Origin of a difference between Jovian and Saturnian satellite systems

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Jovian satellite system consists of four Galilean satellites with similar masses that are trapped in mutual mean motion resonances with negligibly small other satellites, while Saturnian satellite system has only one big body, Titan, with other satellites of two order of magnitude smaller mass. We explain the origin of the difference following the proto-satellite disk model adopted by Canup & Ward (2006). The model is a steady accretion disk with relatively small mass with uniform infall from the circumstellar proto-planetary disk. Applying the 1D planet formation model developed by Ida & Lin (2008) for the satellite formation problem, we have simulated growth and orbital evolution of proto-satellites. Our hypothesis is that the infall to Jupiter was truncated by a gap opening in the proto-planetary gas disk by Jupiter's perturbations while that to Saturn continued until the proto-planetary disk was globally depleted. This difference significantly affects the final configuration of satellite systems, because type I migration timescales of proto-satellites are longer than viscous diffusion timescales of the proto-satellite disks but shorter than expected lifetime of the disks. We show that in the case of Jovian system, a few similar-mass satellites are likely to remain in mean-motion resonances in inner regions, the configuration of which is formed by type I migration and temporal stopping of the migration near the disk inner edge. On the other hand, in the case of Saturnian system, one or two dominant body tends to form by orbit crossing and merging of proto-satellites after disk depletion.