

Proposed List of MELiSSA PhD Topics

Topic Title: Deciphering *Limnospira indica* strain morphological changes

Keywords: Photobioreactor, spirulina, MELiSSA loop

Abstract

MELiSSA stands for “Micro-Ecological Life Support System Alternative”. MELiSSA is the European project for circular life support systems and is characterized by a biological and chemical/physical approach based on first principles modelling and implementation of a suitable deterministic engineering approach. Within the MELiSSA loop, the production of oxygen from carbon dioxide and the production of edible biomass is performed by a photosynthetic compartment, including a microbial photobioreactor inoculated with *Limnospira indica* microalgae (*a.k.a. Arthrospira platensis*).

Limnospira indica has been chosen for its light energy conversion efficiency, its high pH environment that reduces contamination, and its high nutritional value. This microorganism is as well genetically robust and able to adapt to a wide range of culture conditions, including space radiations. However, during laboratory breadboard activities, morphological changes have been observed in *Limnospira indica* cultures, from straight to helical structure. Today the mechanisms behind the morphological changes are not well understood and these uncontrolled changes could impact the performance of MELiSSA photobioreactor-based technologies (e.g. membrane clogging).

The proposed PhD would study the variations in *Limnospira indica* geometry and morphology under varying environmental conditions and how they translate in terms of physiology, metabolic activity and metabolism deviation, cellular growth, growth-relevant metabolic pathways, and gas-liquid transfer capabilities, radiative transfer conditions and hydrodynamics of liquid and gas phases. Attention will be given to understanding the growth conditions and environmental factors enabling the reversibility of these changes. Focus should be placed on the *Limnospira indica* PCC 8005 strain, used in the Artemiss and Biorat-1 payload developments.

Impact on MELiSSA Project:

Definition of technologies and strategies for the microbial photosynthetic process in the MELiSSA loop

Potential MELiSSA Partners:

SCK CEN (B), University Clermont Auvergne (F), University of Mons (B)

References:

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- Lasseur, C., Brunet, J., de Wever, H., Dixon, M., Dussap, G., Godia, F., Leys, N., Mergeay, M., Van Der Straeten, D. (2010), “MELiSSA: the European Project of closed life support system”, Gravitational and Space Biology, 23: 3-12
- Yadav, A., Monsieurs, P., Mistak, A., Waleron, K., Leys, N., Cuypers, A., Janssen, P. (2020), “Helical and linear morphotypes of *Arthrospira* sp. PCC 8005 display genomic differences and respond differently to 60Co gamma irradiation”, European Journal of Phycology

ALISSE criteria presentation. Version 1, issue 0, 18th November 2009.

- ESA Technical Note 137.4 Appendix. Applicable document for using Oscar Methodology System Engineering applied to the MELiSSA data management system: requirements

Candidate's background requirements:

Candidates preferably possess a degree in biology, chemistry, biotechnology or bioengineering. They must be familiar with metabolic pathways analysis, process engineering and simulation tools.