FLUIDS & THERMAL SCIENCES

Seminar

"Complex Flows from Microfluidics to Geophysics"

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Tuesday, February 14, 2017
3:00 p.m.
B&H Room 190

Abstract:

Transport processes are crucial to a wide range of engineering and natural processes. I will talk about two problems at two very different length scales that share the common feature of being governed by fundamental fluid mechanical principles. The first relates to microfluidic flows driven by acoustically excited microbubbles, which have applications such as single-cell manipulation and millisecond-scale particle sorting. Motivated by high-speed trajectory measurements, I will use theory and simulations to show that hydrodynamic interactions between the oscillating bubble interface and nearby particles, when rectified by inertia, produce a net force that results in size-dependent particle sorting. I will argue that this inertial force is part of a broader class of phenomena that includes acoustic radiation forces, and has implications for the acoustic manipulation of soft objects such as cells. The second part of my talk will focus on a climatically important phenomenon pertaining to the flow of sea ice – the formation of ice bridges in narrow straits – which is mechanistically similar to granular jamming in chutes. Adapting ideas from lubrication theory, I will show that ice-bridge formation can be understood by means of a yield-stress mechanism that is encoded into commonly used rheological models of sea ice. The theory, which is validated by simulations and observations, can be employed as a model for transport processes that occur on length scales that are below the resolution of typical climate simulations.

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