Five open research positions in Environmental Microbiology at KU Leuven

Five research positions are open at KU Leuven, Belgium, in the Environmental Microbiology group of Prof. Dirk Springael of the Division of Soil and Water Management, starting from between June – October 2022 (or earlier). The first three ones are 4-years PhD positions. The fourth one can be filled in by either a 4-years PhD or a 3-years post-doc while the fifth one relates to a 3-years post-doc position. Note that the post-doc positions are only for researchers that do not have a Belgian nationality, that did not attain their PhD at a Belgian institute and that did not stay for a period of more than 24 months in the period before the start of the position in Belgium. Applicants should indicate for which position they are applying and can apply for more than one position.

Position 1: PhD position: Study of the biology of the insertion sequence element IS*1071* and of its ability to recruit and spread adaptive traits in microbial communities.

Horizontal gene transfer (HGT) in microbial communities plays an essential role in the adaptation of their community members and the community itself to environmental changes. Typical examples are adaptations that confer traits as antibiotic resistance, metal resistance and catabolism of xenobiotic organics. Among the vehicles that govern HGT of adaptive traits are conjugative elements such as plasmids, and insertion sequence (IS) elements. Conjugative elements transfer the adaptive traits between different organisms while IS elements are key in the acquisition of the traits by the conjugative elements. While much information exists on the molecular mechanisms underlying the mobility of IS elements, less information exist, and this in contrast to plasmids, about its contribution to HGT and microbial adaptation in a wider community context. IS*1071* is an IS element that is primarily known for its involvement in HGT and adaptation to the catabolism of anthropogenic pollutants. This project aims to acquire a better understanding of the contribution of the IS element IS*1071*, in genetic adaptation at the community level. The project will study the host and expression range of IS*1071*, the effectors that govern its mobility and, using innovative tools, its ability to recruit and distribute adaptive gene functions in artificial more or less complex communities this in relation to the applied selection pressure. The project will use a combination of classical culture-dependent microbial techniques, state of the art culture-independent molecular ecology techniques as (meta)omics, high-throughput sequencing and genetic engineering techniques.

Candidates must have a degree in gene technology, genetics, environmental microbiology, microbial ecology, biochemistry, or alike with expertise related to the concepts and techniques mentioned above in the research description. Candidates must be also fluent in English.

Interested candidates should send their application to Prof. Dirk Springael (Tel: ++ 32 16 32 16 04; e-mail: dirk.springael@kuleuven.be), by e-mail, at the latest on February 21, 2022. The application must contain (1) a curriculum vitae, (2) publications record and study results, (3) a motivation letter, and (4) contact details of 2 persons for references. Information about the research group can be found at http://aow.kuleuven.be/bwb/index.html

Position 2: PhD position: World-wide diversity of genotypes determining the bacterial catabolism of a pesticide: does it tell us something about the origin, evolution and distribution of catabolic gene clusters.

Despite the unnatural chemical structure of pesticides and the short time frame in which they occur in the environment, bacteria emerged that carry catabolic pathways for using these chemicals for growth. Although originating from distant geographical areas, isolates that degrade the same pesticide, display basically similar catabolic pathways and genes, although with differences in gene sequence and organization. The questions are whether such genotypes emerged independently and/or whether they spread and further evolved from a few locations and how their genetic make-up

and evolution contributed to their distribution. Due to the limited number of isolates from a limited number of locations and the fact that only information is available from cultured strains, these questions can currently not be answered. This project will do so by interrogating the worldwide variation of a particular pesticide catabolic genotype in soil using culture-dependent and culture independent approaches (DNA-SIP). It will be examined whether region-specific catabolic genotypes and profiles of global distribution and evolution can be recognized. This will be linked to biotic and abiotic soil parameters and climatic and anthropogenic parameters to infer the underlying factors of emergence/evolution/distribution of the catabolic genotype(s) and the role of the genetic make-up in global spread.

Candidates must have a degree in gene technology, genetics, environmental microbiology, microbial ecology, biochemistry, or alike with expertise related to the concepts and techniques mentioned in the research description. Candidates must be also fluent in English.

Interested candidates should send their application to Prof. Dirk Springael (Tel: ++ 32 16 32 16 04; e-mail: dirk.springael@kuleuven.be), by e-mail, at the latest on February 21, 2022. The application must contain (1) a curriculum vitae, (2) publications record and study results, (3) a motivation letter, and (4) contact details of 2 persons for references. Information about the research group can be found at http://aow.kuleuven.be/bwb/index.html

Position 3: PhD position: Putting ecological invasion theories to the test: improving bioaugmentation of drinking water treatment systems for organic micropollutant removal.

Biological treatment involving bioaugmentation has been proposed as a green alternative for physico-chemical treatment of intake groundwaters contaminated with organic micropollutants (OMPs) for drinking water production. A main bottle neck though is the inefficiency of bioaugmentation. Bioaugmentation merely involves an invasion process. In this project, ecological invasion theories are put to the test addressing different determinants of invasion, i.e., selection, dispersion and diversification, to improve bioaugmentation. This will be done for three different OMP catabolic bacterial strains in continuous biofilm ecosystems and the effects of these manipulations on the resident community and its functionality will be examined. Selection is manipulated by creating new niches by adding selective C-sources, by implementing environmental disturbances to remove competing organisms or opening space, and by co-inoculation with beneficially interacting bacteria. Dispersion will focus on propagule pressure while diversification will examine the evolution of the inoculum towards variants with improved invasion abilities. Invasion success will be scored based on both cell numbers and OMP biodegradation activity. This project will provide both novel applied and fundamental information for and regarding the microbial invasion of complex ecosystems.

Candidates must have a degree in environmental microbiology, microbial ecology, biochemistry, gene technology or alike with expertise related to the concepts and techniques mentioned in the research description. Candidates must be also fluent in English.

Interested candidates should send their application to Prof. Dirk Springael (Tel: ++ 32 16 32 16 04; e-mail: dirk.springael@kuleuven.be), by e-mail, at the latest on February 21, 2022. The application must contain (1) a curriculum vitae, (2) publications record and study results, (3) a motivation letter, and (4) contact details of 2 persons for references. Information about the research group can be found at http://aow.kuleuven.be/bwb/index.html

Position 4: PhD position or post-doc position: Improving biodegradation of an organic micropollutant mixture in dilute freshwaters by means of mixed substrate utilization.

Adequate supply of freshwater for drinking water is an immense growing problem worldwide due to increasing demands and pollution. An increasing problem is the occurrence of organic micro-pollutants (OMPs) in freshwater resources. OMPs are organic chemicals that occur at trace concentrations (ng/L – µg/L range) with potential ecotoxicological and/or human health effects. OMPs include pesticide residues, pharmaceuticals, (synthetic) hormones, and others. The research carried out in this project is part of the multi-partner collaborative SBO-FWO funded Smart-Detox project, (https://www.youtube.com/watch?v=clbCB-8WdGA) which aims at developing sustainable advanced water treatment technology combining efficient OMP retention by membrane technology and OMP destruction based on biological and/or plasma-based oxidative degradation processes, together with a minimal input of energy and chemicals. This PhD project focuses on the microbial removal of a OMPs from groundwater by metabolic biodegradation for drinking water treatment. More specifically, it aims at resolving bottle necks for OMP biodegradation linked with the inherent extreme low pollutant concentrations and the oligotrophic nature of the target waters limited in dissolved organic carbon (DOC) required for energy and growth. These conditions in the long term lead to energy constraints, starvation, physiological changes and reduced OMP degradation. As a solution, the project explores whether mixed substrate utilization, i.e., the addition of auxiliary C- and energy sources, improves the sustainability of OMP biodegradation and whether this can be achieved for a consortium of three bacterial strains for simultaneous biodegradation of three different OMP compounds in a membrane reactor setup. Apart from process development, the project aims at the understanding of the underlying physiological adaptations of OMP degrading microbiota to low substrate conditions. This challenging project involves the use of chemostat/retentostat culturing, modelling of substrate utilization and growth kinetics, ULPC-MS/MS for determining OMP concentrations, single cell enumeration techniques such as fluorescence microscopy and flow cytometry combined with staining techniques, molecular techniques as qPCR and proteomic analysis.

Candidates must have a degree in environmental microbiology, microbial ecology, biochemistry or alike with expertise related to the concepts and techniques mentioned in the research description. Candidates must be also fluent in English. The post-doc application is only for researchers that do not have a Belgian nationality, that did not attain their PhD at a Belgian institute and that did not stay for a period of more than 24 months in the period before the start of the post-doc position in Belgium (for study or work).

Interested candidates should send their application to Prof. Dirk Springael (Tel: ++ 32 16 32 16 04; e-mail: dirk.springael@kuleuven.be), by e-mail, at the latest on February 21, 2022. The application must contain (1) a curriculum vitae, (2) publications record and study results, (3) a motivation letter, and (4) contact details of 2 persons for references. Information about the research group can be found at http://aow.kuleuven.be/bwb/index.html

Position 5: Post-doc position: Deciphering the role of insertion elements in community adaptation to anthropogenic environmental changes (Bilateral Flanders-China FWO project).

Horizontal gene transfer plays an essential role in the adaptation of microbial communities to anthropogenic environmental changes. Typical examples are adaptations that confer antibiotic resistance, metal resistance and catabolism of xenobiotic organic pollutants. Among the vehicles that govern HGT are conjugative elements and insertion sequence (IS) elements. Conjugative elements such as plasmids transfer the adaptive gene functions between different organisms while IS elements are thought to play an essential role in the acquisition of the adaptive traits by the conjugative elements as such making the traits prone to lateral transfer. While much information exists on the molecular mechanisms of IS transposition and IS mediated gene acquisition, less information exist, and this in contrast to plasmids, about the contribution of IS elements to HGT and microbial adaptation

in a wider community context. The project aims to acquire a better understanding of the role of IS elements in genetic adaptation at the community level and the anthropogenic environmental drivers underlying IS mediated gene recruitment and HGT in complex communities. Using innovative tools and experimental design, it will examine the abundances and genetic cargo of different IS elements as well as IS mediated gene recruitment and HGT in soil and freshwater environments in Europe and China, and will explore their relationships with environmental parameters and anthropogenic selective pressures. This project relates to a 3 years bilateral collaborative research project with Prof. Su Jian-Qiang of the Institute of Urban Environment, Chinese Academy of Sciences and a long-term research stay is foreseen in the lab of Prof. Su. The chosen candidate will work closely with the successful candidate applying for PhD position 1.

Candidates must have a degree in environmental microbiology, microbial ecology, genetics, genetic engineering, biochemistry or alike with expertise related to the concepts and techniques mentioned in the research description. This post-doc application is only for researchers that do not have a Belgian nationality, that did not attain their PhD at a Belgian institute and that did not stay for a period of more than 24 months in the period before the start of the post-doc position in Belgium (for study or work). Candidates must be also fluent in English.

Interested candidates should send their application to Prof. Dirk Springael (Tel: ++ 32 16 32 16 04; e-mail: dirk.springael@kuleuven.be), by e-mail, at the latest on February 21, 2022. The application must contain (1) a curriculum vitae, (2) publications record and study results, (3) a motivation letter, and (4) contact details of 2 persons for references. Information about the research group can be found at http://aow.kuleuven.be/bwb/index.html