The Mechanics of Active Matter

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A distinguishing feature of many living systems is their ability to move – to be active. Through their motion living systems are able self-assemble: birds flock, fish school, bacteria swarm, etc. But such behavior is not limited to living systems. Advances in colloid chemistry have led to the development of synthetic, nonliving particles that are able to undergo autonomous motion by converting chemical energy into mechanical motion and work. This intrinsic activity imparts new behaviors to active matter that distinguish it from equilibrium systems. Active matter generates its own internal stress, which can drive it far from equilibrium, and by so doing active matter can control and direct its own behavior and that of its surroundings. In this talk I will discuss our work on active matter and on a new source of stress that is responsible for self-assembly and pattern formation in active matter systems. From a purely mechanical perspective I show how one can quantitatively predict motility-induced phase separation (MIPS) of active Brownian particles (APBs). I will also show how the inclusion of hydrodynamic interactions (HI) in active systems can profoundly alter their phase behavior.