Satellite accretion process from a debris disk of midium mass within the Roche limit

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The most favored scenario of the lunar origin is the giant impact hypothesis.
In the thesis, it is considered that the Moon was formed from an impact-generated debris disk.
Recent N-body simulations showed that a single large satellite would be formed from a massive debris disk (with 3 to 5% of the central planet), which is initially confined within the Roche limit.
In the satellite accretion process from a disk within the Roche limit, an essential process is the viscous spreading of the disk, which supplies materials to the satellite seed.

We performed N-body simulations with a wider range of initial disk mass, down to about 1% of the mass of the central planet, and investigated the satellite accretion process
If the initial disk is not such a heavy disk as the proto-lunar disk, the satellite accretion process is more complex, and multiple satellites are formed from such a disk.
Since a less massive debris disk has larger spreading time scale, it is truncated by a satellite, and the material supply to the satellite stops.
The satellite migrates outward by the disk-satellite interaction, and next satellite formation begins when the first satellite migrates outward enough.

However, we found that such a system with satellites and a disk with considerable mass is not stable.
As the second satellite migrates outward by the disk-satellite interaction, it is captured to the resonance to the first satellite, and its eccentricity grows.
In the parameter range of our simulations, the second satellite re-enter the Roche limit, and is destroyed.
Then another satellite is formed from the remaining disk, and it is destroyed in the similar process.
This process continues and the disk mass diminishes.
We stopped simulations at this stage since the remaining particles is too sparse to express a disk.

Our result is that from a disk with medium initial mass, satellites are formed successively from the disk.
However, these satellites are destroyed by the re-entering to the Roche limit, and only one large satellite remains, which is formed at first.
As the disk mass diminishes, small satellites are formed.
These small satellites may survive, since disk-satellite interaction becomes weak in this last stage.
We will discuss about the stablity of multiple satellites system more closely.