

On the transfer of comets from near-parabolic to short-period orbits

Ji-Lin Zhou¹, Yi-Sui Sun²

¹*Department of Astronomy, Nanjing University,
Nanjing 210093, P.R.China. E-mail: zhoujl@nju.edu.cn*

²*Department of Astronomy, Nanjing University,
Nanjing 210093, P.R.China. E-mail: sunys@nju.edu.cn*

Under the framework of circular restricted three-body problem (Sun-planet-Comet), we obtain a map model following the idea of Liu and Sun (1994) but with some modifications. The map is used to study the transfer of comets from near parabolic orbits to short periodic ones. Numerical results show that, the transfer is effective On the following cases: comets in direct or retrograde orbits crossing with the planet's orbit, or comets in direct orbits non-crossing with the planet's orbit but with their perihelion distance close to the semi-major axis of planet's orbit. The dependence of transfer probability and average time on the perihelion distance of comet orbit and planet mass are expressed as some scaling laws. The commonly adopted random walk assumption about the energy change of the comets is also inspected. We find due to the difference of typical change of the comet energy per passage, the statistics on transfer of comets in orbits crossing with Jupiter's orbit is different with those in non-crossing orbits. For comets in the orbits crossing with the Jupiter orbit, the energy change is large due to close encounter, thus the diffusion approximation does not apply. New statistical laws concerning the transfer of comets in this case are revealed with our simple model.