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Growing swimming algae for bioenergy[1]

OTTAVIO CROZE, University of Cambridge

Biofuel production from photosynthetic microalgae is not commercially viable due to high processing costs. New engineering and biological solutions are being sought to reduce these costs by increasing processing efficiency (productivity per energy input). Important physics, however, is ignored. For example, the fluid dynamics of algal suspensions in photobioreactors (ponds or tube arrays) is non-trivial, particularly if the algae swim. Cell reorientation by passive viscous and gravitational torques (gyrotaxis) or active reorientation by light (phototaxis) cause swimming algae in suspension to structure in flows, even turbulent ones. This impacts the distribution and dispersion of swimmers, with significant consequences for photobioreactor operation and design. In this talk, I will describe a theory that predicts swimmer dispersion in laminar pipe flows. I will then then present experimental tests of the theory, as well as new results on the circadian suspension dynamics of the alga *Chlamydomonas reinhardtii* in lab-scale photobioreactors. Finally, I will briefly consider the implications of our work, and related active matter research, for improving algal bioprocessing efficiency.

[1]Winton Programme for the Physics of Sustainability