Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

Swimming with Swirl at Low Weissenberg Number[1] JEREMY BINAGIA, Stanford University, KOSTAS HOUSIADAS, University of the Aegean, ERIC SHAQFEH, Stanford University — Microorganisms commonly swim through complex biological fluids, such as mucus or biofilms, that readily exhibit non-Newtonian behavior. Recently, we have shown using the squirmer model that swimmers with significant azimuthal motion (created for example by a rotating tail, as in the case of *E. coli*) can swim significantly faster in viscoelastic fluids, fluids that exhibit both a viscous and elastic response to deformation (Binagia et al., 2020). In that work, the fluid was modeled using the Giesekeus constitutive equation, which models polymer molecules in the fluid as Hookean dumbbells experiencing an anisotropic drag. In this talk, we revisit this problem considering now a range of polymer constitutive equations. We present analytical results proving that, unless a regularized polymer model is used, asymptotic solutions are only valid up to a relatively modest value of the Weissenberg number, the dimensionless group characterizing the degree of fluid elasticity. We further show that the radius of convergence for such series solutions is equally small for all models when the squirmer model is used. In terms of kinematics, we show that a speed increase is predicted in all cases even when the underlying mechanism (based on the net forces acting on the swimmer) differs.

[1]J.P.B. is supported by a National Science Foundation (NSF) Graduate Research Fellowship (grant no. DGE 1656518). This work is also supported by NSF grant no. CBET 1803765.

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Date submitted: 03 Aug 2020 Electronic form version 1.4