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Hydrodynamic simulations of propellers: Isothermal model

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Abstract

Small moons embedded in Saturn's rings can cause S-shaped density structures, called propellers, in their close vicinity. This structures have been predicted first on base of a combined model involving gravitational scattering of test particles (creating the structure) and diffusion (smearing out the structure) [1, 2]. The propeller model was confirmed later with the help of N-body simulations showing the additional appearance of moon wakes adjacent to the S-shaped gaps [3, 4]. It was a great success of the Cassini mission when the propeller were detected in the ISS imaging [5, 6] and UVIS occultation data [7].

Here we present an isothermal hydrodynamic simulation of a propeller as a further development of the original model [1, 2] where gravitational scattering and diffusion had to be treated separately. With this new approach we prove the correctness of the predicted scaling laws for the radial and azimuthal extent of the propeller. Furthermore, we will show a comparison between results of N-body and hydrodynamic simulations. Finally, we will present simulation results of the giant propeller Bleriot, which can not be modeled by N-body simulations in its full extent yet.

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