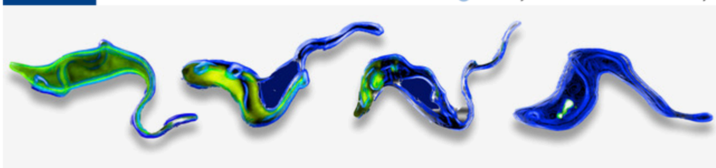

Contribution ID: **64** Type: **PHYMOT contributed talk (20 min)**

MECHANICAL COUPLING IS SUFFICIENT TO SYNCHRONIZE C. REINHARDTII FLAGELLA

Physical laws apply differently at the microscale than at the macroscale, therefore constraining microorganisms'biological functions. A key instance of this is that microbes perceive their surrounding medium as extremely viscous, constraining them to adopt non-symmetric motion to be able to propel forward. Some bacteria (E. coli) and unicellular algae (C. reinhardtii) have evolved different asymmetric motions in order to propel. C. reinhardtii has two flagella, mechanically connected from inside the cell, that beat synchronously in a "breaststroke"pattern. Flagellar synchronization is necessary to propel forward but is not fully understood. More generally, many microorganisms, including human epithelial cells or multiciliate microbes display flagellar synchronization. Experiments on isolated pairs of flagella from multicellular alga Volvox have shown that hydrodynamic coupling alone is sufficient for metachronal synchronization. But C. reinhardtii also display internal mechanical coupling that has been shown to be necessary to synchronize its flagella in a breast stroke movement. So what are the respective roles of hydrodynamic and mechanical coupling in flagellar synchronization of these unicellular alga? To find out, we separate their two flagella by a cantilever to prevent interflagellar hydrodynamic interactions, while holding the cell with a micropipette. We then observe if flagella stay synchronized without hydrodynamic interactions, including when subject to stresses. Is mechanical coupling sufficient to synchronize flagella? If so, then what role does hydrodynamics play in motility?

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