Self-propulsion of suspension microdroplets driven by active microparticles dynamics

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A numerical study of hydrodynamic flows generated within droplets of active particle suspensions is performed. Using a two-phase mathematical model that combines a Lagrangian description of individual particle motion with an Eulerian description of the fluid flow, the research examines how droplet geometry and active force intensity influence the development of self-consistent flow patterns. The results demonstrate that in a spherical droplet where each particle is subjected to an active force with random orientation, a stable spindle-shaped vortex flow emerges, spanning the entire fluid volume. When the active force is uniformly directed, a toroidal flow pattern develops, accompanied by a significant shift in the system's center of mass. The study establishes that the active force parameters critically determine the flow regime, driving a transition from chaotic motion to organized collective behavior. These findings help identify fundamental hydrodynamic principles that govern the self-propulsion mechanisms of active suspensions.

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