

Temporary Capture of Small Bodies by an Eccentric Planet

*Arika Higuchi¹, Shigeru Ida²

1. Tokyo Institute of Technology, 2. Earth-Life Science Institute

We have investigated the probability of temporary capture of asteroids in eccentric orbits by a planet in a circular or an eccentric orbit by analytical and numerical calculations. We found that in the limit of the circular orbit, the capture probability is $\sim 0.1\%$ of encounters to the planet's Hill sphere, independent of planetary mass and semimajor axis. In general, the temporary capture becomes difficult, as the planet's eccentricity (e_p) increases. We found that the capture probability is almost independent of e_p until a critical value (e_p^c) that is given by ~ 5 times of Hill radius scaled by the planet's semimajor axis. For $e_p > e_p^c$, the probability decreases approximately in proportional to e_p^{-1} . The current orbital eccentricity of Mars is several times larger than e_p^c . However, since the range of secular change in Martian eccentricity overlaps e_p^c , the capture of minor bodies by the past Mars is not ruled out.

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