Abstract Submitted
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Balancing energy input and viscous dissipation in the Zooming BioNematic[1] J.O. KESSLER, U. Arizona, R.E. GOLDSTEIN, University of Arizona, R. CORTEZ, Tulane U. — Beyond a concentration threshold, populations of the swimming bacteria *Bacillus subtilis* form a phase (the Zooming BioNematic=ZBN) comprising intermittent domains of co-aligned cells all swimming in the same direction. Collectively generated hydrodynamic forces between bacteria, the cells' ability to flip flagella, thereby changing swimming polarity, and their tendency to swim upstream into a collectively generated current are fundamental interactions leading to the ZBN. But how does the ZBN generate dynamic patterns, similar to ones at $Re \gg 1$? The energy put into the fluid by the swimming organisms overwhelms viscous damping, as demonstrated by a new dimensionless ratio Bs, analogous to Re but replacing the numerator by a measure of bacterial energy input. The magnitude of Bs is estimated via the Navier-Stokes equations, considering individual bacteria at moderate concentration, and entire domains at high. Bs is proportional to the bacterial concentration, and in both of those regimes, $Bs \gg 1$. Remarkably, unlike the Reynolds number, Bs is independent of viscosity.

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