PHYSICAL MATHEMATICS SEMINAR

INTERACTIONS OF PASSIVE AND ACTIVE CAPILLARY DISKS

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ABSTRACT:

In this talk, I will introduce capillary disks - hydrophobic disks at the capillary scale whose weight is supported on the fluid interface by virtue of hydrostatics and capillarity.

I will begin by presenting direct measurements of the attractive force between two capillary disks. It is well known that objects at a fluid interface may interact due to the mutual deformation they induce on the free surface, however few direct measurements of such forces have been reported. In the present work, we characterize how the attraction force depends on the disk radius, mass, and relative spacing, and rationalize our findings with a scaling analysis.

When such disks are then deposited on a vibrating fluid bath, the relative vertical motion of the disk and the interface leads to the generation of outwardly propagating capillary waves. We demonstrate that when the rotational symmetry of an individual particle is broken, the particles can steadily self-propel along the interface and interact with each other via their collective wavefield, forming a myriad of cooperative dynamic states. Our discovery opens the door to further investigations of this active system with fluid-mediated interactions at intermediate Reynolds numbers.

Ongoing work and future directions will be discussed.

BIO ------

Daniel M. Harris is an Assistant Professor of Engineering at Brown University in the Fluids and Thermal Sciences group. Before joining Brown, Dan was a Postdoctoral Research Associate and Lecturer at the University of North Carolina at Chapel Hill in the Department of Mathematics. Dan received his B.S. in Mechanical Engineering from Cornell University in 2010 and his Ph.D. in Applied Mathematics at MIT in 2015.

Dan's primary research interests are in interfacial phenomena, microfluidics, transport phenomena, and nonlinear dynamics. His research involves an integrated experimental and theoretical approach. Dan has also received numerous awards for his scientific visualizations, including being selected as the winner of the 2016 NSF/Popular Science Visualization Challenge in Photography, as well as being a five-time winner of the American Physical Society's Gallery of Fluid Motion.

TUESDAY, MAY 4, 2021
2:30 PM – 3:30 PM

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

https://mit.zoom.us/j/95597721876

Meeting ID: 955 9772 1876

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