

Junior Professor Chair Position
PRISM Inserm U1192

Host Institution: INSERM

Director of the host institution: Gilles BLOCH

Region: Lille

Partner institutions/organizations: *University of Lille*

Project name: intraoperative mass spectrometry for precision health

Keywords: *mass spectrometry, metabolomics, imaging, clinical, surgery*

Duration: 3 years

Scientific panel: Health Technology

CNU section/CoNRS/corresponding CSS: CNU 31 or 85, Inserm CSS7

Institutional strategy: describe how the recruitment is related to the institution's strategy

The Chair project is dedicated to the development of intraoperative mass spectrometry for precision medicine in line with the developments realized at PRISM on *in vivo* mass spectrometry. Intraoperative mass spectrometry is a game changer for clinical applications including surgery and pathology and is expected to create a paradigm shift in the clinical practice. This research field is well positioned within the Health Technology Institute and has been identified as strategic research to support the development of the next generation surgical rooms. Additionally, the thematic is identified to be in the priorities of Lille University Excellence Hub (ISite) "Precision Health" has demonstrated by the funding support given. It has also been targeted in the CPER 2021-2027 TECSANTE, which focuses on technological innovation in the service of acute and chronic precision health, where it will receive funding for equipment. At the university level, this line of research will be an integral part of the Engineering & Health project, positioned at the interface of the "precision health" and "digital world at the service of humans" hubs, with the objective of offering the community new disruptive tools to answer clinical questions.

Strategy of the host laboratory: describe how the recruitment is in line with the strategy of the host laboratory

PRISM Inserm U1192 laboratory is a single-team unit organized around two axes dedicated respectively to technological and therapeutic innovations. PRISM has always been supporting the development of novel technology based on mass spectrometry such as Mass Spectrometry Imaging. Since several years, PRISM is promoting the development of a novel *in vivo* and intraoperative mass spectrometry technology (SpiderMass) which enables *in vivo* and real time molecular analysis for diagnostic and decision support in surgery. PRISM has made the proof-of-concept of the technology at the veterinary surgery room from dog patients first and then on a cohort of 200 volunteers suffering from skin diseases within the framework of a collaboration with the PFDC company. In view of the growing interest of hospital and research academics for intraoperative mass spectrometry, the laboratory wishes to strengthen this research through a professor chair position to enable the development of the technology towards automation and miniaturization (i.e. endoscopy, laparoscopy) and the increase of learning capacities through the development of novel deep learning solutions. This ambitious project requires a reinforcement of the human resources by the recruitment of a talented researcher.

Summary of the scientific project:

Intraoperative mass spectrometry is a new disruptive field of research offering an *in vivo* and real-time collection of molecular data to guide the physician in its decision-making during surgery through the creation of molecular digital twins. It is thus intended to be a new tool for *in vivo* diagnosis and decision support in surgery in the context of precision medicine. In solid cancer surgery, for example, it has been shown that patient survival is closely linked to the quality of the surgery and unfortunately up to 30% of patients must undergo a second operation due to positive margins. Intraoperative mass spectrometry technology allows to collect in real-time molecular profiles that are specific to the cell types and subtypes analyzed. These molecular profiles can be associated to specific cell phenotypes (e.g., cancerous, or inflammatory) through machine-learning or deep learning. The project focuses on the development of intraoperative mass spectrometry, its miniaturization to allow analyses in minimally invasive surgery (e.g., endoscopy), its automation by robotization and the integration of augmented reality.

Summary of the teaching project:

The chair will be offered to teach within the graduate programs of the University of Lille and more precisely in the "Precision Health" graduate program in the field of technologies for health and omics. The professor will also lecture in the Omics & Systems Biology track of the Master of Bioinformatics on metabolomics and mass spectrometry and will also access lectures in the Erasmus Mundus Master "Advanced Spectroscopy in Chemistry".

Financial summary: using the attached financial form, describe the financial needs and their distribution to carry out the scientific project (doctoral student, post-doctoral student, IT, equipment, etc.)

ANR funding package	200 000 €
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Scientific dissemination: specify the expected results in terms of scientific dissemination (publications, communications, etc.)

The SpiderMass project has already been the subject of 4 publications in journals with an impact factor >10 (i.e. Cancer Cell, Nature Protocols, Nature Communications, Trends in Molecular Medicine) and publications for the general public in the press (Inserm Magazine, Le Figaro, Dr Good, The Conversation, Notre Temps) as well as communications in scientific conferences. The ambition is to keep the same publication rate. In particular, we are targeting "Nature Biomedical Engineering" or "Nature Methods" for the in vivo imaging part. For the automation and AI-related developments, we will target journals such as "Science Translational Medicine". Finally, for the clinical studies that will be carried out with the system we will rely on journals such as "Cancer Cell" or "Lancet Oncology". The Chair will also oversee communicating on the developments made in mass spectrometry congresses (in particular American Society for Mass Spectrometry, >6°000 participants) but also on the clinical applications in oncology congresses such as " American Society of Clinical Oncology (ASCO) ". The Chair will be encouraged to carry out dissemination actions to the general public via videos but also by the realization of a MOOC.

Open Science: Is the project part of an open science approach? If so, describe its implementation

The project is part of an open science approach. On the one hand, all the mass spectrometry data that will be generated within the framework of the project will be made public via their deposit on specialized platforms for this type of data (e.g., European initiative Metaspace, <https://metaspace2020.eu> or Metabolomics Workbench www.metabolomicsworkbench.org). In addition, the articles will be in "Open" format if possible and will also be deposited in HAL. A data management plan will be published at the beginning of the project. The experiments will be followed by the electronic laboratory notebook set up in the PRISM laboratory under the control of Inserm via the "Labguru" interface. In the case of clinical studies, these will be carried out in compliance with the legislation in force in France and the data and will guarantee the total anonymization of the data before their treatment.

Science & Society: does the project envisage communication with the general public? If

yes: specify how and when Communication to the public is envisaged.

This will be done by different means of communication. On the one hand, a web page will be dedicated to the project on the laboratory's website, a page that will be regularly updated to describe the project's progress. Videos will be produced and posted on the website and on video hosting platforms (YouTube, Dailymotion, Vimeo, Facebook...). LinkedIn and Tweeter channels will be created and regularly updated to give visibility to the project. Newsletters will be written and communicated via the University of Lille network, the ULNE ISite and Inserm. Exchanges with patient associations will also be organized to promote the technology. Indicators: specify the indicators for monitoring the deployment of the project and the methodology for their monitoring

Indicators for monitoring project deployment will be based on:

1. Patents and publications including publications in high impact journals;
2. Communications in conferences of the field and organization of workshops to bring the project to life;
3. Funding application to provide additional funds to those provided by the ANR;
4. Application to an ERC Advanced Grant within the 3 years of the ANR funding;
5. Supervision of PhD students and post-doctoral fellows ;
6. Pedagogical capacity and transmission of knowledge through teaching;
7. Development of novel European and international research networks.

The objective for the Chair is to be the international leader in intraoperative mass spectrometry.

The follow-up methodology will be ensured by PRISM. An annual report presenting the scientific and financial results will be provided by the Chair to the supervisory bodies (University of Lille, Inserm) and to the ANR.