Title: Role of shape and heterogeneity in active matter

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Abstract: Active matter systems, ranging from bio-filaments to microorganisms and animal groups, extract energy at the single-particle level to generate motion and forces, leading to emergent behaviors such as coordinated migration, self-organization, and phase transitions. Most simulations of active matter often overlook microscopic details of particles, limiting our understanding of how attributes like shape, mechanics, and heterogeneity influence transport, structure, and material properties in these systems. In this talk, I will introduce the field of active matter, outlining its foundational principles and the motivations behind various modeling approaches. I will then present *Plasmodium* sporozoites, the crescent-shaped motile forms of malaria parasites, as a novel system for active matter. Within mosquito salivary glands, sporozoites form large rotating vortices, exhibiting curvature- and speed-dependent sorting and oscillatory "breathing" dynamics in vortex shapes. Using agent-based simulations, we uncover the physics underlying these intriguing behaviors. Finally, I will discuss recent studies in active matter research, highlighting the importance of particle shape and heterogeneity in diverse scenarios, which provide novel scientific insights into structural organization and mechanical responses in biological systems.