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Studies of asymmetric propeller structures in the Saturnian ring system

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Abstract

Small sub-kilometer sized objects (called moonlets) embedded in the dense rings of Saturn cause density structures due to their gravitational interaction with the surrounding ring material which resemble a propeller, giving the structure its name. The prediction of the existence of propeller structures within the dense rings of Saturn [2, 3] led to their detection [5, 4, 6]. The recurrent observation of the largest propeller structure called Blériot in Cassini ISS images allowed the reconstruction of its orbit. The analysis yielded that Blériot is deviating considerably from its expected Keplerian orbit [7]. This offset motion can be astonishlingly well composed by a three-mode hamonic fit [1].

We perform hydrodynamic simulations to study the changes of the propeller structure due to a disk-embedded moonlet which is librating in a certain mode around its mean position. We present results showing how the induced propeller structure changes due to the libration of the moonlet and if these changes are visible in Cassini images. Further, we estimate the influence of the gap's gravity on the moonlet. In this way, we test the model of Seiler et al. (2017), who predict the moonlet to librate around its mean position due to the back reaction of the gap on the moonlet [1].

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