

### Supervisor(s):

Johan Decelle, [johan.decelle@univ-grenoble-alpes.fr](mailto:johan.decelle@univ-grenoble-alpes.fr)

Robert Blanvillain, [Robert.Blanvillain@cea.fr](mailto:Robert.Blanvillain@cea.fr), ChromDev Team (PCV)

### Host laboratory:

Laboratoire de Physiologie Cellulaire & Végétale

<https://www.lpcv.fr/en>

### Title of the M2 research internship:

Cellular and physiological strategies of a marine microalga during polar night

### Project summary:

Microalgae in the oceans are pivotal for the carbon cycle, atmospheric oxygen and trophic networks. These single-celled photosynthetic organisms constantly face environmental variations (nutrients and light), and their physiological responses determine ecosystem functioning. In polar regions, the survival of microalgae in prolonged darkness during the polar night is one of the most intriguing physiological phenomena. These productive regions are important for carbon sequestration but are facing perturbations due to climate change. The microalga *Phaeocystis antarctica* is an important primary producer in the Antarctic (i.e. 60 % of the primary production). This microalga survives long periods of darkness (e.g. 5 months). During the austral spring, the microalga resumes growth and photosynthesis and can form massive blooms. Because of logistical difficulties that prevent winter sampling in these regions, our knowledge on the physiology and cellular adaptation of this microalga in polar night/day remain very limited. Here, we propose to simulate the winter-spring transition in the laboratory and investigate the photo-physiology and metamorphosis of the microalga *Phaeocystis antarctica* that we maintain in culture. The student will measure different photosynthetic parameters (collab. with LPM) and quantify carbon fixation in light/dark transitions. In parallel, she/he will reconstruct in 3D the cellular architecture of microalgae using FIB-SEM (collab. with MEM and IBS), with a focus on the morphometrics (volume, surface) of mitochondria, plastids (thylakoids and pyrenoid), and carbon reserves. This will be also carried out on natural free-living *Phaeocystis* cells collected in the Antarctic by the Tara-Oceans expedition. To identify underpinning molecular players, he/she will search for gene homologs involved in chloroplast biogenesis at dark/light transition in plants (e.g. photoreceptors, PEP) and quantify their activity (collab. with ChromDev). The candidate will be trained to photophysiology, 3D image analysis and molecular methods and will benefit from a collaborative network at IRIG.

### Keywords:

polar microalga, cellular architecture, plastid metamorphosis

### Relevant publications of the team:

Uwizeye Clarisse, Mars Brisbin Margaret, Gallet Benoit, Chevalier Fabien, LeKieffre Charlotte, Schieber L. Nicole, Falconet Denis, Wangpraseurt Daniel, Schertel Lukas, Stryhanyuk Hryhoriy, Musat Niculina, Mitarai Satoshi, Schwab Yannick, Finazzi Giovanni, Decelle Johan. (2020) Cytoklepty in the plankton: a host strategy to optimize the bioenergetic machinery of endosymbiotic algae. *BioRxiv* doi: <https://doi.org/10.1101/2020.12.08.416644>

Uwizeye C, Decelle J\*, Jouneau PH, Flori S, Gallet B, Keck J-B, dal Bo D, Moriscot C, Seydoux C, Chevalier F, Schieber NL, Templin R, Alloreant G, Courtois F, Curien G, Schwab Y, Schoehn G, Zeeman SC, Falconet D\*, Finazzi G\*. Morphological bases of phytoplankton energy management and physiological responses unveiled by 3D subcellular imaging; *Nature Communication*. In Press (\*: corresponding authors).

Decelle J, Veronesi G, Gallet B, Stryhanyuk H, Benettoni P, Schmidt M, Tucoulou R, Passarelli M, Bohic S, Clode P, Musat N (2020) Subcellular Chemical Imaging: New Perspectives in Cell Biology. *Trends in Cell Biology*. 30:173-188 DOI:<https://doi.org/10.1016/j.tcb.2019.12.007>

Decelle J, Stryhanyuk H, Gallet B, Veronesi G, Schmidt M, Balzano S, Marro S, Uwizeye C, Jouhet J, Maréchal E, Lupette J, Schwab Y, Schieber N, Tucoulou R, Richnow H, Finazzi G, Musat N (2019) Algal remodeling in a ubiquitous planktonic photosymbiosis. *Current Biology*. 29, 1-11 doi.org/10.1016/j.cub.2019.01.073

Decelle J, Carradec Q, Pochon X, Henry N, Romac S, Mahé F, Dunthorn M, Kourlaiev A, Voolstra C.R., Winker P, and de Vargas C (2018) Worldwide occurrence and activity of the reef-building coral symbiont *Symbiodinium* in the open ocean. *Current Biology* 28: 28:3625-3633 <https://doi.org/10.1016/j.cub.2018.09.024>