

## Rapid formation of Saturn after Jupiter completion

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Although planets can rapidly migrate through the interaction with massive gas, Jupiter stays at the current location probably without significant migration. Jupiter is thus expected to have finished its formation during the depletion of gas nebula. Therefore, the following formation of Saturn should have occurred in a short timescale, about several million years. Since the core of Saturn is estimated to be about 10 Earth masses, it would be formed via core accretion. Although planetesimal accretion produces a core, a massive core induces the fragmentation of planetesimals, resulting fragments are then removed by their radial drift due to gas drag, and eventually the growth of the core stalls because of the reduction of surrounding bodies. After the completion of Jupiter formation, Jupiter formed a gap in the solar nebula. Since the drift velocities of fragments are lower around pressure maximum produced just beyond the gap in the nebula, the core of Saturn grows rapidly through the accretion of such fragments. At first, we investigate the case of no radial drift around the pressure maximum. In the minimum-mass solar nebula (MMSN), kilometer sized planetesimals can produce a core exceeding 10 Earth masses in several million years. Larger planetesimals need larger amount of solid, 3 times MMSN for 10 km and 10 times MMSN for 100 km. However, fragments drift due to their eccentric and inclined orbits even in the pressure maximum region. Fragments can halt inside the pressure maximum and may contribute the growth of the core. If we assume that such fragments cannot accrete onto the core, the depletion of fragments then stalls core growth. In MMSN, a core resulting from kilometer-sized planetesimals grows rapidly but the core reach only 2 Earth masses due to the depletion of fragments. Despite severe setup, a core can exceed 10 Earth masses within about one million years from kilometer-sized planetesimals in a disk with solid surface density larger than 4 times MMSN. Since the core can reach the critical core mass even in the severe case, Saturn would have formed in such a disk via core accretion.

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