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Analyzing Blériot's propeller gaps in Cassini NAC images

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Abstract

Among the great discoveries of the Cassini mission are the propeller-shaped structures created by small moonlets embedded in Saturn's dense rings. These moonlets are not massive enough to counteract the viscous ring diffusion to open and maintain circumferential gaps, distinguishing them from ring-moons like Pan and Daphnis.

Partial gaps are one of the defining features of propeller structures. Until recently only the largest known propeller named Blériot showed well-formed partial gaps in images taken by the Narrow Angle Camera onboard the Cassini spacecraft [1]. We analyze images of the sunlit side of Saturn's outer A ring which show the propeller Blériot with clearly visible gaps. By fitting a Gaussian to radial brightness profiles at different azimuthal locations, we obtain the evolution of gap minimum and gap width downstream of the moonlet.

We report two findings:

1. Numerical simulations indicate that the radial separation of the partial propeller gaps is expected to be 4 Hill radii [1, 2, 3]. From the radial separation of the gaps in the analyzed images, we infer Blériot's Hill radius to be a few hundred meters, consistent with values given by [4, 5, 6].

2. In order to estimate the ring viscosity in the region of Saturn's outer A ring, where Blériot orbits, we fit several model functions (one example being the analytic solution derived in [7]), which describe the azimuthal evolution of the surface density in the propeller gap region, to the data obtained from the image analysis. We find viscosity values consistent with the parameterization of ring viscosity by [8], but significantly lower than the upper limit given by [9].

[1] Recently, partial gaps were also resolved for the propellers Earhart and Santos-Dumont in high resolution images taken during Cassini's *ring grazing orbits.*

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