PHYSICAL MATH SEMINAR

Modeling the waves and interactions of capillary surfers

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We present a combined experimental and theoretical investigation into "capillary surfers," which are millimetric objects that self-propel while floating at the interface of a vibrating fluid bath. Recent experiments showed that surfer pairs may lock into one of seven bound states, and that larger collectives of surfers self-organize into coherent flocking states. Our theoretical model for the surfers' positional and orientational dynamics approximates a surfer as a pair of vertically oscillating point sources of weakly viscous gravity-capillary waves. We derive an analytical solution for the associated interfacial deformation and thus the hydrodynamic force exerted by one surfer on another. Our model recovers the bound states found in experiments and exhibits good quantitative agreement with experimental data. Generally, our work shows that self-propelling objects coupled by interfacial flows constitute a promising platform for studying active matter systems in which both inertial and viscous effects are relevant.

TUESDAY, October 17, 2023

2:30 PM – 3:30 PM

Building 2, Room 449

https://math.mit.edu/pms/

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