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

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**Host laboratory:**
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**Title of the M2 research internship:**
Identification of new transcription factors involved in the acclimation of algae to changing light and CO2 availability.

**Project summary:**
Photosynthesis converts the light energy into chemical energy to fuel CO2 fixation into organic carbon. Excess light can cause oxidative damage; microalgae avoid this via the photoprotective mechanism qE (energy dependent quenching) that converts the excess absorbed light energy into harmless heat. CO2 limitation can limit photoautotrophic growth and cause oxidative damage; microalgae avoid this via the CO2 concentrating mechanism (CCM). Major components of the CCM are carbonic anhydrases, which catalyse interconversions among CO2, bicarbonate and carbonate, and inorganic carbon transporters. The mechanisms of qE and CCM capacity are intimately interconnected; low CO2 activates not only CCM genes but also qE genes; HL activates not only qE but also CCM genes. CCM and qE gene expression are highly regulated and involve calcium- and photoreceptors-depending signalling; yet how qE and CCM are regulated and interconnect remains largely unknown.
By applying mathematical modelling approaches, we recently built a gene regulatory network (involving interactions between large numbers of genes and their regulators) based on own and public RNAseq databases; The outcome of this approach was a collection of ranked predicted transcription factors (TFs) that respond to CO2 and light availability; three out of the ten predicted TFs were previously shown to control CCM or qE, highlighting the predictive power of our approach. Aim of the proposed project will be to validate some of the predicted TFs. For this, the master student will employ the CRISPR-CAS9 technique to delete the genes encoding the TFs of interest; the generated mutants will be characterized in terms of qE and CCM gene expression, in vivo photosynthetic activity, growth under changing light and CO2 conditions, in order to get insights on the role of these TFs in regulating qE and CCM and in the cellular homeostasis of Chlamydomonas reinhardtii, our model green microalga.

**Keywords:**
transcription factor, CRISPR-CAS9, gene expression

**Relevant publications of the team:**
Petroutsos, D.; Tokutsu, R.; Maruyama, S.; Flori, S.; Greiner, A.; Magneschi, L.; Cusant, L.; Kottke, T.; Mittag, M.; Hegemann, P.; et al. A Blue-Light Photoreceptor Mediates the Feedback Regulation of Photosynthesis. Nature 2016, 537 (7621), 563. https://www.nature.com/articles/nature19358