Geophysical Research Abstracts
Vol. 14, EGU2012-3121-1, 2012
EGU General Assembly 2012

Chaotic diffusion caused by close encounters with more than one massive asteroid

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Close encounters with massive asteroids are known to be a mechanism of dynamical mobility able to significantly alter proper elements of minor bodies, and they are the main source of dynamical mobility for medium sized and large asteroids (D $>$ 20 km, approximately). Orbital mobility caused by close encounters with (4) Vesta has been studied in the past and could be a viable mechanism to produce the current orbital location of some of the V-type asteroids currently outside the Vesta family. It is well known, however, that the proper frequencies of precession of pericenter g and longitude of the node s of terrestrial planets change when one or more of the other planets is not considered in the integration scheme. For instance, the g_4 and s_4 frequencies are different when the full Solar System is considered or when only Mars and the Jovian planets are accounted for. In this work we consider the effect that including one or more (up to 51) massive asteroids in the integration scheme has on Vesta orbit, and, indirectly on the statistics of changes in semi-major axis caused by close encounters with this massive asteroid. By using chaos indicators such as the Maximum Lyapunov Exponent, and integrations with symplectic integrators able to account for the interaction between a massive asteroid and a massless particle, we study the problem of scattering caused by close encounters with (4) Vesta, when only (4) Vesta (and the eight planets) are considered, and when (4) Vesta and other massive main belt asteroids are also accounted for. We find that (4) Vesta proper frequencies are dependent on the number of other massive asteroids considered in the integration scheme and that, as a result, the whole statistics of encounters with (4) Vesta is also affected. Variances of the change in proper a caused by the four most massive asteroids varied up to 22.5% in the five integration schemes that we used, and the number of encounters that caused the largest changes in semi-major axis varied up to a factor 2. The indirect effect caused by the presence of other massive asteroids introduces therefore an additional source of uncertainty in estimating the long term effect of close encounters with massive asteroids, that was not accounted for in previous works on the subject, and that may reach up to 30% of the known drift rates.