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Macroscopic bodies in Saturn's G ring arc: dynamics and dust generation

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A bright arc structure in the G ring was discovered by Cassini in 2006, and the strong forward scattering indicates the arc population is dominated by dust particles. This region, which covers 250 km in radius and 60º in longitude, is created by a 7:6 corotation resonance with Mimas. The source for this structure was credited to Aegeon, a 240 m in radius satellite, which lies embedded in the arc. However, Madeira et al. (2008) showed the solar radiation pressure is strong enough to remove the dust particles from region in a rate much faster than the time required to repopulated the arc when considered the ejection of particles from the surface of Aegeon due the impacts of micrometeoroids.

Here we investigate a different mechanism to replenish the arc. Cassini data suggest the region contains meter-sized objects, which may collide among themselves and fragment. To test this hypothesis we performed a series of numerical simulations taking the account an oblate Saturn, Mimas, Aegeon and an ensemble of objects with 50 m and 100 m in radius. The number of objects of each size was chosen to be comparable to the Cassini estimation. Our results shows that, when considering the autogravity, a large number of collisions among the bodies happens in supercatastrophic regime, and the amount of dust created due to the fragmentation surpass the amount produced by impacts with Aegeon. This dust generation process is efficient enough to keep a steady regime for hundreds of years, therefore this mechanism may be responsible to create the arc instead of Aegeon. As a byproduct, our simulations showed that its likely that Aegeon itself will be destroyed by the collisions, so the satellite we see now can be the remnant of a larger body that inhabited the region in the past.

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