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Nonlinear Resonance of Mechanically Excited Sessile Drops

CHUN-TI CHANG, SUSAN DANIEL, PAUL STEEN, Cornell University — The spectrum of frequencies and mode shapes for an inviscid drop on a planar substrate have recently been documented. For vertical excitation, zonal modes respond to the driving frequency harmonically and non-zonal modes subharmonically, consistent with the prior literature. In this study, we report observations from the regime of nonlinear response. Here, zonals can respond non-harmonically, both sub- and super-harmonic responses are reported. The principal challenge to generating and observing superharmonic resonances of higher zonal modes is a mode-mixing behavior. However, using a simple visual simulation based on the ray-tracing technique, the individual contributions to the mixed resonance behavior can be extracted. In summary, results from experiment and theory show that the zonal modes, which respond harmonically and can mix with non-zonal modes without interfering with one another in the linear regime, tend to respond sub- or superharmonically and compete with non-zonal modes in the nonlinear regime.

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