

The Close Encounters of (1) Ceres with the Near-Earth Asteroids

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We computed the close encounters of (1) Ceres with the first 3000 numbered near-Earth Asteroids. We have shown that the mean distance between (1) Ceres and the near-Earth Asteroids is 0.12 au. The corresponding value of a velocity is 4.8 km s^{-1} .

1 Introduction

In Włodarczyk (1996), we computed the close encounters of (4) Vesta with the first 2000 numbered Minor Planets. We have shown that the mean distance between Vesta and the minor planets is 0.367 au in 1970-2170 and 0.375 au in 1770-1970. The corresponding values of velocities are 5.308 and 5.341 km s^{-1} , respectively. We computed close encounters between (1) Ceres and the first 3000 near-Earth Asteroids (NEAs), and we present our results in this paper.

(1) Ceres is the largest object in the Main Belt; hence it has a significant influence on the motion of small bodies there, in particular in calculating the risk of collision of potentially dangerous asteroids to Earth. An example is the calculation of the influence of Ceres on the danger of colliding with Earth (99942) Apophis (Włodarczyk, 2007). The frequency and depth of close approaches, both Ceres and the Vesta with asteroids, have a significant influence in predicting the motion of asteroids in the future.

2 Results

We used the Mercury software described in Chambers (1999). The starting positions and velocities of the first 3000 NEAs are taken from the JPL Solar System Dynamics¹. We integrated the equation of motions of NEAs 1 ky in the future and searched for minimum distance between (1) Ceres and each NEA. Also, for this moment, we computed velocity between (1) Ceres and NEA. It is visible in Fig. 1, that the minimal distance between (1) Ceres and the first 3000 NEAs is about 0.12 au, and that minimal velocity between (1) Ceres and the first 3000 NEAs is about 4.8 km s^{-1} . These are the values from the maximum distribution read from the histograms.

Hence, the distances between Ceres and near-Earth Asteroids are smaller than between Vesta and the numbered asteroids. The speeds are also slower for Ceres compared to Vesta. It may be since, in the case of Ceres, we calculate its approaches with the near-Earth Asteroids and in the case of Vesta with numbered asteroids.

¹https://ssd.jpl.nasa.gov/sbdb_query.cgi

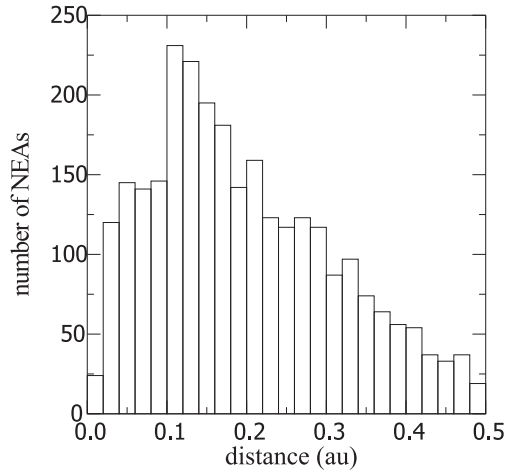


Fig. 1: Histograms of minimal distances between (1) Ceres and the first 3000 NEAs.

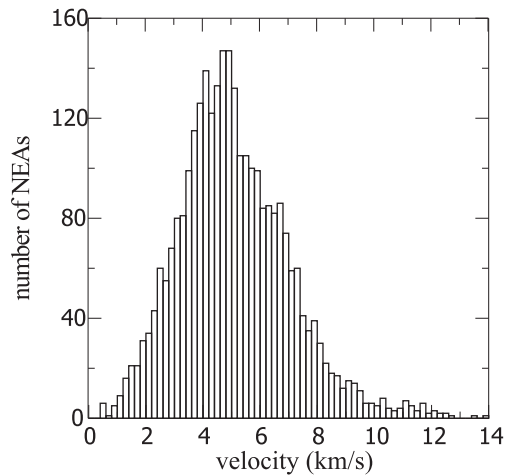


Fig. 2: Histograms of minimal velocities between (1) Ceres and the first 3000 NEAs.

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References

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