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Saturn's F Ring: Observations and Modelling

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Saturn's narrow F ring is one of the most dynamic structures observed in the rings. Transient features and brightness fluctuations are partially attributed to a population of moonlets hidden well within the bright core of the structure. Recent detections of opaque features during stellar occultations of the UVIS and VIMS instrument (Esposito et al., 2007, Icarus) of the ring strongly support this idea. A collision model accounting for attractive particle interactions has been developed and allows for a consistent treatment of aggregation and restitution. Collisionally formed aggregates are found to be stable with respect to the planetary tides. Numerical experiments on the three-body capture probability reveal an overall different dependence on particles size and distance to the planet than in the case of purely gravitational interactions. Centimetre-sized particles are likely to stick together. Moreover, an enhanced capture probability as well as aggregate stability even within the Roche zone promotes the existence of regolith layers and rubble pile formation. Regolith layers are expected to be thicker farther out from Saturn, where in turn the elasticity of follow-up collisions would decrease. The initial implementation of attractive particle forces into a more general kinetic study revealed a possible collisional growth of particles of up to centimetres in size. Multiple subsequent collisions of larger bodies could shatter their regolith thereby temporarily releasing vast amounts of small particles. On the other hand, these impacts could compactify loose aggregates. In these studies we concentrate on modelling a ring with an emphasis on its size distribution dynamics and summarize related UVIS observations. The ultimate goal is to constrain model parameters using UVIS and other Cassini observations.