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An Analytical Model for the Dust Environment around Saturn's Moons Pallene, Methone and Anthe

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Abstract

Since its arrival at Saturn in 2004 the observations by the spacecraft Cassini have revolutionised the understanding of the dynamics in planetary rings. By analysing Cassini images, Hedman et al. [1] detected faint dust along the orbits of Saturn's tiny moons Methone, Anthe and Pallene. While the ring material around Methone and Anthe appears to be longitudinally confined to arcs, a continuous ring of material has been observed around the orbit of Pallene by the Cassini dust analyzer. The data show, that at least part of the torus lies exterior Pallene's orbit.

Many tiny moons are located between Mimas and Enceladus and are known to be resonantly perturbed by these [2, 3]. In this work, we will present an analytical model to describe the particle density of the dust environment around Pallene, Methone and Anthe and to explain a radially outward shift of the dust torus. We assume the dust torus to originate from particles, which are ejected from the surface of the moon by micrometeroidal bombardment. We concentrate on the interaction of the dust particles with corotational resonances and plasma drag, where the plasma drag limits the life time of the dust particles within the resonances. Additionally, in order to describe the extension of the dust torus, we include the effect of radiation pressure, Lorentz force and planetary oblateness.

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References

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