

Master 2 research internship in Integrated Structural & Cell Biology in Grenoble

Supervisor(s):

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Host laboratory:

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

Host group/team:

Lipid: Biogenesis, dynamics and homeostasis of membrane lipids

Title of the M2 research internship:

Characterization of genes involved in plastid lipids synthesis and structural arrangement of thylakoids in diatoms

Project summary:

Diatoms are unicellular photosynthetic algae. They play a very important role in ocean biological activity, being responsible of up to 40% of the net primary production in the oceans, which represents a fifth of the whole carbon fixation on Earth. Their physiology and cell biology are more complex than higher plants because they stem from a secondary endosymbiosis and their plastid is bounded by four membranes instead of two. In higher plants, the major components of chloroplasts membranes are galactolipids i.e. mono- and di-galactosyl diacylglycerol (MGDG and DGDG, respectively), sulfoquinovosyl diacylglycerol (SQDG) and phosphatidylglycerol (PG) and the pathways to their synthesis is well-known. On the contrary, diatoms' plastid lipids synthesis has yet to be disentangled into detail. In order to do that, mutants were generated using CRISPR-Cas9 technology to knock-out (KO) candidate genes involved in the synthesis of plastid lipids. The aim of the internship will be to phenotypically analyse such mutants at the lipidomic, physiological and morphological levels. For this, the student will generate lipidomics data using methods established within the host team (via GC-MS and LC-MS/MS), transcriptional study (via qPCR), growth, photosynthetic activity tests (in collaboration with a team within the department specialised in photosynthesis), and morphological characterisation of the mutants' plastids by means of both 2D and 3D electron microscopy (EM), with a particular focus on thylakoid membrane arrangement.

Keywords:

microalgae, secondary plastids,

Relevant publications of the team:

Lingjie You, Juliette Jouhet, Eric Maréchal, Alberto Amato, Xiahui Hao, Donghui Zhang, Antoni Banaś and Yangmin Gong. Acyl-CoA:lysophosphatidylcholine acyltransferase from the unicellular diatom *Phaeodactylum tricornutum* (PtLPCAT1) is involved in triacylglycerol and galactoglycerolipid synthesis and enhances eicosapentaenoic acid accumulation in recombinant oleaginous yeast. *Plant Biotechnology Journal*, 2023. doi: 10.1111/pbi.13952

Xiahui Hao, Wenchao Chen, Alberto Amato, Juliette Jouhet, Eric Maréchal, Daniel Moog, Hanhua Hu, Hu Jin, Lingjie You, Fenghong Huang, Mark Moosburner, Andrew E. Allen, Yangmin Gong. Multiplexed CRISPR/Cas9 editing of the long-chain acyl-CoA synthetase family in the diatom *Phaeodactylum tricornutum* reveals that mitochondrial ptACSL3 is involved in the synthesis of storage lipids. *New Phytologist*, 2022. <https://doi.org/10.1111/nph.17911>

Nolwenn Guéguen, Félix Cicéron, Valérie Gros, Grégory Si Larbi, Denis Falconet, Etienne Deragon, Dimitris Petroutsos, Hanhua Hu, Yangmin Gong, Morgane Michaud, Juliette Jouhet, Juliette Salvaing, Alberto Amato, Eric Maréchal. Characterization of the three monogalactosyldiacylglycerol synthase isoforms in the diatom *Phaeodactylum tricornutum*. Under review.

Lingjie You, Ada Połońska, Katarzyna Jasieniecka-Gazarkiewicz, Fabien Richard,

Juliette Jouhet, Eric Maréchal, Antoni Banaś, Hanhua Hu, Xiahui Hao, Andrew E. Allen, Yufang Pan, Xiahui Hao, Hu Jin, Andrew E. Allen, Alberto Amato, Yangmin Gong. Two plastidial lysophosphatidic acid acyltransferases differentially mediate the biosynthesis of membrane lipids and triacylglycerols in *Phaeodactylum tricornutum*. Under review.