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Phase transitions in dense active suspensions SAM MATTHEW, PALLAB SIMHAMAHAPATRA, SRIKANTH VEDANTAM, MAHESH PANCHAGNULA, Indian Institute of Technology Madras — We study dense suspensions of active particles embedded in a Newtonian fluid medium using discrete element computations. The particles are modeled as soft spheres capable of generating a thrust oriented in the direction of its instantaneous velocity. The embedding fluid provides viscous drag in the Stokes regime. The dynamics of the active suspension are investigated in a square cavity. Simulations of dilute suspensions show classical clustering and collective motion. In dense suspensions, the ratio of the thrust to drag force (denoted by λ) is found to be an important dimensionless parameter governing the system dynamics. Phase transitions in this material are investigated in this parameter space. It was observed that for low values of λ, the material arranges itself an oscillatory modes. At intermediate values of λ, the oscillatory modes transition to a single steady vortex. At higher λ, multiple vortices are observed in the computational domain. At very high λ, diffusive effects dominate and a gas-like phase is observed. All the transitions occur over small changes in λ indicating sharp transitions between the phases. This model system shows multiple phase transitions driven by a single parameter.

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