# PHYSICS COLLOQUIUM:
# Pushing and Pulling Through an Active Fluid


Wylie Ahmed
Associate Professor of Physics
California State University Fullerton


**Date:**
11/4/2022

**Time:**
10:30 AM - 11:50 AM

**Location:**
KOLLIG 217

## About The Speaker:

Dr. Wylie Ahmed is an Associate Professor of Physics at Cal State Fullerton, where he leads the Laboratory for Soft, Living, and Active Matter (SLAMLab). Before he joined CSUF in 2016 he was a Marie Skłodowska-Curie Research Fellow at the Institut Curie in Paris, France. He completed his Ph.D. at the University of Illinois at Urbana-Champaign. His research interests are in cellular biophysics, soft and active matter physics, and bio-inspired materials. He also enjoys being involved in outreach and mentorship to communicate scientific findings with society and promote Science, Technology, Engineering, and Mathematics (STEM) education. Dr. Ahmed's research activities have been funded by the Marie Curie Actions (FP7-MC-IIF-624887) and the National Science Foundation (NSF DMR-2004566 and DMS-2010018).


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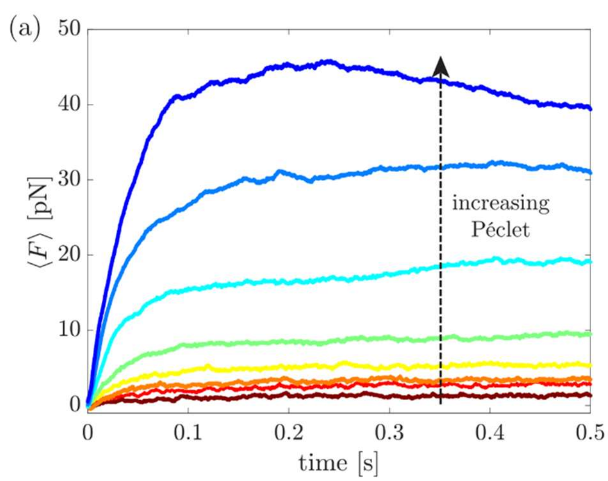
## Abstract:

An active fluid is a suspension of active and passive components driven out of equilibrium by local energy injection. Examples span a wide range including: the cytoplasm of living cells, suspensions of micro-swimmers or self-propelled particles, and reconstituted cytoskeletal systems. Uniquely, active fluids exhibit novel properties not observed in equilibrium such as non-thermal diffusion, rectification, structure formation, vanishing viscosity, the ability to do productive work, and many others. However, these interesting behaviors vary widely depending on the specific details of the active fluid and the space/time scale of the measurement. In this talk, I will discuss our efforts to understand the basic properties of an active fluid bath using swimming bacteria as a model system. Specifically, I will focus on force measurements via optical tweezers to characterize two physical processes: (1) non-equilibrium fluctuations and energy transfer from the active fluid to a passive tracer particle, and (2) the friction experienced by the particle as it is driven through the active fluid. We find that the force dynamics of our micron-scale tracer particle reveal a complex relationship with the surrounding media including: superfluidity, enhanced diffusion, force thickening, and an average energy dissipation rate of ~10^3 kT/s under no external load. This complexity highlights the challenge in forming a general picture of active fluid properties, but more importantly uncovers a wide range of new directions to harness their unique behavior. Our work provides a basis to tune the non-equilibrium properties of active fluids at the microscopic scale to create new living materials.



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