DFD15-2015-001403

Abstract for an Invited Paper
for the DFD15 Meeting of
the American Physical Society

Corrsin Award Talk - Collide and conquer: flow-induced segregation in blood and other multicomponent suspensions[1]

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Blood is a suspension of objects of various shapes, sizes and mechanical properties, whose distribution during flow is important in many contexts. Red blood cells tend to migrate toward the center of a blood vessel, leaving a cell-free layer at the vessel wall, while white blood cells and platelets are preferentially found near the walls, a phenomenon called margination that is critical for the physiological responses of inflammation and hemostasis. Additionally, drug delivery particles in the bloodstream will also undergo segregation the influence of these phenomena on the efficacy of such particles is unknown. This talk describes efforts to gain a systematic understanding of flow-induced segregation phenomena in blood and other complex mixtures, using a combination of theory and direct simulations. Contrasts in size, deformability and shape can all lead to segregation. A kinetic theory model based on pair collisions and wall-induced hydrodynamic migration can capture the key effects observed in direct simulations, including a drainage transition in which one component is completely depleted from the bulk of the flow. Experiments performed in the laboratory of Wilbur Lam indicate the physiological and clinical importance of these observations.

[1]This talk is based upon work supported by the National Science Foundation under Grants No. CBET- 1132579 and No. CBET-1436082