Transport of Asteroids into Jupiter/Saturn Regions : The Origin of their Irregular Satellites

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We have investigated the possibility of irregular satellites, having their origin in the asteroid belt. The irregular satellites may not have been formed by accretion in a circumplanetary disk, as in the case of the regular satellites. The inclination distribution and large semimajor axes of the irregular satellites tell us that they must have formed elsewhere and later been captured into their current orbits around their host planets. The original places where irregular satellites were formed have not been clarified so far. However, their observed low albedos of approximately 0.05 indicate that they may have more physical similarities to asteroids than Kuiper belt objects. Our study started from this possibility

How many asteroids have been transported near Jupiter/Saturn? What is the ratio of particles transported near Jupiter to the number of particles transported near Saturn? To answer these questions we calculate the orbit of mass-less particles initially distributed around the asteroid belt (2-5AU) under the perturbations of Jupiter and Saturn. Jupiter and Saturn have their current masses and are in circular orbits with their current semimajor axes. These two planets have no gravitational interaction between them (the so-called restricted circular 4-body problem). During our calculations, we counted the number of particle encounters within the Hill radii of Jupiter and Saturn as irregular satellite candidates (hereafter J- and S-candidates).

We find that (1) asteroids can be transported near both Jupiter and Saturn, (2) the number of J-candidates is about three times larger than that of S-candidates, and (3) the orbital distribution has some differences between J- and S-candidates.

We will show the detailed results and discuss the consistency of the produced candidates by our calculations and the observational results referring to the scenario of the long-term dynamical evolution of the captured objects around planets proposed by several authors.