MECHANISM OF RADIATION RESISTANCE IN ARTHROSPIRA SP. PCC 8005 A. Yadav[1], N. Leys[1], A. Cuypers[2], A. Misztak[3], M. Waleron[3], K. Waleron[4], and P. J. Janssen[1], [1]Molecular and Cellular Biology, Belgian Nuclear Research Centre (SCK•CEN), Boeretang 200, B-2400 Mol, Belgium (ayadav@sckcen.be), [2]University of Hasselt, Centre for Environmental Sciences, Universiteit Hasselt, Agoralaan Gebouw D, B-3590 Diepenbeek, Belgium (ann.cuypers@uhasselt.be), [3]Dept. of Biotechnology, University of Gdańsk, ul. Abrahama 58, 80-307 Gdańsk, Poland, [4]Pharmaceutical Microbiology, Medical University of Gdańsk, ul. Gen. Hallera 107, 80-416 Gdańsk, Poland.

Introduction: The oxygenic, photosynthetic cyanobacterium *Arthrospira* typically resides in alkaline environments (e.g. soda lakes) and has a wide array of uses in the natural and commercial world. It produces essential fatty acids and a range of minerals, pigments, vitamins, and carbohydrates while being edible owing to a low purine to protein ratio. Being such a useful source of food and oxygen, via solar energy-driven carbon fixation and oxidation of water, it is intensively studied by the MIC group at SCK•CEN in frame of MELiSSA, an ESA-funded project on life support in Space. Our research aims to define optimal growth conditions of *Arthrospira* to conserve its nutritious properties and oxygenic and carbon-reducing capacities in radiation-intensive space environments. Particular challenges to study this organism are its multicellularity and gliding mobility, a complex, thick cell wall, a genome stocked with multiple CRISPR/cas elements and a plethora of restriction-modification systems preventing DNA transformation hence genetic manipulation, and assay-interfering autofluoroscence.

Aims: In this work we set out to study the genetic and biochemical pathways involved in the resistance of strain PCC 8005 - used in the MELiSSA life support system designed and developed by the European Space Agency [1] - to extreme high doses of gamma radiation (up to 5 kGy) as a continuation of earlier work in our group [2,3]. We are focusing on trancriptomics (including ncRNAs), DNA damage, protein modification, ROS avoidance and -detoxification, and antioxidants composition. Our primary approaches are to establish a catalogue of all the genes and pathways known for other ionizing radiation (IR) resistant organisms and check by bioinformatic means, and based on the PCC 8005 genome sequence obtained by us [4], the absence or presence of these genes and pathways in *Arthrospira*, to test IR-resistance mechanisms in different *Arthrospira* strains and species, to compare their genomes and relate any genomic differences with a variable IR sensitivity towards IR, and to study molecular and cellular responses of *Arthrospira* exposed to IR during at least one cycle of photosynthetic growth i.e. under light.

Experimental prelude: To study the effect of radiation on growth and morphology and to check whether IR-resistance is a general trait in *Arthrospira* sp. or not, different strains of *Arthrospira* isolated from different geographic locations were exposed to increasing doses of gamma radiation and were analyzed for growth recovery and morphological changes after irradiation.

Preliminary results. From this we conclude that different strains of *Arthrospira* have different sensitivity towards radiation. Even the two morphotypes of *Arthrospira* sp. strain PCC 8005 (straight versus helical trichomes) show distinct sensitivities towards IR. Furthermore, there is no morphological change observed immediately after radiation except for some filament breakage.

Ongoing experiments. To further understand the mechanisms, these strains are being studied by us for radiation-induced cellular and molecular effects using LC-MS/ESI-TOF metabolic profiling and TEM microscopy. Furthermore, the strain PCC 8005 will be exposed to radiation for a cycle of photosynthetic growth and transcriptomics analysis will be done using RNAseq. These studies will provide a profile of genes and metabolites being induced or reduced due to radiation and the effect of radiation on the organelles of *Arthrospira.*

References:

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Acknowledgments: the authors are grateful for funds obtained via the SCK•CEN Doctoral Studies Grant PO4500029305 to AY, and a FWO-Flanders / Polisch Academy of Sciences Scientific Exchange Grant FWO52162NB to AM, MW, KW, and PJ.