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Effect of viscoelasticity on the collective behavior of swimming microorganisms PATRICK UNDERHILL, YASER BOZORGI, Rensselaer Polytechnic Institute — Hydrodynamic interactions of swimming microorganisms can lead to coordinated behaviors of large groups. Previous theoretical work has shown that in mean-field theories the interactions give rise to a linear instability of the uniform isotropic state if the organisms push themselves forward. However, that work is done with the organisms suspended in a Newtonian fluid, while many organisms exist in a non-Newtonian medium. Using a mean-field theory and the Oldroyd-B constitutive equation, we show how viscoelasticity of the suspending fluid alters the hydrodynamic interactions and therefore the ability of the group to coordinate. We quantify the ability to coordinate by the initial growth rate of a small disturbance from the uniform isotropic state. For small wavenumbers the response is qualitatively similar to a Newtonian fluid but the Deborah number determines the effective viscosity of the suspension. At higher wavenumber, the response of the fluid to small amplitude oscillatory shear flow leads to a maximal growth rate at a particular wavelength. This is in stark contrast to the Newtonian result.

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