The calculation was made for an albedo value of 0.15.

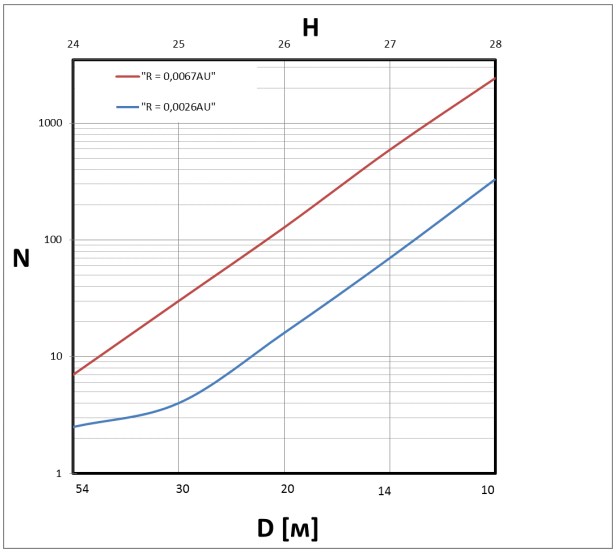

Fig. 1. Dependence of the average number of near-Earth asteroids from the size of the asteroid

As a results of the work, it was discovered that the number of NEAs more than 10 m in diameter entering the 1 million km radius near-Earth space is about 3200 per year. Dependences of the entrance frequency to this zone on the size of the NEAs are obtained.

References:

[1] Debiased Orbital and Absolute Magnitude Distribution of the Near-Earth Objects, William F. Bottke Jr., Alessandro Morbidelli, Icarus 156, 399–433 (2002).