Abstract Submitted
for the DFD13 Meeting of
The American Physical Society

Simulation of collective behaviour in micro-scale swimmers: Effects of tumbling and rotary diffusion DEEPAK KRISHNAMURTHY, GANESH SUBRAMANIAN, Jawaharlal Nehru Centre for Advanced Scientific Research — Recent experiments have shown that suspensions of swimming micro-organisms are characterized by complex dynamics involving enhanced swimming speeds, large-scale correlated motions and enhanced tracer diffusion. Understanding this dynamics is of fundamental interest and also has relevance to biological systems. In this work we develop a particle-based computational model to study a suspension of hydrodynamically interacting rod-like swimmers with the relation between the swimming velocity and intrinsic stress being enforced from slender body theory. Such an *a priori* specification reduces the computational cost since one now has a "kinematic" simulation with a fixed interaction law between swimmers; this does not restrict our study of the dynamics since the destabilizing mechanism has been attributed to the intrinsic (rather than the induced) stress field. Importantly, the model will include intrinsic de-correlation mechanisms found in bacteria such as rotary diffusion and tumbling whose effects have so far not been studied via simulations. Using this model we predict a box-size independent stability threshold based on the suspension concentration, tumble-time (duration between subsequent tumble events) and rotary diffusivity. Comparisons are made with the linear stability theory predictions by Subramanian & Koch (JFM 2009). We demonstrate that the effect of tumbling and rotary diffusion is to stabilize the suspension.

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Date submitted: 31 Jul 2013 Electronic form version 1.4