Fiche projet type

**Établissement/organisme porteur** : Inserm
Nom du chef d'établissement/d'organisme : Gilles Bloch
Site concerné : Ile-de-France Centre-Est
Région académique : Paris

**Établissements/organismes partenaires envisagés** : *Sorbonne Université*

**Nom du projet** : Neurotechnologies: innovations for a better portability of medical devices
**Mots-clés** : brain imaging, brain signalling, biomarkers, data sciences, artificial intelligence, diagnosis, prognosis, personalized medicine, brain disorders

**Durée visée** :  5 years

**Scientific domain** : Neurotechnologies, Data Sciences, Neurosciences, Neurologie

**Section (s) CNU/CoNRS/CSS correspondante (s)** : 27, 61, CSS7

**Strategy of the host institution**: *(15 lignes maximum)*

In 2018, *Sorbonne Université* (SU) regrouped major Humanities, Science & Engineering and Medical faculties in Paris to empower multidisciplinary teaching and research to meet major challenges facing today's world. SU offers a large range of academic programs, includes 159 research laboratories and works in close association with all the national research organizations, including Inserm. SU's strategy is based on 3 fundamental pillars to: (i) support emerging research and transmit knowledge at the frontier of current research (ii) favor interdisciplinary research and education and (iii) promote open science. SU is engaged in A*lliance 4EU+*, an innovative European University, for which the 1st of 4 flagship programs is "Health and demographic change in an urban environment". SU established the Sorbonne Center for Artificial Intelligence (SCAI) to promote interdisciplinary research in artificial intelligence (AI). With its partners in *Alliance SU*, SU was awarded the project *Excellence ES SOUND* in 2022 for which the "Global approach for health" is one of the three major programs. This Inserm CPJ is strongly placed within SU's priority to develop interdisciplinary AI and health science, open science and academic exchange with national and international partners. This project is also soundly within Inserm's Strategic Plan, 2020-2025, which underlines the call to reinforce the health research continuum while promoting disruptive research.

**Strategy of the host laboratory** :*(15 lignes maximum)*

The Laboratory of Biomedical Imaging (LIB, U1146) leads research in advanced biomedical imaging and engineering to better understand pathophysiological processes, provide more sensitive diagnosis and improve patient care. Neurological diseases are a key focus in LIB research with i) The Neural Connectivity and Plasticity (NCP) team at Pitié-Salpêtrière hospital, working with the departments of neurology, neuro-resuscitation, nuclear medicine and rehabilitation to probe anatomical and functional organization of neural networks and their modulation under physio- and pathological conditions in humans by coupling multimodal neuroimaging and electrophysiology to develop models of connectivity and plasticity, isolate quantitative parameters used as biomarkers to improve diagnosis, prognosis and develop new tools for precision medicine and ii) The Physiology and Pathology of Microcirculation (PPM) team at Cordeliers Research Center developing 3D, super-resolution ultrasound techniques based on micrometric localization and tracking of injected ultrasound contrast microbubbles to noninvasively reveal microvascular architecture and flow in the brain for transfer to diagnosis of stroke victims. The LIB regroups multidisciplinary expertise in neurosciences, mathematics, physics, biomedical engineering and clinical research supported by prestigious grants (EU grant programs including ERC, ANR, BPIFrance etc.).

**Summary of the scientific project** : *15 lignes maximum*

On-line and transportable new approaches to optimize personalized neuropathological evaluation, that can be used in or out of the hospital, are central to LIB research. The NCP team is developing an in-ear EEG device to monitor neural signals in ambulatory patients (with NaoxTechnologies), statistical models independent of lesion origin for prognosis of comatose patients (with BrainTale) and an autonomous neurorehabilitation device (with TechnoConcept). The PPM is developing a 3D, super-resolution ultrasound device for rapid diagnosis of strokes during patient transport to the hospital and for ICU monitoring (with ResolveStroke). Novel analysis techniques in neurotechnology relying on AI are expected to deeply modify clinical routine and to be key in meeting portable deployment challenges for devices relying on complex data acquisition and large data volumes by automatizing complex analysis and more fully interpreting these rich sources of patient data. In the NCP team, the recruited researcher will explore AI approaches in neuro-technological projects providing, for example, more efficient identification of changes in EEG signals, design of more relevant models to predict coma functional outcome or identification of microvascular patterns linked to neurological diseases. The recruited researcher will also participate in transverse working groups within the LIB in the field of AI and in scientific exchanges within SCAI.

**Summary of the teaching project** : *15 lignes maximum*

The recruited researcher will reinforce teaching in courses related to AI within the bachelor's program for computer science as well as master's level courses in computing and robotic automation at SU. The undergraduate courses provide an initial introduction to data science and to key approaches in AI. Master's courses are more specialized and organized around a dedicated cursus. The recruited researcher will be particularly called upon to strengthen courses related to advanced image and signal processing within the Master's degrees in "Computer Science" or "Engineering of Intelligent Systems" or "Robotic Automation". He/she will be encouraged to introduce practical laboratory instruction based on his/her research into all levels of training at SU and to contribute to the international program project led by SCAI and the Computer Science Master-level program to develop courses in English on AI.

**Funding** :

| ANR package | 200k€ |
|---|---|
| Co-funding* | 0k€ |
| Total project | 200k€ |

*source et montant


**Scientific communication and dissemination**:
The policy of the U1146 lab is to publish in the best journals and conferences in our discipline. The recruited researcher is expected to publish regularly as principal author but also as co-author. Several presentations at key international conferences in neurotechnogy and specific technologies related to his/her research will be part of the expected contributions.


**Open Science**:
In view of the industrial potential for this work, major innovations will systematically combine patent filling followed by scientific publications. All published articles will be on HAL in their integral version. As for the data collected and prepared for research, they will be made available to the community as soon as possible, after a possible embargo period.


**Science and society**:
*SU* participates every year in the *Fête de la Science* and the *Nuit des Chercheurs*. The recruited researcher will be expected to actively participate in these events and communicate with the general public. Depending on his or her current situation, he or she may also be interviewed by journalists from the general or popular scientific press.


**Indicators**:

Teaching: The recruited researcher will contribute to the new international program project led by SCAI and Alliance 4EU+ with Master's level courses in his/her domain of expertise in English and potential participation in the organizational basis of the courses. In addition to reinforcement of course teaching in AI and related subjects, he/she will be encouraged to introduce practical laboratory instruction based on his/her research.

Research: Regular publication and co-publication of research and participation in professional international conferences and scientific organizations and expertise will be fostered and expected to ensure that the recruited researcher attains the level of scientific recognition associated with an Inserm DR. Active initiation of new projects and search for independent funding is expected. The recruited researcher is expected, in particular, to apply ambitiously for high level funding such as (but not limited to) ERC grants or ANR. In these efforts, the researcher will be well guided and oriented by members of the LIB who already have obtained such funding and the guidance program, APACHE, which has recently been established by the Faculty of Sciences and Engineering (FSI) of SU.

Knowledge transfer: The recruited researcher will be expected to invest within the programs of SCAI to share knowledge in AI within the university. He/she will also animate a transversal working group to transfer techniques to researchers and students within the LIB.