Gliding dynamics of microalgae

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Dynamics, mechanics and biology of motion of unicellular algae is an emerging topic with a high potential of application in green energy and ecology [1].
We propose to use a magnetic trap coupled to microscopic tracking [2] in order to study the movement of motile microalgae *Chlamidomonas reinhardtii* near a flat surface. In particular, we want to decipher dynamics and forces that are generated in a particular mode of algae movement: the *gliding*. It is a nearly linear slow displacement of the alga whose flagella are in contact with the surface in a split geometry [3,4] (see figures 1-3).
The project is articulated in two parts.

- The gliding of free algae will be monitored by a real-time fast tracking using Picotwist apparatus, and analyzed in order to get typical time scales of gliding dynamics.
- The magnetic trap experiment will be designed by binding a superparamagnetic bead to the flagellum. The bead will be captured in the magnetic trap and manipulated by micro-controlled motors. The response of the flagellum to these displacements will be analyzed. In particular, the work done by flagella molecular motors will be quantified.

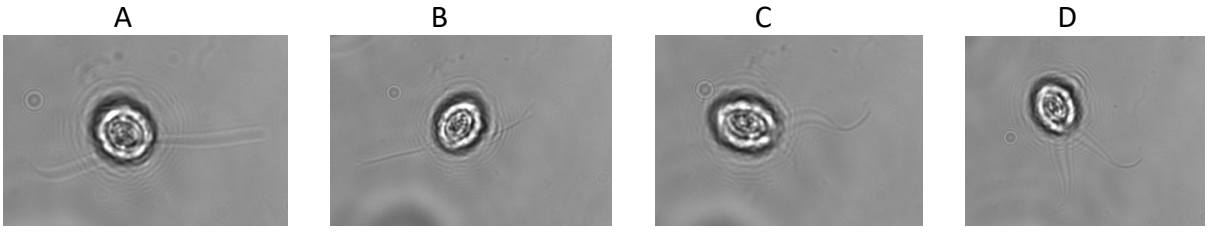

Figure 1 : Alga on the flat surface. A) gliding to the left, B) gliding to the right C) and D) end of gliding, disengagement of flagella of the surface and remobilization of swimming mode.

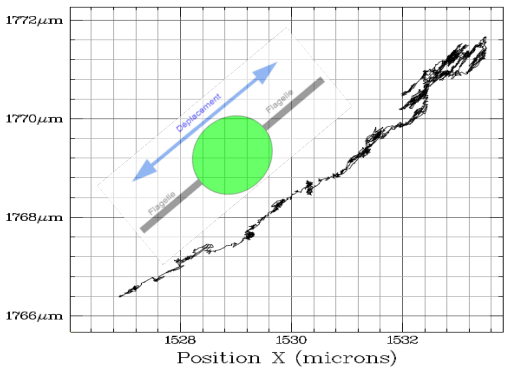

Figure 2 : Track of a gliding alga over 15 s.

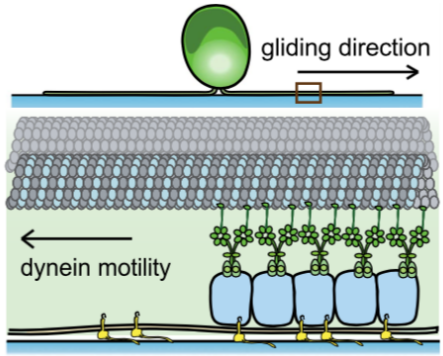

Figure 3 : Molecular motors for gliding flagellum; after [4].

References:
[1] *The Chlamydomonas*, 2. edition, Vol. 1 & 2, E. H. Harris & David B. Stern eds., Elsevier (2009).
[2] Timothée Lionnet, Jean-François Allemand, Andrey Revyakin, Terence R. Strick, Omar A. Saleh, David Bensimon and Vincent Croquette, Cold Spring Harbor Protoc; 2012; doi: 10.1101/pdb.top067488
[3] Christian Titus Kreis, Alice Grangier and Oliver Bäumchen, Soft Matter 15, 3027 (2019)
[4] Shih et al. eLife 2013;2:e00744.