



Qu'est-ce que le dispositif ExposUM Doctoral Nexus ?

Les Doctoral Nexus proposés par [l'Institut ExposUM](#) sont des réseaux de 3 à 4 doctorantes et doctorants, issus de disciplines différentes et affiliés à au minimum deux unités de recherche différentes.

Par rapport à une thèse classique, participer à un Doctoral Nexus favorisera la capacité à travailler en équipe et à concevoir des projets de manière transdisciplinaire tout en approfondissant son propre champ d'expertise.

Un programme pédagogique spécifique sera proposé et les doctorant(e)s concerné(e)s auront également l'opportunité d'organiser un séminaire au sein du réseau Nexus.

Les thèses sont financées d'emblée pour 4 années, comprenant le salaire du doctorant ou de la doctorante ainsi qu'une enveloppe d'environnement.



Sujet de thèse

Intitulé du sujet de thèse : **Development of original biophysical tools to evaluate the combined effect of pollutants and viruses on model lung tissue** / Part of the COCKTAIL Nexus project

Date envisagée de démarrage de la thèse : 10/2024

Directeur de thèse : MASSIERA, Gladys, UMR5221 (L2C), école doctorale I2S, fraction d'encadrement du doctorant proposé 50%, taux d'encadrement total actuellement engagé 80%

Co-directeur/encadrant de thèse : BLANC Christophe, I2S (pas de HDR), UMR5221, I2S, 25%, taux d'encadrement total actuellement engagé 20%. Le candidat interagira également avec un chercheur postdoctorant expérimenté 25%, impliqué sur un projet différent mais impliquant des outils proches en microfluidique et analyse d'images et de données.

Context : Exposure to air pollutants is known to have a profound impact on human health as well as viruses, as illustrated by the recent pandemic. The mucus and the cilia beating in our lung tissue ensures, for healthy subjects, a continuous cleaning called the mucociliary function. When pollutants and viruses both reach this barrier, some cocktail effects can occur and favor infection.

Proposed objectives and methods : As an alternative to animal testing, we propose to develop an airway on a chip (iOC) setup, mimicking the principal features of the lung tissues and allowing to apply physiological flow of relevant aerosols. The goal is to decipher the mechanisms of deposition and alteration of the lung tissue function, when exposed to pollutants alone or to a combination of fine particles and viruses.

A microfluidic chamber similar to the one published in (Nikolaev et al., 2020) is currently being developed. It includes a media reservoir and a central chamber containing a biopolymeric gel in





which a cylindrical lumen will be sculpted by laser ablation. Cells from lung organoids will be seeded on this gel, to form a functional tissue mimicking a bronchial branch. An air flow will then be applied with an aerosol containing specific particles of controlled concentration, that will be fine particles. The exposed mini-lung will later be infected with viruses. This will serve as a testing platform. Biophysical parameters to quantify the mucociliary function alteration will be inferred from high-speed imaging, image and data analysis: the density and beating frequency of active cilia, mucus rheology, mucus flow and beating coordination using correlation functions. The project is part of a Nexus project implying 2 other PhD students in the respective team of John De Vos and Delphine Muriaux, whose expertise will be in organoids biology and in virology and with who the recruited physicist candidate will closely interact, both for the airway on a chip development and optimization, as well as for the design of the aerosols and the imaging acquisition and analysis.

Expected results : Combining biological and genetical measurements monitored by D1, D3 teams, to our quantitative evaluation of the mucociliary function, to understand the respective impact of some specific pollutants and viruses on lung tissues and the corresponding mechanism, thanks to our airway organ on a chip. More specifically, we expect to decipher the synergistic effect favoring tissue infection by viruses.

Feasibility : Applying protocols already published (Jory et al., 2022; Jory et al., 2019), and leveraging on the L2C team equipment and knowledge/knowhows in microfluidics specific design (Loiseau et al., 2015) (Layachi et al., 2022), we expect to obtain a chamber to be seeded with organoid cells before the PhD starts, as this is already being built up for a related preclinical project led by a postdoctoral researcher. A biophysical tools box has been developed to measure the physical characteristics of muco-clearance (flow fields, cilia beating characteristics) as well as original rheology experiments to measure mucus rheology on the culture (Jory et al., 2022; Jory et al., 2019). The testing platform and the analysis tools will be optimized jointly with D1 and D2 teams.

Modalités de candidature

La candidature doit être composée des éléments suivants :

- Un CV
- Une lettre de motivation
- De la copie du diplôme permettant l'inscription
- Des éléments spécifiques demandés par l'école doctorale I2S (<https://edi2s.umontpellier.fr/>)

Si vous souhaitez postuler sur ce sujet, adressez au plus vite un mail à Gladys.Massiera@umontpellier.fr en mettant en copie john.devos@inserm.fr et exposum-aap@umontpellier.fr afin de les informer de votre intérêt.

Avant le dimanche 21 avril, 20h CET





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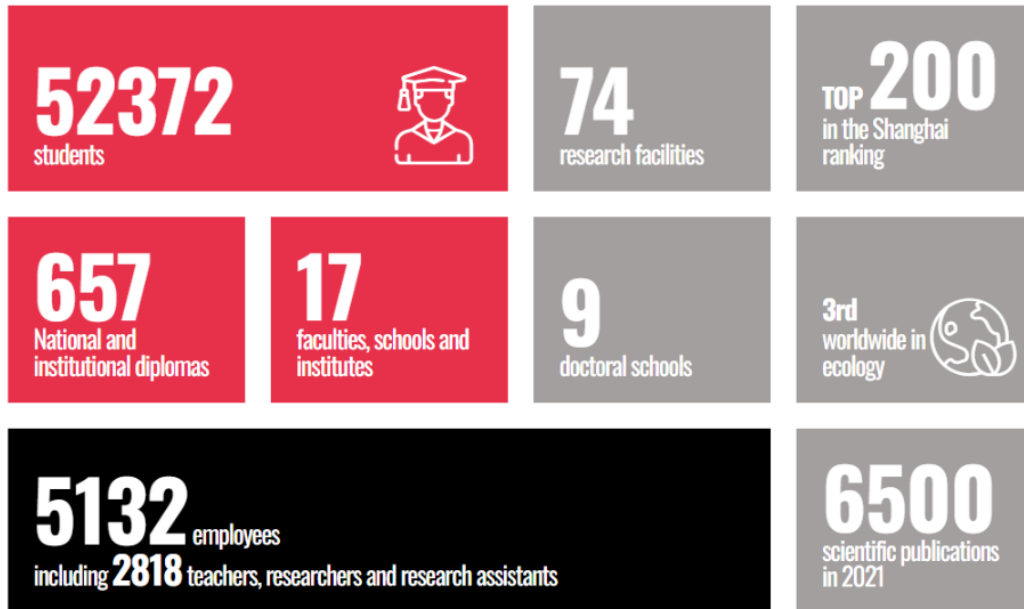


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KEY FIGURES



RESEARCH CENTERS

From space exploration and robotics to ecological engineering and chronic diseases, UM researchers are inventing tomorrow's solutions for mankind and the environment. Dynamic research, conducted in close collaboration with research organizations and benefiting from high-level technological platforms to meet the needs of 21st century society.

The UM is committed to promoting its cutting-edge research by forging close links with local industry, particularly in the biomedical and new technologies sectors.

More Information: <https://www.umontpellier.fr/en/recherche/unites-de-recherche>

SCIENTIFIC APPEAL

Open to the world, the University of Montpellier contributes to the structuring of the European higher education area, and strengthens its international positioning and attractiveness, in close collaboration with its partners in the I-SITE Program of Excellence, through programs adapted to the major scientific challenges it faces.

More Information:



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<https://www.umontpellier.fr/en/international/attractivite-scientifique>



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