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Rheology of Bacteria Superfluids in Viscous Environments JANE CHUI, MIT, KAREN FAHRNER, Harvard University, CARINE DOUARCHE, HAROLD AURADOU, Université Paris-Sud, CNRS, RUBEN JUANES, MIT — Viscous environments are ubiquitous in nature and engineering applications – such as mucous in lungs and oil recovery strategies in the earth's subsurface – and in all these environments, bacteria also thrive. It has been well documented that active suspensions of bacteria can behave as a superfluid, in terms of reducing the viscosity of the surrounding fluid by their collective motion, but it is not known what their effect is when they are introduced to a viscous environment. Here, we investigate experimentally how viscous environments can change the ability of pusher-type bacteria (*E. coli*) in creating a superfluid regime. Using a Couette rheometer, we measure stress as a function of the applied shear rate, and define the apparent viscosity of *E. coli* suspensions, varying both the density of the bacteria population within the suspension and the viscosity of the suspending fluid. We find that the bacteria suspensions remain capable of behaving as a superfluid by reducing their surrounding viscosity to zero, and that changes in solvent viscosity mainly affects the range of shear rates over which the superfluid regime is possible. From the data, we assemble the ingredients needed to build a theoretical model that describes the effective viscosity of an active fluid as a function of the bacteria density and its environment (shear rate, solvent viscosity). Beyond the value for developing a theoretical model, our results open the possibility of giving an empirical guidance for numerical simulations involving bacteria and fluid flow.

Jane Chui
MIT

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