



iMIND

International Master In Neurodegenerative Diseases

PARIS

2024-2025



Programme presentation ----- 3

Main modules of the programme:

- Developing a Research Project ----- 4
- Hot Topics: Transdisciplinary Approaches to Neurodegenerative and Psychiatric Diseases ----- 5
- Novel Technologies applied to Human Neuropathologies ----- 6
- Glial Pathologies and Neurodegenerative Diseases ----- 7
- Brain to Market Summer School ----- 8
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- Neuron-glia interactions ----- 11
- Neuropsychiatry genetics ----- 12

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Specialized and selective track of the **Master BIP - Neuroscience** (year 2), developed with the **Paris Brain Institute**

The first masters programme to focus specifically on neurodegenerative disorders

Recruits students who wish to understand the functioning of the brain in normal and pathological conditions

Coursework (30 ECTS), Msc second year, first semester

Main thematic courses (4 x 6 ECTS)

- Novel Technologies applied to Human Neuropathologies
- Developing a Research Project
- Hot Topics: Transdisciplinary Approaches in Neurodegenerative and Psychiatric Diseases
- Glial Pathologies and Neurodegenerative Diseases

Specialization coursework (6 ECTS)

Brain to Market
Summer School
(6 ECTS)

OR 1 specialization module
from each series
(2 x 3 ECTS)

Series 2
Series 1

- New Methods for Behavioral and Cognitive Explorations
- Hippocampus: from cells to physiology and human pathology
- Neuron-glia interactions
- Neuropsychiatry genetics

- **Research-oriented** programme (medical, scientific, R&D...), entirely taught in **English**
- **Flexibility** allowed regarding course choices (*access to Neurosciences master BIP modules*)

Up to 4 scholarships (1000 €/month) offered to international students for the first semester upon selection

Master's thesis (30 ECTS), Msc second year, second semester

- Partnership with the **University of Heidelberg**, **Trinity College Dublin**, the **Catholic University of Leuven** and the **Technical University of Munich**.
- **Referent researcher** assigned to each student going abroad.



UNIVERSITÄT
HEIDELBERG
ZUKUNFT
SEIT 1386



iMIND is designed to teach the latest scientific advances in the field of neurodegenerative diseases and to stimulate scientific curiosity, creativity, autonomous and team work, as well as critical thinking.

Prerequisites: first year of Msc (M1) level in neurosciences, biology or equivalent



HOT TOPICS: TRANSDISCIPLINARY APPROACHES TO NEURODEGENERATIVE AND PSYCHIATRIC DISEASES

Students will develop a research project under the supervision of an expert tutor in the field, **a cross between research and library project**.

Project topics will cover **the latest advances in neurosciences**, specifically regarding neurodegenerative or psychiatric pathologies as well as cutting-edge technologies.

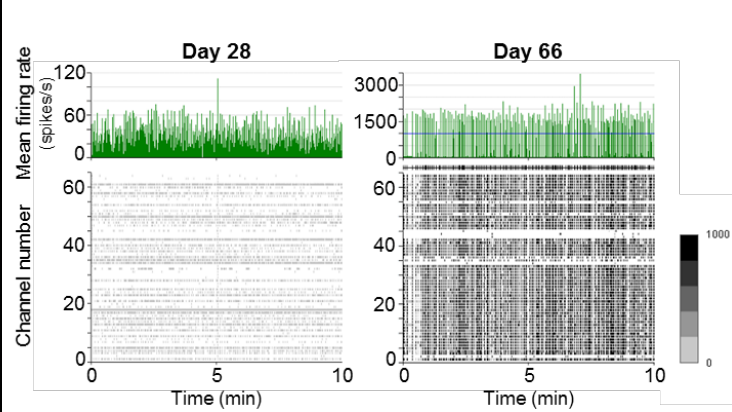
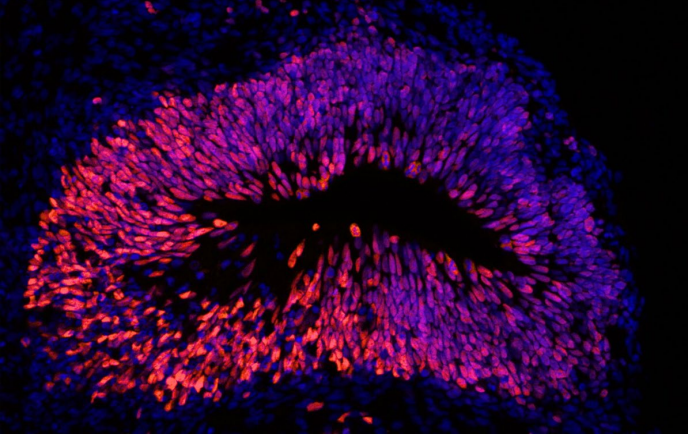
Students will be exposed to notions of fundamental, translational and clinical research by attending **conferences at the Paris Brain Institute**, where they will participate to discussions with the international scientists presenting.

- ➔ Exposure to the multidisciplinary aspects of neurodegenerative and psychiatric diseases research
- ➔ Participation in discussions with international experts *via* the **Paris Brain Institute conference series** which is integrated into the programme
- ➔ **Tutorship with scientists from the Paris Brain Institute and the Neuroscience Paris Seine Institute** to develop a research project

- ✓ Critically analyse the scientific literature
- ✓ Master approaches and tools to study neurodegenerative and psychiatric diseases
 - ✓ Evaluate the validity of these approaches and tools
 - ✓ Suggest experimental approaches to answer scientific issues
 - ✓ Elaborate and organise the interpretation of research data
 - ✓ Present in a clear summarized manner

6 ECTS
iMIND students

4



NOVEL TECHNOLOGIES APPLIED TO HUMAN NEUROPATHOLOGIES

Overview of the **latest methodological approaches** used to study in an integrative way the molecular and cellular mechanisms associated with neuronal function and dysfunction

Focus on four main domains: **Omics, stem cell research, imaging and electrophysiology**

Applications to advance research on **diverse brain disorders** including: Parkinson's disease, ALS, Alzheimer's disease, MS, cancer, neurodevelopmental and psychiatric disorders

- ➔ **Theoretical bases** underlying the main techniques addressed in this course.
- ➔ **Technical demonstrations** at the cutting-edge facilities of the Paris Brain Institute (electrophysiology, Calcium imaging, spatial transcriptomics, research and development...).
- ➔ **Talks from expert scientists** covering their latest research on neurodegenerative diseases (Parkinson's Disease, Alzheimer's Disease, ALS, MS), as well as other human pathologies (neurodevelopmental diseases, epilepsy, addiction, cancer).
- ➔ **Talks from junior scientists** discussing their research projects as well as their professional experience and training.
- ➔ **Workshop on ethical considerations** regarding these new methodological approaches.

- ✓ Understand the most recent approaches to study cellular and molecular mechanisms underlying human diseases
 - ✓ Gain knowledge on the scientific advances in these fields
- ✓ Acquire the methodological understanding (advantages and drawbacks of different approaches) to answer a specific scientific issue
 - ✓ Develop critical thinking regarding an experimental design, results and literature
 - ✓ Develop analysis and synthesis skills

6 ECTS
20 students maximum



DEVELOPING A RESEARCH PROJECT

Acquire the tools to **describe and present a research project**

Students will introduce the scientific question that they will study during their **Master's thesis**

With the help of their host laboratory, students will **develop their experimental approach** with detailed protocols and feasibility considerations.

Opportunity to acquire the pre-requisites skills necessary to complete the Master's thesis, with literature analysis and discussion with the host team during the first semester.

- ➔ **Writing a letter of intention** (scientific background, question raised, experimental strategy)
- ➔ **Oral presentation** and discussion with a researcher

- ✓ Present in a synthetic manner
 - ✓ Conduct a literature review and critical analysis
 - ✓ Describe a research project and experimental protocols
- ✓ Acquire theoretical skills necessary to apprehend useful concepts for experimental practice in biology
 - ✓ Assess feasibility and limits associated with planned experiments

6 ECTS

7

The Brain to Market Summer School



BRAIN TO MARKET SUMMER SCHOOL PARIS BRAIN INSTITUTE (ICM) COURSEWORK

Brings together a diverse group of students from backgrounds in science, engineering, design and medicine **to develop original solutions for people living with brain disorders**

Basis of **entrepreneurship** and **business plan development** including project management

Themes have included depression, Parkinson's, MS, epilepsy and rehabilitation.

Continuity with Paris Brain Institute tech transfer team's annual hackathon and prototyping sessions

No prerequisite in marketing or business required

Day
1

Introduction of the scientific topic by all the care workflow (researchers, clinicians, paramedical staff).

Days
2-3

Basis of marketing, business, health economy, ethic and regulatory aspects by actors of the Health and Wellbeing Business Community examples (companies, patients, regulators professionals).

Days
3-5

Within multidisciplinary teams, design of a valuable proposal to develop concepts and products transferable from research to business and vice versa.

Day
5

Presentation of the projects to a panel of experts.

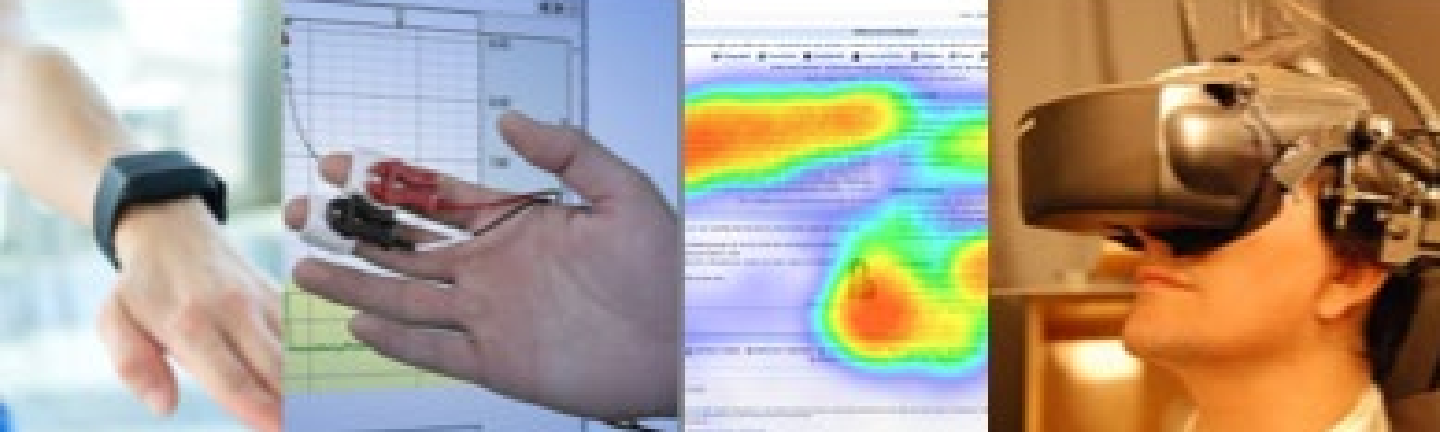
Topic of this year:
**Amyotrophic
Lateral Sclerosis**

- ✓ Identify challenges raised by a neurological/psychiatric disease in the context of ageing
 - ✓ Learn and exchange within a multidisciplinary group
 - ✓ How to prepare a marketable project
 - ✓ Create a network of alumni
 - ✓ How to pitch a project in front of potential investors

6 ECTS

10 students maximum

8



NEW METHODS FOR BEHAVIORAL & COGNITIVE EXPLORATIONS: APPLICATIONS TO NEURODEGENERATIVE DISEASES (NDD)

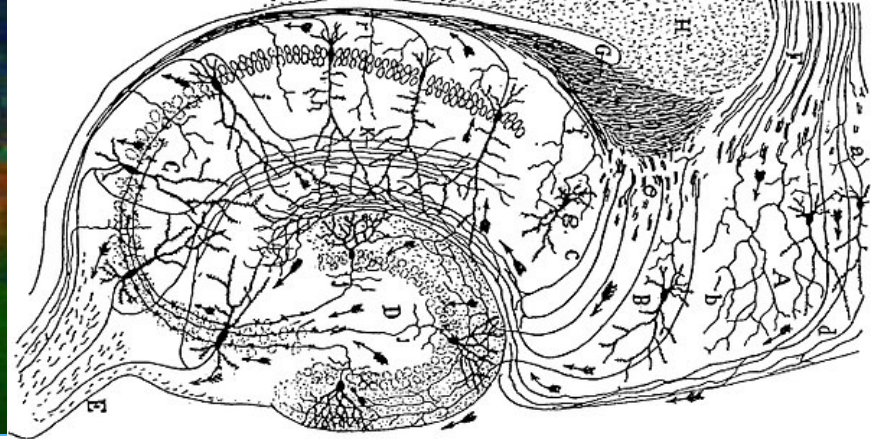
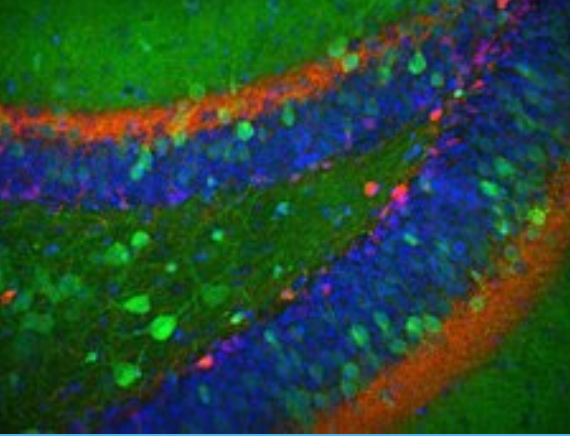
Overview of the **latest methods** from cognitive, behavioral and engineering sciences to refine our understanding of the behavioral and cognitive aspects of NDD.

Approach centered on humans: focus on methodologies to quantitatively assess the **behaving patients**.

- ➔ **Practical demonstrations** of the research tools available at the Paris Brain Institute (ICM), for exploring the behavior and the cognition (emotion and thought processes) in patients, mostly at the PRISME core facility.
- ➔ Presentation of a **variety of assessment tools** such as: computerized cognitive tests, eye-tracking systems, movement trackers, digital devices.
- ➔ **Talks from expert scientists** illustrating through concrete research programs how such tools have been used to investigate motivational disorders in Parkinson's Disease, apathy in Fronto-temporal Dementia, spatial memory deficits in Alzheimer's Disease.
- ➔ Connections with **functional brain imaging** (brain imaging facility, CENIR).
- ➔ **Demonstrations of real-life market-ready applications** in partnership with the ICM startup program.

- ✓ Introduction to cognitive and behavioural research
 - ✓ Basic knowledge of the cognitive and behavioural symptoms of NDD
- ✓ Interests and limits of current methodologies used in experimental psychology
 - ✓ Evaluate the validity and relevance of these approaches and tools in NDD
- ✓ Understanding the current hypotheses on the connections between psychological disorders and neurobiological mechanisms in NDD

3 ECTS
12 students maximum



HIPPOCAMPUS: FROM CELLS TO PHYSIOLOGY AND HUMAN PATHOLOGY

Overview of the **physiological functions of the hippocampus and their alterations** in a variety of neurological and psychiatric disorders, including epilepsy, schizophrenia and Alzheimer's disease

Description of the hippocampal functions at all levels, **from cells and their synapses to human brain and its pathology**

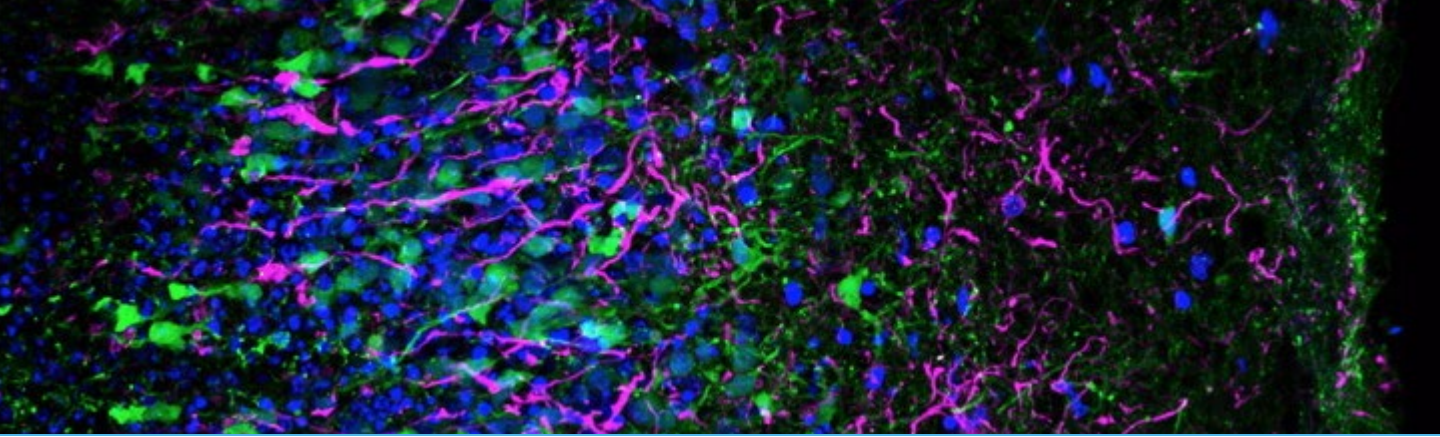
Talks from expert scientists studying

- ➔ Development, anatomy and morphology of the hippocampus
- ➔ Cellular and synaptic physiology
- ➔ Long-term synaptic plasticity
- ➔ Hippocampal rhythmogenesis and behavior
- ➔ Spatial navigation
- ➔ Functional imaging and memory
- ➔ Hippocampus and diseases

- ✓ In depth knowledge about hippocampal anatomy, cells, circuits and synaptic functions
- ✓ In depth knowledge of hippocampal rhythmogenesis in normal and pathological conditions
 - ✓ Basic concepts on fMRI and clinical imaging approaches
 - ✓ Clinical and cellular aspects of temporal lobe epilepsy
 - ✓ Anatomical alterations in Alzheimer's disease

3 ECTS

10



NEURON-GLIA INTERACTIONS

Discovery of the fascinating world of neuron-glia interactions and **their roles in the brain physiology and pathophysiology.**

Different examples of neuroglia-interactions will be illustrated along 11 lectures:

- ➔ Astrocytes/neurons (tripartite synapse, synapse development, astrocyte networks...)
- ➔ Oligodendrocytes/neurons (myelin plasticity in health and disease)
- ➔ OPCs/neurons (NG2 cell/neuron synapse)
- ➔ Microglia/neurons(roles in neuronal functions and neurodegenerative diseases)
- ➔ Neuroglia metabolic coupling
- ➔ Glioma cells/neurons (role in gliomagenesis)
- ➔ Specific techniques to study glial cells
- ➔ Neuron-astrocyte interactions in brain diseases
- ➔ Glia cell development
- ➔ Glial cell roles in complex behaviors

- ✓ Basic knowledge on neuron-glia interactions in health and disease
- ✓ Technical approaches to study neuron-glia interactions

3 ECTS

11



NEUROPSYCHIATRY GENETICS

Introduction to the study of **etiopathogenic factors of neuropsychiatric disorders**.

Overview of a variety of techniques and their developments, including epidemiological and molecular genetics, gene expression regulation, brain imaging, neuropsychology evaluation, animal models, and tools for gene x gene and gene x environment interactions.

Applications to various diseases: bipolar disorder, schizophrenia, suicidal behaviour, autism, intellectual disability, attention deficit and hyperactivity disorders.

Talks from expert scientists studying

- ➔ Molecular genetics of psychiatric disorders
- ➔ Epigenetics and psychiatric disorders
- ➔ Pharmacogenetic and biomarkers of the response to treatments
- ➔ Neuro-imaging
- ➔ Psychotic disorders and immuno-inflammatory hypothesis
- ➔ Autistic spectrum disorders and developmental hypothesis
- ➔ Suicidal behavior: a trans-nosographical entity
- ➔ Genetic of substance abuse disorders
- ➔ Bipolar disorders and circadian hypothesis

✓ Update in psychiatry genetics: recent findings, technology, expected progress...

✓ How to appreciate scientific publication: take home message, limits, strength and weaknesses.

3 ECTS

12

Contacts

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Applications: from March 28th to June 13th 2024

Should you have any questions, please contact: **Hélène Cheval**

<https://sciences.sorbonne-universite.fr/formation-sciences/masters/biologie-integrative-et-physiologie/international-master>



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