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A nonlocal kinetic theory for active suspensions in confined geometries BARATH EZHILAN, DAVID SAINTILLAN, Department of Mechanical Science and Engineering, University of Illinois at Urbana-Champaign, Urbana, Illinois 61801, USA — We consider a suspension of biologically active particles confined by bounding walls separated by distances that are of the same-order as (or one order of magnitude higher than) the individual particle length. In such systems, the fluid velocity, particle concentration and orientation distribution vary on length scales that are comparable to that of the suspended active particles and a nonlocal theory is required to explain the dynamics. The theory presented here is based on our previous kinetic model for active suspensions, where nonlocal effects are taken into account by extending previous theories for passive fiber suspensions [Schiek and Shaqfeh (1995)]. Contacts between the active particles and the solid walls create sterically-excluded regions of particle configurations within a distance of a half particle length from the walls, and a rigorous no-flux boundary condition is imposed on the hypersurfaces separating the allowed and forbidden configurations. A pressure-driven flow is also imposed on this system and a numerical solution is utilized to study the concentration, orientation distributions, stress profiles, and effective viscosity. Comparisons are made to recent rheological measurements in confined bacterial suspensions [Gachelin et al (2013)].

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