ST. OLAF PHYSICS DEPARTMENT

Universality and tunability in shear thickening suspensions:

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Meera Ramaswamy is an Assistant Professor of Mechanical Engineering at the University of Minnesota, where she studies soft and living matter systems. She previously held a postdoctoral position at Princeton, working with Prof. Sujit Datta on bacterial behavior in complex environments. She earned her undergraduate degree from IIT Bombay and her PhD from Cornell, where she researched shear thickening fluids. Her current work focuses on how bacteria navigate, grow, and respond to mechanical forces at the intersection of soft matter, active matter, and mechanics.

MAY 6 | 3:00 PM | RNS 210

Nearly all dense suspensions exhibit shear thickening, where viscosity increases under high stress as particle interactions shift from hydrodynamic to frictional. We interpret abrupt thickening as a precursor to a rigidity transition and present a universal scaling theory linking frictionless jamming to frictional, shear-driven rigidity. Experiments on cornstarch–glycerol and silica–glycerol systems collapse onto a single curve across wide conditions, revealing two regimes: frictionless isotropic jamming and frictional shear jamming, each with distinct scaling. The framework also explains dethickening under orthogonal shear perturbations and enables the design of tunable viscosity metamaterials, including zero, infinite, and negative viscosities.