# Biophysics of light-induced motility in microalgae

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**At a Glance:** The project focusses on the mechanisms by which motile microalgae (prominent e.g. within phytoplankton) sense, elaborate and respond to light. We aim to understand how these ecologically and industrially important microorganisms combine motility (phototaxis) and intracellular processes (photosynthesis and photoprotection) to optimise light exposure. This project, which will combine experiments and modelling, is fundamentally interdisciplinary. Based in the lab of Marco Polin (Physics, Warwick), it hinges on an exciting new collaboration with Dimitrios Petroutsos (CEA Grenoble), an expert in photosynthesis; and Idan Tuval (IMEDEA, Mallorca), an expert in biophysical modelling.

**Notes:** A full 3.5 year studentship (fees and maintenance) at the UKRI level is available, funded by the Leverhulme Trust. This studentship is available for UK and EU students. We are looking for outstanding candidates coming from a quantitative background (Physics or a related subject area), who are strongly driven and are excited about biophysics. Candidates should hold or expect to hold a UK 1st (or high 2.1) class degree, or equivalent. The Physics Department is proud to be an IOP Juno Champion and a winner of an Athena Swan Silver Award, reflecting our commitment to equal opportunity and to fostering an environment in which all can excel.

**More in Depth:** Photosynthetic microorganisms are fundamental for life on Earth: at the base of major food webs (e.g. in oceans), and contributing about half of the global oxygen production. They are also promising systems to produce complex chemicals and biofuels, with unparalleled conversion rates of solar energy to carbon-rich molecules and negligible pressure on arable land.

Light is essential for these microorganisms, and it plays two roles: i) variations in time and space provide information used by the cell to regulate its biology; ii) its absorption provides energy driving the intracellular mechanism of photosynthesis. To thrive, cells integrate these two functions in ways currently not well understood.

Crucially, they need to avoid excess light: as little as ~10% of standard daylight can already lead to serious cellular damage and potentially death. Motile photosynthetic microorganisms avoid excess light in two ways: by detecting light and redirecting their motion (**phototaxis**; information-role); or as a result of energy absorption through intracellular biochemical responses which lower the amount of light captured (**photoprotection**; energy- role). Despite several observations pointing strongly at a fundamental link between phototaxis and photosynthesis, these are still mainly studied as separate processes.

In this project we want to fill this gap and understand how motile microalgae combine these responses into a coherent and effective strategy for light management. We will focus on the unicellular green alga *Chlamydomonas reinhardtii*, an important model system in biology for both motility (its flagella are virtually identical to human cilia found in lungs and brain) and photosynthesis; and a species relevant for biotechnological applications.

**References:**


- J. Arrieta, A. Barreira, M. Chioccioli, M. Polin, and I. Tuval. Phototaxis beyond turning: persistent accumulation and response acclimation of the micro alga *Chlamydomonas reinhardtii*. Scientific Reports 7, 3447 (2017).
- G. Allorent G and D. Petroutsos. Photoreceptor dependent regulation of photoprotection. Current Opinion in Plant Biology 37, 102 (2017).


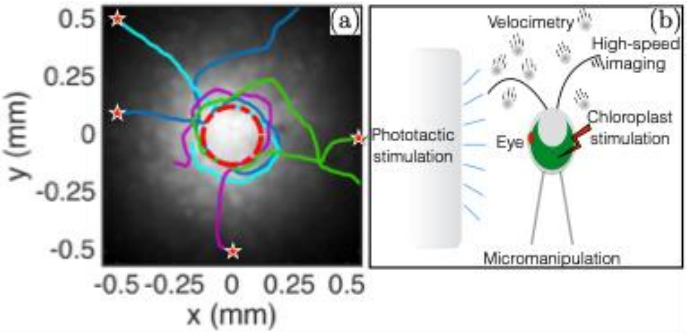


**Fig.1 Chlamydomonas phototaxis.** (a) Individual tracks (★ starting pnt.) show cells approach a localised light source, move around it and depart. (b) Main setup to be developed and used to study single-cell phototaxis and photosynthesis.