RESEARCH TEAMS AND TECHNOLOGICAL PLATFORMS OF THE ICM
INSTITUT DU CERVEAU ET DE LA MOELLE ÉPINIÈRE — ICM
ITS MISSION
Develop basic and clinical research on the nervous system, in order to understand its organization and functioning under both normal and pathological conditions.

ITS OBJECTIVES
• Elucidate the mechanisms underlying the development and functioning of the nervous system.
• Propose new diagnostic and therapeutic strategies.

ITS STRONG POINTS
• Internationally recognized scientific, medical and technical expertise.
• The proximity between clinicians and researchers, which encourages fruitful interactions and allows access to a variety of animal models and a large number of patients with neurological disorders.
• Multidisciplinary research involving basic science—developmental biology, molecular and cellular biology, genetics, physiology, imaging, cognitive sciences—and clinical disciplines: neurology and psychiatry.
• National, European and international collaborations between scientists and clinicians.

ITS RESEARCH
Its studies range from molecules to healthy or diseased humans and from physiopathology to human physiology. The questions approached include:
• The development of the nervous system;
• Cognitive functions;
• Neurological and psychiatric disorders: neurodegenerative diseases, multiple sclerosis, prion diseases, epilepsy, brain tumours, rare diseases;
• Methodological research in neuroimaging, electrophysiology and transgenesis.

The ICM is an international centre of scientific excellence, located on the site of the Pitié-Salpêtrière University Hospital in Paris, focused on an important issue of public health. An exceptional pluridisciplinary establishment, in which research is transversal and dedicated to diseases of the brain and the spinal cord. An association between the public and private sectors united by a unique entrepreneurial spirit.

An institute “at the service of patients”, which brings together, on the same site, patients, physicians and researchers with a common aim; make rapid advances in research and accelerate the discovery of innovative treatments. The institute hosts about 600 researchers, teachers, clinicians, engineers, technicians, post-doctoral fellows and administrators, working in 25 research teams. The latter have access to a dozen cutting-edge technological platforms.
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Probing dynamic sensory-motor integration in spinal circuits
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PHENO-ICMice

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iVector

HISTOMICS

CENIR-MEG/EEG

PHENO-PRIM

CENIR-SA MRI

CELIS

CENIR-HUMAN MRI

PHENO-ZFish

PRISME

CENIR-STIM

CENIR-PANAM

iCONICS

TECHNOLOGICAL PLATFORMS AND DATA BANKS
Séverine Boillée’s team focuses on the pathological interactions between the affected motor neurons in Amyotrophic Lateral Sclerosis (ALS or Lou Gehrig’s disease) and their reactive neighboring microglia and macrophages. Our aim is to find new deleterious and beneficial pathways that could be therapeutically targeted to slow progression of motor neuron degeneration and ameliorate ALS disease course.

To achieve this, we work both with experimental models and ALS patients to ultimately assess how known and novel genetic causes influence non-cell autonomous ALS toxicity. Our link with the ALS clinic, patient history and pathology allows us to both search for novel genetic causes and translate findings established in experimental models in vitro and in vivo to the actual disease in ALS patients using disease modeling with induced pluripotent stem cells (iPSC) and analysis of post-mortem tissues.

Séverine Boillée is the head of the “ALS causes and mechanisms of motor neuron degeneration” team at the ICM and is an associate professor at INSERM. She received her PhD in Neurosciences in 2001 at the University Paris XII and specialized on ALS through her post-doc at UCSD with Pr. Don W Cleveland. In 2011, she received, together with the Pr. Vincent Meininger the “NRJ-Institut de France” prize for her research on ALS. She is a scientific board member of the Thierry Latran Foundation (European ALS association), the ARSLA (French ALS association) and of the scientific program committee of the ENCAILS (European Network for the cure of ALS) yearly meeting.

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**MAJOR PUBLICATIONS**

Alexis Brice’s research group mainly focuses on 3 types of neurodegenerative diseases: Parkinson’s disease-PD, spinocerebellar degenerations-SCD, and frontotemporal lobar degenerations-FTLD, which share many clinical and physiopathological features. His team is developing an integrated approach to these disorders, from their genetic bases to their physiopathology, including preclinical and clinical studies to identify prognosis, disease progression biomarkers and ultimately new treatments.
Marie-Claude Potier’s and Stéphane Haïk’s group aims at understanding the role of lipids, particularly cholesterol and ApoE, in the secretion and neuronal transport, of AB, their involvement in endosomal modifications that occur early during the course of the disease and novel mechanisms of AB toxicity identified in vivo.

Stéphane Haïk’s group studies the development of pre-mortem diagnostic procedures for Prion’s disease, the characterization of classical and emerging human prion strains, the understanding of the molecular and cellular mechanisms underlying prion strain selection, propagation and pathogenicity in the human brain.

Marie-Claude Potier is co-leader of the Alzheimer’s and Prion’s Diseases team at the ICM, and Research Director at CNRS. She received a PharmD in 1983 and a PhD in Neuropharmacology from the University Pierre and Marie Curie in 1988. She is member of the American Society for Neuroscience, of the International Society to Advance Alzheimer’s Research and Treatment and on the board of the Société des Neuroscience. She is a referee for numerous international journals and national and international foundations. In 2005 she received the Dagnan Bouveret Prize from the Institut de France.

Stéphane Haïk is co-leader of the Alzheimer’s and Prion Diseases team at the ICM, Research Director at INSERM and coordinator of the French National Center of Reference for Unconventional Transmissible Agents. He received a MD in 1997 or University Paris V René Descartes, and a PhD in Neurosciences in 2003. He received the “Prix de l’Internant/Paris-2000” and an Inserm Avenir Award 2005. He is a referee for numerous international journals and for National agencies involved in risk assessment and public health surveillance.

MAJOR PUBLICATIONS


Fontaine and Nicole’s team has three objectives, to understand neuromuscular excitability by studying orphan monogenic diseases (congenital myasthenic syndromes, muscle channelopathies and related disorders), to advance the knowledge of Multiple Sclerosis pathophysiology by studying specific biological pathways, and to increase its knowledge on amyloid accumulation in Alzheimer’s Disease through receptor modulation.

**PRINCIPAL INVESTIGATORS**

Mohamed El Behi  
Cécile Delarasse  
Bruno Eymard  
Emmanuel Fournier  
Isabelle Rebeix  
Damien Sternberg  
Savine Vicart

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**MAJOR PUBLICATIONS**


Etienne Hirsch’s team focuses the neuro-immune pathological interactions in Parkinson Disease. The goals are to uncover the identity, origin and function of the various innate and adaptive immune cells involved in response to dopamine (DA) neuron degeneration, investigate the pathological impact of DA lesions on non-DA systems and its reciprocity.

Using a combination of clinical, physiological, imaging and transcranial magnetic stimulation studies, the team will decipher the role of non-DA lesions in gait and balance disorders. This project will highlight new symptomatic and curative therapies.

**Major Publications**


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**Principal Investigators**

François Chantal
David Grabli
Stéphane Hunot
Annie Lannuzel
Rita Raisman
Marie-Laure Welter
Patrick-Pierre Michel
Edor Kabashi’s team is aiming to identify novel genetic causes in Amyotrophic Lateral Sclerosis (ALS) and to develop mutant transgenic zebrafish models for these genes to study neurodegenerative processes. This approach also allows the team to use these genetic models for multigenic interactions and drug discovery.

Our team has developed innovative screening protocols to identify neuroprotective compounds, to understand molecular mechanisms modulated by these compounds and to advance therapy development in neurological diseases. This project aims at accelerating transition from lab bench to bedside by defining therapeutic avenues for neurodegenerative diseases.
Parkinson Disease (PD) results in severe motor dysfunction that is alleviated by deep brain stimulation (DBS) of the STN, but debilitating side effects are observed in some cases. Yet, the function of the STN remains unclear, making it difficult to interpret the effects of DBS. A detailed understanding of the role of the STN in voluntary movements is necessary for developing new treatments for PD. Brian Lau’s aim is to characterize the role of the STN and to understand how information flow from the cortex shapes activity in the STN.

Brian Lau is leader of the Experimental Neurosurgery team. He received a PhD in Neural Science of the New York University in 2007. He did postdoctoral work at Columbia University from 2007 to 2012, before to join the ICM. In 2012 he is laureate of Atip Avenir program, a tender of CNRS and INSERM which allow young researchers to develop and lead a team within a structure of French research.

PRINCIPAL INVESTIGATORS

Carine Karashi
Marie Vidailhet and Stéphane Lehéricy’s team aims to characterize the cortical and subcortical networks involved in normal and pathological motor control and learning. Motor control is explored in physiological conditions in healthy volunteers and monkey models and in pathological ones in healthy subjects after virtual lesion of different brain areas or in patients with movement disorders such as dystonia or mirror movements or Parkinson’s disease. The second aim of the team’s project is to identify potential targets for non-invasive and adaptable therapeutic strategies.

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MAJOR PUBLICATIONS


Marie Vidailhet is professor of Neurology at the Pitié-Salpêtrière Hospital and leader of the team “Movement disorders and basal ganglia: physiopathology and experimental therapeutics”. She received a MD in 1988 from the Pierre and Marie Curie University. She is president of the CNU Neurology, and member of “Bureau du Collège des Enseignants de Neurologie”. She is currently in the scientific councils of several societies including that of Movements disorders society, European Federation of neurological Society, Dystonia Coalition (USA), and in editorial board of different journal including Mov Disord, J Neurology or Rev Neurol.

PRINCIPAL INVESTIGATORS

Emmanuel Roze
Pierre Pouget
Isabelle Arnuff
Sabine Meunier

S téphane Lehéricy is Pro- fessor of Neuroradiology at the Pitié-Salpêtrière and director of the CENIR (Centre for Neuroimaging Research) in the Salpetrière hospital. He completed is PhD in basic neuroscience with Pr Yves Agid (INSERM U678, Paris) and his post-doc in functional neuroimaging at SHF-CEA in Orsay with Denis Le Bihan. He spent three years at the Centre for Magnetic Resonance Research / University of Minnesota (Pr Kamil Ugurbil). He is research active with PHRC, ANR and France Alzheimer programme grants. His scientific interest is in structural and functional brain mapping in the normal and pathological brain, including movement disorders and neurodegenerative dementias. His focus is on the functional organization of the normal human basal ganglia and movement disorders. He has contributed to the understanding of the functional and anatomical circuity of the basal ganglia using fMRI and DTI.
Emmanuelle Huillard’s team is interested in understanding the cellular and molecular cascades that underlie the formation of high-grade gliomas such as Glioblastoma (GBM). GBM is the most aggressive form of glioma, the most common primary brain cancer in adults. GBM is notoriously resistant to standard radiotherapy and chemotherapy treatments and thus represent a leading cause of cancer-related death worldwide.

Emmanuelle Huillard is leader of the Cellular and molecular mechanisms of glioma development team. She received a MSc in Cancer biology in 1999 and a PhD in cancer biology of University Paris XI in 2003. She did her postdoctoral studies in the laboratory of Pr. David Rowitch, first at Dana Farber Cancer Institute in Boston, then at University of California in San Francisco. In 2011, she joined the team of Jean-Yves Delattre at the ICM. In 2012, she was a laureate of the Atip Avenir starting grant, which allowed her to start her research group, supported by INSERM and the Fondation ARC.

**MAJOR PUBLICATIONS**


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Catherine Lubetzki’s and Bruno Stankoff’s team focuses on the pathophysiology of multiple sclerosis (MS), notably the mechanisms of CNS myelination and remyelination and aims at translating gained insights into clinical practice.
**CELLULAR AND MOLECULAR APPROACHES FOR MYELIN REPAIR**

**DISEASES OF DEVELOPMENT, GLIAL PATHOLOGY AND REPAIR**

**BRAHIM NAIT OUMESMAR AND ANNE BARON-VAN EVERCOOREN**

Based on complementary expertises in oligodendrocyte regeneration (B. Nait-Oumesmar), neuro-inflammation (V. Zujovic) and stem cell biology (A. Baron-Van Evercooren), the common goal of team is to provide a better understanding of the cellular and molecular mechanisms involved in myelin regeneration and to develop innovative therapies enhancing remyelination and providing effective neuroprotection for demyelinating disorders.

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**Brahim Nait-Oumesmar** joined the ICM in 2009, where is co-leader of the Cellular and Molecular Approaches for Myelin Repair team and coordinator of the axis Development, Pathology and Repair of the ICM. He received a PhD in Neurosciences, before going for a post-doctoral training at Mount Sinai School of Medicine (NY). He is member of several scientific boards including the French MS tissue bank and the French Glial Cell Club. He is expert of grants for the Multiple Sclerosis Societies (Australia, UK) and Biological Sciences Research Council (UK).

**Anne Baron-Van Evercooren** is co-leader of Cellular and Molecular Approaches for Myelin Repair team, coordinator of IHU workpackages on MS and animal models. She received a PhD in Medical and Experimental Sciences of the University of Liège (BE) in 1983. She received several awards, including the NRJ foundation prize, Charles Ketelear Prize on MS, the INSERM Excellency Awards “Chevalier de la Légion d’Honneur” in 2009. She is the former president of the French Glial Cell Club and member of several scientific councils including that of ELA Foundation and the Myelin project.

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**MAJOR PUBLICATIONS**

Pr Marc Sanson’s team focuses on biology of primary brain tumors in adults, mainly gliomas and primary central nervous system lymphoma. Indeed, these tumors are the most prevalent primary brain cancers in adults. Three major goals are aimed by the team:

• Identification of clinically relevant molecular biomarker through genotype/phenotype correlations;
• A better understanding of molecular and cellular abnormalities driving brain tumors oncogenesis;
• Evaluation of novel therapeutic strategies in preclinical models of glioblastoma (GlioTex Project);

Marc Sanson joined the ICM in 2011. He is leader of the experimental neuro-oncology team, neuro-oncologist at Pitié-Salpêtrière hospital and professor of neurology at Pierre & Marie University. He received a MD in 1990 and trained in neurogenetics at Montreal general Hospital.

PRINCIPAL INVESTIGATORS
Khê Hoang-Xuan
Ahmed Idbaih
Jean-Yves Delattre

MAJOR PUBLICATIONS


One aspect of Jean-Léon Thomas and Bernard Zalc’s team research is the study of oligodendroglial cell development in the embryonic brain, especially the specification and migration of oligodendrocyte precursor cells (OPCs).

In addition, since the development of the central nervous system depends on constant interactions between neural cells and the cerebral vascular network, their studies extend to the neurovascular interactions occurring in the neurogenic niches and the white matter of the normal brain, as well as in the context of neural pathologies such as Multiple Sclerosis (MS) and gliomas.

Jean-Léon Thomas is co-leader of Oligodendrocyte Development and Neurovascular Interactions at the ICM since 2009, and Associate professor in Department of Neurology at Yale School of Medicine. He received a MSc in 1981 of the University of Nantes and a PhD in molecular and cell biology from University of Paris VII in 1992. He is Review Editor for Cell.Mol. Life Science.

Bernard Zalc is co-leader of Oligodendrocyte Development and Neurovascular Interactions at the ICM since 2009. He received a MD in 1974 and a PhD in Natural Sciences from Pierre et Marie Curie University in 1981. He is reviewer for several scientific journals and member of Scientific Council of national and international Foundation or University.
Alberto Bacci’s team aims at gaining more detailed information on the properties of neocortical interneurons, using a combination of electrophysiological, cellular, biochemical and morphological techniques. The ultimate goal of his research is to understand the functional relevance of these different neuron subtypes within cortical circuits.

Alberto Bacci joined the ICM in 2011, with him team Cellular physiology of cortical microcircuits. He received a MSc in 1994 and a PhD in experimental pharmacology and therapeutics from University of Milano in 2000, and did postdoctoral work at the Department of Neurology of Stanford University. He is recipient of several awards and his research has been and is currently supported by the ERC, Giovanni Armenise-Harvard Foundation, NARSAD.

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MAJOR PUBLICATIONS


Cerebral activities are underlain by definite dynamics and plastic phenomena in neural networks, which result from continuous and complex interactions between synaptic and intrinsic properties of neurons. The goal of Stéphane Charpier’s team is to determine the cellular, synaptic and membrane mechanisms responsible for various brain states: normal (memory and endogenous patterns) and pathological (epilepsy). Electrophysiological studies are thus performed at different levels of integration: of the neuronal membrane to “large scale” synaptic networks.

Stéphane Charpier is the coordinator of the team Network dynamics & cellular excitability at the ICM and Professor of Neurosciences at Pierre and Marie Curie University. He received a MD in 1991 and a PhD in neurosciences in 1995 from Pierre and Marie Curie University. He is expert for the French Evaluation Agency for Research and Higher education (AERES), and member of the scientific board of the “Fondation de France” [“Parkinson” Committee]. He received in 2011 the Valerie Chamaillard Prize, an award from the French foundation for the research on epilepsy.

PRINCIPAL INVESTIGATORS
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MAJOR PUBLICATIONS
Eric Leguern and Stephanie Baulac’s team are passionate about the monogenic epileptic syndromes which, additionally to being a significant health problem, are likely the most straightforward and reliable way to identify key proteins and pathways of epileptogenesis and ictogenesis.

The team is particularly interested in epilepsies associated with febrile seizures, temporal lobe epilepsy and autosomal recessive forms of idiopathic generalized epilepsies. The team collaborates with several researchers in Australia (I. Scheffer and S. Berkovic), USA (M. Meisler, M. Anderson) and Japan (T. Serikawa) and is part of European projects and consortiums: the EPICURE project (2006-2011) and the EuroEPINOMICS consortium (since 2011).

Eric Leguern is leader of the Genetics and physiology of inherited epilepsy team at the ICM. He received a MD in 1990, and a PhD in 1991 of Paris V University. Since 2011, he is professor of Medical genetics and hospital praticien in the department of genetics and cytogenetics of the Pitié-Salpêtrière Hospital. In the same time, he is member of several scientific committee or society, including the European Academy of Sciences, the French Society of Neurology or the National assembly of specialists in molecular genetics.

Stephanie Baulac is co-leader with Eric Leguern of the team Genetics and physiology of inherited epilepsy at the ICM. She received a MSc in human genetics in 1998, and a PhD in Neurogenetics of the University Paris V René Descartes in 2001. In 2010, she received the price for the best publication of the year of the ”Ligue Française contre l’Épilepsie”.

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PRINCIPAL INVESTIGATORS
Michel Baulac
Christel Depienne

MAJOR PUBLICATIONS


Richard Miles’s team studies cortical function and dysfunction in focal epilepsies, developing and exploiting new techniques of stimulation and optical recording. The team then uses them in physiological and pathological situations, to stimulate specific cell types, to image lipids and ions and to perform multi-cell activity recording while modulating certain receptor function.

Richard Miles is leader of Cortex and Epilepsy team at the ICM. He received a MSc in 1976 and a PhD in Physiology from university of Bristol in 1981. He is scientific expert for "Fondation française pour la recherche sur l’épilepsie" since 2003.

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MAJOR PUBLICATIONS

Claire Wyart’s team is interested in understanding how specific circuits are recruited in the spinal cord to produce complex motor outputs. Locomotion depends on the activity of spinal circuits termed Central Pattern Generators (CPGs) which have been characterized by Sten Grillner and others. Physiological, pharmacological and anatomical data have been used to construct schemes of connectivity for groups of excitatory and inhibitory interneurons and to predict how they generate oscillations in vitro.

However, such an approach does not reveal whether firing in a given neuronal subgroup is necessary and sufficient to generate a movement. The team identifies the function of specific spinal cells by remotely manipulating and recording neuronal activity while monitoring behavior in a small transparent animal, the zebrafish larva. Claire Wyart developed sophisticated methods to optically control neuronal activity in vivo, termed optogenetics.

Claire Wyart did her PhD between 2000 and 2003 in Strasbourg University in Biophysics working on small networks of controlled architecture. She performed her postdoc in UC Berkeley from 2005-2010, developing optogenetics in vivo in the zebrafish larva to probe the circuits underlying behavior in the intact animal. Since 2011, she has launched her team in the ICM with the label ATIP/Avenir, the ENP Chair of Excellence and the Emergence prize from the City of Paris.

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MAJOR PUBLICATIONS


PICNIC LAB: PHYSIOLOGICAL INVESTIGATIONS OF CLINICALLY NORMAL AND IMPAIRED COGNITION
COGNITION, EMOTION, ACTION
LAURENT COHEN, LIONEL NACCACHE AND PAOLO BARTOLOMEO

Laurent Cohen, Lionel Naccache and Paolo Bartolomeo’s team is devoted to the study of cognitive functions with an exclusive or prevalent development in humans, namely language and conscious cognition. The study of brain-damaged patients occupies a central position in its methodological approach. For the study of both language and consciousness, and with both patients and healthy subjects, it resorts to state-of-the-art behavioural methods and multimodal brain imaging.

Laurent Cohen is co-leader of Physiological Investigation of clinically normal & impaired cognition team at the ICM. He is Professor of neurology at the Pitié Salpêtrière hospital and University of Paris. He received a MD in 1988 and a PhD in Cognitive Science in 1994. He is currently on the Scientific Committee of the Fyssen Foundation and the NRJ Foundation.

Lionel Naccache is co-leader of Physiological Investigation of clinically normal & impaired cognition team at the ICM, and is Professor of Physiology at the Pitié Salpêtrière hospital and University of Paris. He received a MD in 1998 and a PhD in Cognitive Science in 2002. He is nominated “Rising Star of Psychology” by the Association of Psychological Science in USA in 2009. He received in 2011 the prize Goff Lemonon Hourly Laveran of the Academy of Sciences.

Dr. Paolo Bartolomeo, MD, PhD trained as a clinical neurologist and as a neuroscientist. He is head scientist of the research team investigating the Cognitive Neurosciences of Attention at the Brain and Spine Institute in the Salpêtrière Hospital, Paris, France, and full professor of Neuropsychology and Cognitive Neuroscience at the Catholic University, Milan, Italy. By using advanced behavioural, neuroimaging and neurostimulation methods, Dr. Bartolomeo has developed high impact work revealing the structural and functional neuroanatomy of attentional functions in normal individuals and in brain-damaged patients.

PRINCIPAL INVESTIGATORS
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MAJOR PUBLICATIONS


Bruno Dubois’s team focuses on the study of the anatomical and functional underpinnings of the brain systems subserving human cognition for functions such as goal-directed behaviors, memory and spatial attention. It expands its interest to an additional cognitive function: language and its relationships with perisylvian circuitry particularly in the domain of neurodegenerative diseases. The long-term goal of the project is the development of efficient diagnostic and therapeutic tools for neurological diseases, challenging such abilities.

Bruno Dubois is a Neurologist at the Pitié-Salpêtrière Hospital and leader of the Cognition, Neuroimaging and Brain Diseases team at the ICM. He is coordinator of the National Reference Centre on “Rare Dementias”, of the National Reference Centre on “Young onset Alzheimer” and of the Regional Network of Memory Centers. He received MSc in 1982 and a MD in 1984. He is president of the scientific committee of France Alzheimer Association, International Fund Raising for Alzheimer Disease (IFRAD), PSP-France Association (Progressive Supranuclear Palsy), and DFT-France (National Association for Fronto-Temporal Dementia).

**MAJOR PUBLICATIONS**


**PRINCIPAL INVESTIGATORS**

Marc Teichman
Michel Thiebaut de Schotten
Antoni Valerocabre
Emmanuelle Volle
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**R**ichard Levy (MD, PhD) is professor of neurology, head of the neurology department of Saint-Antoine University hospital, co-director (with his colleague Pr B. Dubois) of a research lab focused on the functions of the prefrontal cortex in human (the FRONTlab) at the Brain and Spine Institute (ICM) at La Salpêtrière hospital (Paris, France). He is also co-leader of the program called “Behavior and Motivation”, sponsored by the IHU-A-ICM, which aims are to develop clinical, research and educational programs in the field of behavioral neurology and cognitive neuroscience. In this framework, R. Levy has built with psychiatrist colleagues, a clinical unit of behavioral neurology at la Salpêtrière hospital, dedicated to patients with medical problems at the crossroad of neurology and psychiatry.
The SAN team gathers together three PIs with complementary expertise in affective neuroscience, social neuroscience, and psychiatry, with the aim of understanding the neural mechanisms by which social processes activate and regulate the emotional brain.

Nathalie George is co-leader of the Social and Affective Neuroscience team at the ICM. She is research director at the CNRS. She received a PhD in Cognitive Neuroscience of University Pierre and Marie Curie in 1997. She is member of the editorial board of NeuroImage and expert reviewer for many scientific journals. She is member of the French Society for Psychophysiology and Cognitive Neuroscience, of the French Society for Neuroscience, of the Social and Affective Neuroscience Society (SANS), and of the European Society for Cognitive and Affective Neuroscience.

Philippe Fossati is co-leader of the Social and Affective Neuroscience team at the ICM. He is full professor of Psychiatry at the Pitié-Salpêtrière hospital. He received a MD in 1993 and a PhD in Cognitive Neuroscience in 2001. He is scientific editor of the International Journal of Methods in Psychiatric Research. He is member of the French Society of Biological Psychiatry and of the European College of Neuropsychopharmacology (ECNP) Brain Imaging Network.

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Major Publications


Luc Mallet's research is based on a confrontation between experimental and psychopathological studies of neuropsychiatric disorders involving the basal ganglia; using anatomical, behavioural, and physiological data. Precise anatomical locations of both electrophysiological and imaging data, using an original histological 3D atlas, allow him to model the different circuits involved and their interactions. New therapeutic hypotheses are tested in parallel through clinical trials and animal experiments.

Luc Mallet is leader of the Behavior, emotion, and basal ganglia team at the ICM and psychiatrist in the Department of Psychiatry and in the Centre of Clinical Investigation in Neuroscience at the Pitié-Salpêtrière Hospital. He is also involved in a steering committee in the Multi-body subject-specific Institute for Neurosciences, Cognitive Sciences, Neurology and Psychiatry, Aviesan, for structuring the research in psychiatry in France.

MAJOR PUBLICATIONS

Our team aims at understanding the determinants of behavior (why we do what we do), in both normal and pathological conditions. To this aim we combine different scientific approaches: human cognitive neuroscience, primate neurophysiology, and computational modeling. Our fundamental objective is to elucidate the brain mechanisms that form goals and translate them into particular behaviors. As clinical applications we develop tools that allow inferring predictive markers for a variety of psychiatric and neurological diseases in which motivation is deficient (as in apathy) or uncontrolled (as in impulsivity).

**MAJOR PUBLICATIONS**


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ARAMIS: ALGORITHMS, MODELS AND METHODS FOR IMAGES AND SIGNALS OF THE HUMAN BRAIN
MODELS AND METHODS FOR THE NEUROSCIENCES
OLIVIER COLLIOT AND DIDIER DORMONT

ARAMIS is a joint research team between CNRS, Inria, Inserm and UPMC (University Pierre et Marie Curie) within the ICM. The overall aim of the team is to design new computational and mathematical approaches for studying brain structure (based on anatomical and diffusion MRI) and functional connectivity (based on EEG, MEG and intracerebral recordings).

The goal is to transform raw unstructured images and signals into formalized, operational models such as geometric models of brain structures, statistical population models, graph-theoretic models of brain connectivity... These approaches can then be used to find biomarkers of a disease, for genotype/phenotype correlations, or to characterize functional responses for instance. These new approaches are applied to brain pathologies, in particular in neurodegenerative disorders (Alzheimer’s disease and other dementias), epilepsy, neurodevelopmental disorders and to design brain–computer interfaces for rehabilitation.

Olivier Colliot PhD, is co-leader of the ARAMIS team, a joint research team between CNRS, Inria, Inserm and UPMC within the ICM. He is research scientist at CNRS. He received the PhD degree in Signal and Image Processing from Telecom-ParisTech in 2003, was a postdoctoral fellow at the Montreal Neurological Institute of McGill University from 2003 to 2005 and received the “Habilitation à Diriger des Recherches” in 2011. He has contributed to the design of advanced approaches for structural MRI analysis and to the development of neuroimaging biomarkers of neurological disorders (automatic segmentation, shape analysis and high-dimensional pattern classification). He is a key member (leader of the WP Research and Development and member of the Executive Committee) of the CATI, a national platform for large multi-site studies in neuroimaging.

Didier Dormont MD, is leader of the ARAMIS team, a joint research team between CNRS, Inria, Inserm and UPMC within the ICM. He is professor of neuroradiology at University Pierre and Marie Curie and hospital neuroradiologist (PU-PH). He received the MSc degree in Physics from University of Paris 7 in 1984, the MD degree from University of Paris 5—Descartes in 1986 and the “Habilitation à diriger des recherches” in 1996 from University Pierre and Marie Curie. He is the head of the department of diagnostic and functional neuroradiology and the head of the medical imaging pole of the Pitié-Salpêtrière Charles Foix Hospital Group.

PRINCIPAL INVESTIGATORS
Marie Chupin, Hugues-Pascal Mousselard, Stanley Durrleman, Mario Chavez, Yves Sanson, Damien Galano, Dominique Hasboun, Sophie Dupont

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MAJOR PUBLICATIONS


Philippe Ravassard leads the Biotechnology and Biotherapy team at the ICM. He became an Associate Professor of Biochemistry and Bioengineering in 1989, obtained his PhD in 1996 and carried out his Postdoctoral studies at McGill University (Montreal) as a developmental neurobiologist. His work on the transcription factor Neurogenin 3 he initially cloned led him to study developmental differentiation in both central nervous system and pancreas. During the past years he significantly contributed in the field of pancreas development yielding to the engineering of the first and only human pancreatic beta cell line and the creation of the biotechnology company, Endocells® located in the ICM biotech Incubator. He is member of international networks including the JDRF Centre for Beta Cell Therapy as well as the NIH Beta Cell Biology Consortium.

**MAJOR PUBLICATIONS**

The quality of scientific discoveries depends on the performance of the technological platforms. Revolutionary in its conception, innovative in its organization, the ICM is also unique because of its advanced equipment.
MOLECULAR EXPLORATION
- iGenSeq
- iVaractor

CELLULAR EXPLORATION
- CELIS
- CELIS-E-PHYS
- CELIS-iPS
- Histomics

PRECLINICAL FUNCTIONAL EXPLORATION
- PHENOPARC
- PHENO-ICMice
- PHENO-ICMaze
- PHENO-PRIMR
- PHENO-ZFish
- CENIR-SA MRI

FUNCTIONAL EXPLORATION
- CENIR-Human MRI
- CENIR-MEG/EEG
- CENIR-PANAM
- CENIR-STIM
- CENIR-SA MRI
- PRISME

BIOINFORMATIC AND BIOSTATISTIC
- ICONICS
The Rodent Service is a 1500 sqm facility in Paris dedicated to research on new rodent models of human diseases and their use in preclinical studies. The facility supplies state of the art equipment and specialized staff to academics and industrials. With 7000 ventilated cages, both SOPF and SPF housing areas are provided, including ABSL1 and ABSL2 and 40 equipped procedure rooms. A well-established outsource company is in charge of animal care. PHENO-ICMice is part of the ICM core facility network (small animal MRI, sequencing, vectorology, histology, microscopy...) which facilitates translational research.

ACTIVITIES
- Rodent Behavior: locomotion, anxiety, depression, memory, sociability...
- Rodent Surgery: stereotactic surgery, live imaging, electroporation, tissue harvest...
- Rodent Neurophysiology: EEG, EMG, evoked potentials, optogenetics...
- Renting of procedure rooms
- Consulting

EQUIPMENT
- Housing capacity: 7000 cages
  3000 ventilated cages SPF
  4000 ventilated cages SOPF
- Automated cage wash system
- Biosafety level
  ABSL 1
  ABSL 2
- 40 equipped procedure rooms
- Restricted access
- 11.7T MRI

PROCEDURE ROOMS
- 12 for behavioral tests
- 12 for surgery (binoculars, microscopes, stereotaxy frames, electrodes)
- 11 for experimentation (PSM, binoculars, microscopes, electrodes)

ANIMAL CARE
(Ethical respect of 3R rules)
- Breeding
- Plugging
- Weaning
- Tissue harvest-genotyping
- Tattooing
- Cleaning-feeding

TEAM
Brahim Nait Oumesmar
—Scientific advisor
Magali Dumont
—Head
Doriane Foret
—Behavior manager
Anne-Laure Privat
—Surgery manager
Delphine Roussel
—Neurophysiology manager

CONTACT
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Magali Dumont received her PhD in neurosciences and held a position for 8 years at Weill Cornell Medical College (New York, USA) to study in vivo models of neurodegenerative diseases. She is now Adjunct Assistant Professor at WCMC, Head of the PHENOPARC at ICM, and a member of the steering committee of the facility and the ethical committee. In addition, she is a consultant for research project designing. Magali has a strong experience on behavioral analyses and the use of models of human diseases.
The rodent behavior Service assists academics and industrials to design and conduct research projects using behavioral testing to characterize new transgenic lines and therapeutic targets. The service provides more than 20 tests for mice and rats to ensure the success of research projects. PHENO-ICMaze is part of the ICM core facility network (small animal MRI, sequencing, vectorology, histology, microscopy...) which facilitates translational research.

M agali Dumont received her PhD in neurosciences and held a position for 8 years at Weill Cornell Medical College (New York, USA) to study in vivo models of neurodegenerative diseases. She is now Adjunct Assistant Professor at WCMC, Head of the PHENOPARC at ICM, and a member of the steering committee of the facility and the ethical committee. In addition, she is a consultant for research project designing. Magali has a strong experience on behavioral analyses and the use of models of human diseases.

ACTIVITIES
Three activities are offered to support research projects at any step:
• Consulting: the team provides advice about design of experimental projects or protocols, adequate selection and use of specific behavioral tests, data analyses and manuscript writing
• Staff training: the team also proposes specialized training sessions for the use of specific equipment and software
• Room/Equipment rental: 12 procedure rooms including more than 20 behavioral tests are available for rent

EQUIPMENT
• Basic motor and sensory function: homecage scan, seizure scan, rotarod, locomotoric, open field, actimeter, running wheel, Y maze, runway, treadmill, hot/cold plate, SHIRPA
• Learning and memory: Morris water maze, radial arm maze, fear conditioning, empathy chamber, object recognition
• Social behavior: group scan, sociability chamber
• Anxiety and depression-like behaviors: elevated plus maze, dark/light chamber, tail suspension, forced swim
• Metabolism/calorimetry: metabolic cages
• Attention: 5-9 holes
• Muscular strength: Grip strength meter, grid
• CleverSys software suite
• Any maze software (Stoelting)

TEAM
Magali Dumont  
—Scientific manager
Doriane Foret  
—Operational manager

CONTACT
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CELIS-E-PHYS provides high quality services to academics and industry requiring in vitro electrophysiology techniques for successful completion of neurosciences studies. The facility is well equipped for patch clamp and field potential recordings. The facility is involved in many different research projects as diverse as the functional characterization of channelopathies, characterization of human iPSC derived neurons and lead optimization. CELIS-E-PHYS is part of the ICM core facility network (sequencing, vectorology, cell culture, iPS ...) which facilitates translational research projects. CELIS-E-PHYS is supported by the IHU-A-ICM funding.

ACTIVITIES
• Generation of full set of data by the staff (experimental design, data acquisition, analysis and interpretation)
• Access to the instrumentation for independent use
• Preliminary experiments designed to assess project feasibility
• Consulting
• Training scientists to electrophysiology techniques

EQUIPMENT
• Patch-clamp rig equipped with an inverted fluorescence microscope, amplifier and micromanipulator for electrophysiological recordings from cell culture
• Extracellular rig equipped with an upright fluorescence microscope, amplifier and micromanipulator for electrophysiological recordings from brain slice and zebrafish
• Fast pressurized system for recording of ligand-gated ion channels and fast drug application, a temperature control system
• Electrode puller, microforge...

TEAM
Patrick Michel
—Scientific manager
Sophie Nicole
—Scientific manager
Carine Dalle
—Operational manager

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iGenSeq provides tools and services for genome analysis to academics or industrials. More specifically, services include real-time PCR, sequencing, CGH-array experiments, as well as purification and analysis of nucleic acids. Each project submitted to the core facility is discussed with the investigator to optimize the design and the feasibility. This platform masters the techniques of high-throughput sequencing and can also provide medium-throughput new generation sequencing and associated biostatistics services. iGenSeq is part of the ICM core facility network (vectorology, histology, microscopy, cellular culture...) which facilitates translational research projects.

Yannick Marie manages the iGenSeq core facility since 2011. He has a biological engineering and life sciences diploma from the Conservatoire National des Arts et Métiers (CNAM). For five years, he held several research positions at INSERM until he joined the ICM team of Professor Delattre in 2010. He works now on the characterization of glial tumors gaining experience on genotyping, real-time PCR, CGH Array, transcriptomics, etc.

ACTIVITIES
• Real-time PCR:
  SybrGreen or probespecific technology, RNA quantification, Digital PCR, HRM
• Sequencing:
  medium throughput using GS Junior and Miseq Illumina systems including multiplex amplicon (Fluidigm ACCESS ARRAY), long-range, ultra-deep sequencing applications and Capture (DNA and RNA)
• Microarray pole:
  CGH-array (DNA extracted from fresh tissue or FFPE)
• Genotyping:
  animals (tissue)
• PCR products purification and analysis:
  PCR or sequence purification and quantitative analysis of DNA or RNA

EQUIPMENT
• 4 Real-time PCR (2x96 wells, 384 wells, 1536 wells)
• 11 PCR apparatus (Applied Biosystem, MJ Research, Eppendorf)
• 1 454 GS Junior system
• 1 Miseq Illumina system
• 1 Access Array FLUIDIGM
• 1 Microarray scanner (MS200)
• 1 Bravo pipetting system
• 1 plateLoc system
• 1 Labchip GX
• 1 MagnaPure Compact system

TEAM
Giovanni Stevanin
—Scientific manager
Yannick Marie
—Operational manager
Jérôme Garrigue
—Genotyping
Delphine Bouteiller
—Real-time PCR
Emeline Mundwiller
—Sequencing
Blandine Boisselier
—Microarray
Mailys Daniau
—Sequencing

CONTACT
igenseq@icm-institute.org
The Vectorology core facility produces batches of highly concentrated \(10^9\) TU/mL average lentiviral gene transfer vectors of controlled quality at small and large scale, under GLP standards. The laboratory staff has developed an important collection of lentiviral expression backbones ready to accept any gene of interest in order to provide the best solution for every in vitro or in vivo application encompassing basic research, gene therapy, cellular therapy and vaccine. The BSL2 and BSL3 confined zones allow to satisfy every demand of viral production. The close collaboration between iVector and the biotechnology & biotherapy team ensures the constant evolution of gene transfer technologies. iVector is part of the ICM core facility network (genotyping, histology, microscopy, cellular culture...) which facilitates translational research projects.

Philippe Ravassard leads the Biotechnology and Bio-therapy team at the ICM. He became an Associate Professor of Biochemistry and Bioengineering in 1989, obtained his PhD in 1996 and carried out his Postdoctoral studies at McGill University (Montreal) as a developmental neurobiologist. His work on the transcription factor Neurogenin 3 he initially cloned led him to study developmental differentiation in both central nervous system and pancreas. During the past years he significantly contributed in the field of pancreas development yielding to the engineering of the first and only human pancreatic beta cell line and the creation of the biotechnology company, Endocells® located in the ICM biotech Incubator. He is member of international networks including the JDRF Centre for Beta Cell Therapy as well as the NIH Beta Cell Biology Consortium.

### ACTIVITIES
- Design and construction of viral and non-viral vectors
- Maxi and Giga-preparations of vectors (endotoxin free conditions)
- Production of Rv (retroviral) and Lv (lentiviral) recombinant viral vectors (3rd generation vectors ‘ΔU3 or SIN’)
- Collection of control lentivectors (GFP, miR neg...)
- Development of transduced BSL2 or BSL3 cell lines, cell banking
- Quality control: viral vectors titration [FACS, qPCR], transduced cells, declassification [BSL3 to BSL2]
- USP and DSP optimization for production and purification of viral particles
- Scientific, technical and regulatory consulting for viral vectors design and production

### EQUIPMENT
- Molecular biology laboratory dedicated to vector design and construction
- Bacterial biomass production
- Core facility for viral particles production (6 independent confined culture rooms, 3 BSL2 and 3 BSL3)
- 2 ultracentrifuges [one in BSL2 and one in BSL3 premises]
- Class-II biological safety cabinets
- 8 PSM Class II
- 8 CO₂ incubators
- Confinement area C3/L3
- Confinement area C2/L2

### TEAM
- Philippe Ravassard — Scientific manager
- André Sobczyk — Operational manager
- Blandine Bonnamy — Viral bioproduction
- Clémentine Ripoll — Viral bioproduction
- Julian Roussel — Viral bioproduction

### CONTACT
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Histomics is a technical support center open to researchers of the ICM and to academic/industrial partners. It is accessible on a space-rent or service basis and uses standardized protocols and up-to-date equipment (ultramicrotomes, cryostats, freezing microtomes...) for the processing of histological (animal and human) material. The staff is able to offer technical and scientific services, to train users to histological techniques and also to perform work for specific projects. Histomics is part of the ICM core facility network (genotyping-sequencing, vectorology, cellular exploration...) which facilitates translational research projects.

Dr. Delatour is a senior researcher at ICM and CNRS. His research focuses on memory disorders related to pathological conditions (Alzheimer’s disease and associated pathologies). His work relies on the in vivo study of mice models of neurodegenerative diseases through neuroimaging, histological and behavioral approaches. His research is carried out in a pluridisciplinary context, relying on active partnership with scientists developing various technical and conceptual expertise and working in both academic and industrial backgrounds.
Human induced-pluripotent stem (iPS) cells are produced in order to model in a culture dish degenerative disorders of the brain and the spinal cord. This is to better investigate the molecular and cellular mechanisms underlying these disorders and to develop a screening approach for drugs of therapeutical interest. The specific goals of the platform are three-fold:

1- to generate and maintain iPS cells through genetic reprogramming of skin cells from patients and healthy volunteers;
2- to correct or introduce mutations of interest using appropriate genetic tools;
3- to create a repository of disease-specific iPS cells. This activity is part of the ICM’s cell culture facility and is supported by the IHU-A-ICM.

Delphine Bohl holds a PhD in virology and gene therapy from University Paris 7 (1997), carried out in the department of neuroscience at Institut Pasteur of Paris. In 1998, she was recruited as an assistant professor within an INSERM unit at Institut Pasteur where she developed a solid expertise in human iPS cell technology used to model neurodegenerative disorders. She became an associate professor in 2000. Since January 2014, she is a member of the “ALS causes and mechanisms of motor neuron degeneration” team at the ICM and manages ICM CELIS-iPS activity.
The CENIR–MEG/EEG core facility is part of the Center for NeuroImaging Research (CENIR). It is dedicated to the development of noninvasive methods that allow visualizing brain activity on a millisecond time scale in normal or pathological conditions. With the latest equipment, the highly skilled team helps academic and industrial partners that wish to undergo clinical or fundamental research to perform the acquisitions as well as to develop integrated analysis tools for multi-level electrophysiological data. CENIR–MEG/EEG is part of the ICM core facility network (MRI, PANAM, PRISME…) which facilitates translational research projects.

The CENIR–MEG/EEG core facility is part of the Center for NeuroImaging Research (CENIR). It is dedicated to the development of noninvasive methods that allow visualizing brain activity on a millisecond time scale in normal or pathological conditions. With the latest equipment, the highly skilled team helps academic and industrial partners that wish to undergo clinical or fundamental research to perform the acquisitions as well as to develop integrated analysis tools for multi-level electrophysiological data. CENIR–MEG/EEG is part of the ICM core facility network (MRI, PANAM, PRISME…) which facilitates translational research projects.

ACTIVITIES
- Clinical and fundamental research on the normal or pathological brain
- Methodological development of integrated analysis tools for multilevel electrophysiological data (EEG, MEG, depth recording, peripheral neurophysiological measures)
- In-house software development for data processing, statistical analysis and visualization

EQUIPMENT
- Acquisition:
  - MEG Elekta Neuromag TRIUX (306 sensors, 28 EEG, eyetracker)
  - EEG: 2 64-channel Brainamp systems (3D localization of electrodes, 2 faraday rooms)
  - Biopac MP150 for SCR, EMG, EKG recording
  - Audio, visual, and tactile stimulation equipment
- Analysis and visualization:
  - Event classification
  - Artifact detection and correction
  - Analysis on sensors
  - Analysis on sources
  - Statistics
  - Data visualization

TEAM
Nathalie George —Scientific manager
Denis Schwartz —Operational manager
Laurent Hugueville, Christophe Gitton —Stimulation, acquisition
Antoine Ducorps, Lydia Yahia-Cherif, Jean-Didier Lemaréchal —Data analysis, software development
Nathalie Panurge —Administration

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The combination of a highly skilled team and most technologically advanced equipment, allows academics and industrials to perform a wide range of experiments (electrophysiology, surgery, MRI, behavioral tests...) on macaque and squirrel monkey models of neurodegenerative diseases and cognitive disorders. Altogether, the training of primates for complex behavioral tests and the presence of neurologists as well as neurosurgeons constitute a core facility for pre-clinical studies. PHENO-PRIM is part of the ICM core facility network (MRI, cell culture, MEG/EEG...) which facilitates translational research projects.

Pierre Pouget is a CNRS researcher and the scientific coordinator of the primate experimentation facility. He received his PhD degree in cognitive psychology from the Paris Descartes University in France and held a postdoctoral position in the laboratory of Jeffrey Schall (Vanderbilt University, USA). He is specialized in the cortical control of eye movements in humans and non-human primates and has developed relevant non-human primate models of mental disorders. His activity focuses on both clinical research and clinical evaluation of neurological patients. Pierre is also a member of the steering committee of the CNRS’s station of primatology (Rousset, France).
The SA MRI core facility is part of the Center for Neuroimaging Research (CENIR). This platform is dedicated to imaging experimental models of diseases (mainly rodents and potentially any species small enough to fit inside the magnet). A very high magnetic field, associated with high quality probes (Cryoprobe™ for mice), a wide range of imaging protocols and support to data analysis, bring the quality needed for a small animal MRI core facility. CENIR–SA MRI is part of the ICM core facility network (PHENO-ICMice, PHENO-PRIM...) which facilitates translational research projects.

Alexandra Petiet received her PhD in biomedical engineering from Duke University (USA). She was then a post-doctoral fellow at Sanofi-Aventis (France) and at the French Alternatives Energy and Atomic Energy Commission (NeuroSpin, MIRCen) where she developed MRI methods for the longitudinal evaluation of amyloid plaque load in a mouse model of Alzheimer’s disease. Among other skills, Alexandra has expertise in structural, functional and diffusion imaging of animal models of neurological diseases at high magnetic fields.
This core facility makes available a very large panel of cell and tissue culture models and up-to-date technologies to academic researchers and industrials that 1— pursue experimental projects on pathologies of the brain and spinal cord and 2— wish to perform small molecule screening towards the discovery of promising drug candidates for these pathologies. Other activities operated by a dedicated staff, include the production of induced pluripotent stem (iPS) cells and electrophysiological recordings on isolated cells. The facility is part of the ICM core facility network (sequencing, vectorology, histology, microscopy...) and supported by the IHU-A-ICM.

ACTIVITIES
• Modeling brain, spinal cord and skeletal muscle disorders with cell or tissue culture systems
• Drug screening for neuronal and glial pathologies, including glioma tumors
• Molecular and cellular pharmacology
• Conventional or automated fluorescent imaging; infrared fluorescence imaging
• Real-time monitoring of cell proliferation
• Electrophysiological characterization of ion channel dysfunction
• Production of iPS cell lines
• Single-cell whole transcriptome analysis
• Flow cytometry
• Conventional ELISA and electrochemiluminescence immunoassays

EQUIPMENT
• Workstation for automated screening (Arrayscan XTI)
• Inverted fluorescent microscopes for conventional fluorescence microscopy and dynamic imaging. Fluorescence stereomicroscopes
• BD FACSVerse Flow cytometer.
• Tali Image-Based Cytometer
• Countess Automated Cell Counter
• xCELLigence system to monitor real-time cell proliferation
• Incubator for hypoxia studies
• Two-color infrared imaging (Odyssey system) for protein detection
• Box for iPS cell cultures and for manipulating radioactive material
• Set-up for electrophysiological recordings on isolated cultured cells
• MESO QuickPlex SQ 120 for singleplex and multiplex immunoassays

TEAM
Patrick-Pierre Michel
— Scientific manager
Laetitia Strehl
— Operational manager
Marie-Stéphane Aigrot
— Engineer
Cyrille Deboux
— Technician
Carine Dalle
— Research engineer, electrophysiology
Sophie Duffaure
— Engineer, iPS
Stéphanie Bigou
— Technician

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CENIR (Center for NeuroImaging Research) is the ICM main *in vivo* imaging core facility. With a core set of expertise around neurological diseases, cognitive neuroscience and image analysis, it offers academic and industrial investigators high quality imaging tools for investigating human brain and spinal cord. Personnel with complementary expertise (neurology, neuroimaging, neuroscience, imaging, NMR, image processing, data analysis) design protocols and run the imaging equipment for more than 80 projects each year. The use of 3T MRI, and MRI-compatible EEG creates the perfect environment to conduct neuroimaging projects.

**ACTIVITIES**
- Clinical research: integrated studies of the physiopathology of neurological and psychiatric diseases, including clinical care and therapeutics. Protocols include all major pathologies of the nervous system: neurodegenerative diseases, white matter pathologies, epilepsy, movement disorders, psychiatry, brain plasticity and functional recovery
- Cognitive neuroscience: brain function, neural basis of cognition and behavior, aging
- Image processing: development of data processing methods and tools for functional and structural neuroimaging
- Full support from stimulation and acquisition protocols to advance data analysis

**EQUIPMENT**
- 3 Tesla MRI Trio 32 channel TIM system
- 3 Tesla MRI Verio 32 channel TIM system
- Each MRI has its set of coils for head, neck, spine, and body imaging
- 31P magnetic resonance spectroscopy
- MRI-compatible EEG system BrainMap, TMS system Magstim and optical imaging system
- MRI-compatible audio-visual and tactile stimulations systems, behavioral, oculomotor and physiological response monitoring

**TEAM**
- Stéphane Lehéricy — Scientific manager
- Eric Bardinet — Operational manager
- Romain Valabrège — Research engineer
- Daniel Garcia-Lorenzo — Research engineer
- Anne-Charlotte Philippe — Post-doc
- Mathieu Santin — Non-human primate imaging

**CONTACT**
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This service is dedicated to pre-clinical research on zebrafish. With more than 20,000 adult fishes capacity and high quality equipment such as the automated feeding robot, 6 injectors for transgenesis users combine imaging, optogenetics, behavioral experiments on mutant and transgenic lines. External partners have access to specific training sessions such as fish manipulation (crossing, eggs collection), transgenesis, screening and sperm freezing. Highly skilled technicians are in charge of fish care, crosses and health monitoring. PHENO-ZFish is part of the ICM core facility network (vectorology, genotyping sequencing, cell culture, electrophysiology...) which facilitates translational research projects.

ACTIVITIES
- Production and caring of transgenic and mutant lines
- PCR genotyping
- Transgenesis: Tol2/CrispR/Talen
- Fluorescent in situ hybridization (FISH)
- Fluorescent immunohistochemistry on embryos / larvae in toto or on slice
- Confocal, bi-photon and spinning disk imaging
- Immuno-reactive area quantification on ImageJ
- Behavioral analysis, results interpretation on mutant and drug screening
- Sperm Freezing
- Electron microscopy on embryos and larvae (1-3 days)
- Calcium imaging and optogenetics on wild type animals and transgenic lines
- New lines for sensors and actuators of neuronal activity in vivo

EQUIPMENT
- Quarantine: 100 aquariums
- Housing area: 900 aquariums (about 20,000 adults)
- Daily artemia production
- Automated feeding of adults with a robot
- More than 500 transgenic lines
- In vitro fertilisation
- Health follow up program (PCR analysis and histology)
- 6 injectors optimized for mutagenesis, transgenesis and genetic knock down
- High-throughput crossing with the iSpawn for high scale eggs production

TEAM
Claire Wyart
—Scientific manager
Sophie Nunes-Figueiredo
—Operational manager

CONTACT
pheno-zfish@icm-institute.org

Claire Wyart joined the ICM in 2011, with her team “Probing dynamic sensorymotor integration in spinal circuits”. She received a PhD in biophysics/neuroscience on spontaneous dynamics of neuronal networks from the University Pasteur (Strasbourg) in 2003, and did postdoctoral work at UC Berkeley (USA) in collaboration with UC San Francisco where she developed optical methods for recording and stimulating electrical activity and behavior analysis in vivo in the zebrafish larvae. She has 8 years of experience with the zebrafish model.
PRISME is the ICM’s core facility dedicated to the functional exploration of human behavior. It is divided into 2 entities: 1– PRISME-Virtual Reality that focuses on developing and adapting new paradigms of virtual reality for behavioral and cognitive neuroscience. The facility also means to set up new therapeutic protocols applied to neuropsychiatric diseases; 2– PRISME-Real life that is dedicated to the study of human cognitive functions, motor performance and social interaction in an ecological environment. Academic and industrial partners have access to the equipment and are helped by the team to design needed protocols. PRISME is part of the ICM core facility network (MRI, MEG/EEG, TMS...) which facilitates translational research projects.

Mathias Pessiglione has been trained as both a fundamental biologist and a clinical psychologist. He has conducted pioneering studies combining cognitive testing, functional neuroimaging and computational modeling. He is now ICM team leader and Inserm research director.

Philippe Fossati is a full professor of psychiatry and chief of the Mood Treatment Center for Adults at the Pitié-Salpêtrière Hospital. He is also co-leader of ICM research team ‘Social and Affective Neuroscience’. His main clinical and research interests include the study of the self, memory and emotion in depression and healthy subjects.

ACTIVITIES
PRISME-Virtual reality
• Cognitive remediation programme, including web-therapy and virtual reality therapy
• Exploration of walk, spatial cognition and interpersonal space
• Social interactions: Embodied conversational agents
• Virtual reality: Environments and avatars creation
PRISME-Real life
• Test of cognitive functions
• Assessment of sport performance
• Study of social interactions
• Freely moving subjects
• Multimodal recordings
• Brain stimulation

EQUIPMENT
PRISME-Virtual reality
• Four headmounted displays, including one with eye-tracking device
• One eye-tracker Eyelink (500Hz)
• Several virtual 3D and 2D environments (street, plane, mountain, subway, city, social interaction, etc.)
• Realistic conversational virtual humans
PRISME-Real life
• 12 computer-equipped seats
• Training bikes, treadmill and golf simulator
• Audio-video recording
• Eye-tracking
• Physiology monitoring (skin conductance, heart rate...)
• Brain activity (scalp EEG)
• Transcranial direct current stimulation

TEAM
Mathias Pessiglione
—Scientific manager
Philippe Fossati
—Scientific manager
Pierre Leboucher
—Operational manager
Gilles Rautureau
—Developer
Pierre Canet
—Technical support
Odile Komano
—Experimental therapist

CONTACT
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STIM is part of the Center for Neuroimaging Research (CENIR) and is dedicated to supporting research done on stereotactic data. It provides specific software development, data analysis, and expertise in research projects. Its main application fields are deep brain stimulation (DBS), surgery (pre, per and post-operatively) and epilepsy. The YeB Atlas, developed by Jérome Yelnik and Eric Bardinet, is a strong support for data analysis. The core facility is involved in several DBS protocols in collaboration with other research institutes and industrials. Interaction with la Pitié-Salpêtrière hospital departments such as neuroradiology, neurosurgery and neurology, adds up to the expertise of the core facility. The ICM core facility network (more than 20) facilitates translational research projects.

ACTIVITIES
• Pre-surgical target determination for DBS
• Pre and post-operative localization of DBS electrodes
• MRI sequences optimization for DBS protocols
• Data analysis with support of the YeB Atlas
• Software developments for DBS and epilepsy
• Expertise: Evaluation of new MRI sequences by researchers and engineers to be able to reveal brain regions not seen before
• Strong collaboration between researchers and clinicians

EQUIPMENT
• YeB Atlas
• Data storage on CENIR servers
• Computational services of CENIR

TEAM
Jérome Yelnik — Scientific manager
Carine Karachi — Scientific manager
Sara Fernandez Vidal — Operational manager
Eric Bardinet — Image processing engineer

CONTACT
cenir-stim@icm-institute.org
ACTIVITIES
• Electrophysiological studies (TMS, EMG, EEG, LFP…)
• Clinical research and experimental therapeutics using non-invasive cerebral stimulation
• Mapping cortical organization/desorganization in various neuropsychiatric conditions (parkinson disease, ALS, essential tremor)
• Effects of "virtual" lesions of various brain areas during cognitive and motor tasks
• Set up of experimental therapeutics using high and low frequency rTMS and tDCS in neuropsychiatric conditions
• Development of cerebellar stimulation (TMS, tDCS, tACS…)
• Development of TMS/MRI and TMS/EEG and LFP/EEG coupled recordings

EQUIPMENT
• 2 neuronavigation systems (NEXSTIM and BRAINSIGHT)
• 4 TMS stimulators (2 rTMS, 1 bistim)
• 15 TMS coils
• 3 EMG recordings, including 1 wireless EMG
• 2 electrical stimulators (Digitimer)
• 3 tDCS (including 1 allowing tACS and tRNS)
• Vicon system with 10 cameras
• Force platform (AMTI, 180x90)
• 1 wireless EEG

TEAM
Jean-Charles Lamy
—Scientific manager TMS
Marie-Laure Welter
—Scientific manager gait and equilibrium
Xavier Drevelle
—Engineer, gait and equilibrium
Sophien Medhi
—Technician

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The PANAM core facility is part of the Center for Neuroimaging Research (CENIR) and focuses on two axes: 1– clinical research and therapeutics using non-invasive cerebral stimulation in neurological and psychiatric diseases; 2– the study of movement, gait and balance in patients with neurological diseases. Moreover the facility develops new techniques of non-invasive cerebellar stimulation, TMS/MRI, LFP-EEG coupled recordings. The platform is part of the ICM core facility network (preclinical models, neuroimaging, MEG/EEG, deep brain stimulation…) which facilitates translational research projects.
The iCONICS platform comprises two teams: “Databases and Datawarehouse” and “Bioinformatics/Biostatistics”. The Databases and Datawarehouse division develops relational databases with secure web interfaces, supported by a shared data model which covers a variety of domains (clinics, biology, demographics, genetics, neuropsychology, environment, images, disease’s evolution, raw and analyzed data, diagnostics...). Then, data are extracted and cross-referenced in datawarehouses and datamarts, and dynamic reports are generated. The Bioinformatics/Biostatistics core facility develops and disseminates computational methods and tools for the analysis of a variety of data (see above), namely clinical observations, genetics/omics and neuroimaging data. Integrative exploration of multimodal and high-dimensional data requires specialized statistical methodologies. The platform thus provides scientists and physicians with an expert analytical support, and devises innovative software.

ACTIVITIES
Databases and Datawarehouse
• Information system architecture for databases and associated files
• Installing and modeling databases
• Development of secure web interfaces
• Modelling of Datawarehouses and Datamarts
• Development of dynamic reports (BI)

Bioinformatics/Biostatistics
• Provide methodological advice and expert assistance in the design and interpretation of biomedical studies
• Define, implement and make accessible procedures for processing high-throughput omics data
• Elaborate and apply statistical methodologies (especially integrative strategies for multimodal data analysis)

EQUIPMENT
Databases and Datawarehouse
• ICM’s IT infrastructure with NAS and SAN storage
• Several databases, web and ftp servers
• Oracle software
• Informatica Powercenter software
• Oracle BI software

Bioinformatics/Biostatistics
• 400-core computing cluster (ICM IT department)
• BladeSystem to host application servers for bioinformatics solutions

TEAM
Ivan Moszer
—Scientific and operational manager
Laure Seux
—Operational manager, databases
Justine Guégan
—Genomics/transcriptomics
Vincent Guillemot
—Biostatistics
Andigoni Malousi
—Genomics/epigenomics
Vincent Perlbarg
—Neuroimaging
Arthur Tenenhaus
—Multimodal integration

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