PHYSICAL MATH SEMINAR

Shell buckling for programmable metafluids

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ABSTRACT:

The pursuit of materials with enhanced functionality has led to the emergence of metamaterials—artificially engineered materials whose properties are determined by their structure rather than composition. Traditionally, the building blocks of metamaterials are arranged in fixed positions within a lattice structure. However, recent research has revealed the potential of mixing disconnected building blocks in a fluidic medium. Inspired by these recent advances, here we show that by mixing highly deformable spherical capsules into an incompressible fluid, we can realize a 'metafluid' with programmable compressibility, optical behaviour and viscosity. First, we experimentally and numerically demonstrate that the buckling of the shells endows the fluid with a highly nonlinear behaviour. Subsequently, we harness this behaviour to develop smart robotic systems, highly tunable logic gates and optical elements with switchable characteristics. Finally, we demonstrate that the collapse of the shells upon buckling leads to a large increase in the suspension viscosity in the laminar regime. As such, the proposed metafluid provides a promising platform for enhancing the functionality of existing fluidic devices by expanding the capabilities of the fluid itself.

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2:30 PM – 3:30 PM

Building 2, Room 449

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