Abstract Submitted
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Taylor-Aris dispersion of swimming algae in pipe flow: predictions and experimental tests[1] OTTAVIO CROZE, MARTIN BEES, University of Glasgow, RACHEL BEARON, University of Liverpool — Classical Taylor-Aris dispersion theory is extended to describe the transport of suspensions of biased swimming cells in a vertical pipe flow. These suspensions differ from those of molecular or colloidal solutes: e.g. algae or bacteria in suspension respond to directional stimuli (e.g. chemotaxis, phototaxis or gyrotaxis). Gyrotactic instabilities focus bottom-heavy swimming cells into beautiful plumes. Solving for axial moments, we have derived general exact expressions for the mean drift and effective diffusivity of cells along such plumes, and apply these to predict the dispersion of a "dyed slug" of gyrotactic algae in a down-welling flow in a tube. We present predictions for the effective axial drift and diffusivity of the slug using consitutive relations from: (a) generalised Taylor dispersion theory and (b) Fokker-Planck models of dispersion. We then discuss experimental measurements to test our predictions using dyed cells and the relevance to bioreactor design.

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