SUMMARY
The mission of the Brain Mind Institute (BMI) is to understand the fundamental principles of brain function in health and disease, by using and developing unique experimental, theoretical, technological and computational approaches. The scientific challenge addressed by the BMI consists in connecting different levels of analysis of brain activity, such that cognitive functions can be understood as a manifestation of specific brain processes, specific brain processes as emerging from the collective activity of thousands of cells and synapses, synaptic and neuronal activity in turn as emerging properties of the biophysical and molecular mechanisms of cellular compartments.

Research at the BMI focuses on four main areas:

• Mechanisms of brain function and dysfunction, with a particular focus on neurodegeneration and stress-related psychopathologies.
• Molecular and cellular mechanisms of synapse and microcircuit function up to the behavioral level and including metabolic aspects.
• Sensory and body perception and cognition in humans.
• Designing innovative interventions to restore sensorimotor functions after neural disorders.

In all areas, the BMI strives to integrate knowledge gained by multidisciplinary approaches and across different disciplines and research laboratories. An important second mission of the BMI is to bridge scientific approaches and questions with research carried out within the EPFL campus, as well as in related institutions and companies in the area, specifically with the fields of nano- and micro-technology, computer sciences, physics, neuroprosthetics, robotics, signal and medical imaging processing, genetics, metabolism, neuroscience, psychiatry and neurology. Major goals of the BMI are to bridge basic science approaches with clinical applications and to merge areas of experimental work with theory and modeling. Finally, the BMI is fully engaged in the teaching mission of the School of Life Sciences at the Bachelor and Master levels – with a full Neuroscience track at the Master level – and organizes the PhD program in Neurosciences.

Notably, the BMI benefits from a unique academic environment:

• A campus that stands out as a premier technological university in engineering, computer science and basic sciences.
• An intimate collaboration with the Human Brain Project.
• Our participation in the EPFL Center for Neuroprosthetics.
The main focus of our laboratory is to develop translational approaches for gene therapy in the central nervous system. Innovative techniques of gene delivery are used for the modeling and treatment of neurodegenerative diseases such as Parkinson’s disease, Alzheimer’s disease and amyotrophic lateral sclerosis. Using viral vectors such as adenovirus, we modulate long-term expression of genes within the central nervous system, in order to either develop animal models of disease, or test the efficacy of genetic modifications against neuronal degeneration. In parallel, we are also developing a cell encapsulation system for the delivery recombinant antibodies. This system is based on a permeable polymer membrane, which prevents any cell-to-cell contact between transplanted cells and the host immune system. These cells are genetically engineered to produce the molecule of interest in situ. In order to demonstrate the functional effects of the gene delivery systems at hand, our laboratory has full access to a wide range of techniques allowing behavioral assessment, in vivo imaging, morphological and biochemical analysis.

**Research Interests**
- Gene therapy
- Animal models of disease
- Parkinson’s disease
- Amyotrophic lateral sclerosis
- Alzheimer’s disease
- Viral vectors
- Mice-associated antigens
- Cell encapsulation
- Brain imaging

**Selected Publications**


LABORATORY OF COGNITIVE NEUROSCIENCE

LAB DESCRIPTION
The Laboratory of Cognitive Neuroprosthetics (Bertarelli Chair in Cognitive Neuroprosthetics) targets the brain mechanisms of multisensory body perception and consciousness and applies neuroscience and technology findings in the fields of neuroprosthetics and neurorehabilitation. Projects rely on the investigation of healthy subjects, neurological, psychiatric, and orthopedic patients by combining behavioral paradigms, neuroimaging and neurophysiological techniques, and several engineering-based approaches (robotics, brain-computer interfaces, virtual reality). In robotic psychiatry, a major achievement was the design of a master-slave robotic system that manipulates sensorimotor signals and is able to induce altered bodily experience and psychosis-like states in healthy participants. The same states and the involved brain circuits were also studied in neurological patients and we currently investigate the involved brain circuits in healthy participants with a new MRI-compatible robotic system. In another line of neuroscience research, we found that experimental alternations of bodily experience by automatized visual, tactile, and interoceptive stimulation impact physiological states mediated by bilateral insular and temporo-parietal cortex activity. We also showed how these low-level multisensory mechanisms impact cognitive functions, such as social cognition, processing of bodily sounds, pain, and visual consciousness. We currently apply these findings in the field of cognaurobics, where we develop novel treatments for patients with chronic pain on a new integrated virtual reality clinical platform with our medical partners in the Rehabilitation clinics in Sion and Geneva.

RESEARCH INTERESTS
- Cognitive neuroprosthetics
- Multisensory and sensorimotor integration
- Cognition
- Consciousness
- Neuroimaging
- EEG
- Neurophysiology
- Virtual reality

SELECTED PUBLICATIONS

MORE INFO
http://lnco.epfl.ch

Brain areas causing illusory own-body perceptions and hallucinations.
Our mission is to design interventions to restore sensorimotor functions after CNS disorders, especially spinal cord injury, and to translate our findings into effective clinical applications capable of improving the quality of life of people with neuromotor impairments. We also aim at improving our understanding of the locomotor system organization, and of the mechanisms underlying the recovery of motor function after neurological disorders.

To achieve these goals, we address a wide range of research paradigms in mice, rats, cats, monkeys, and humans. Recently, we introduced an electrochemical spinal neuroprosthesis and a robotic postural interface that restored cortical control over complex locomotor movements through the extensive remodeling of supraspinal and intraspinal pathways in rats with a paralyzing spinal cord injury.

We are now developing integrated neuropsychiatric systems and novel robotic support systems for humans in order to translate this discovery into viable applications for spinal-cord-injured people.

**Selected Publications**


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**Research Interests**

- Spinal cord injury
- Neural repair
- Neuroprosthetics
- Brain-machine interface
- Robotic
- Neural recordings
- Optogenetic
- EMG
- Kinematic
- Locomotion
- Neuroanatomy
- Mice
- Rats
- Monkeys
- Humans

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**More Info**

http://courtine-lab.epfl.ch

Grégoire Courtine
Associate Professor

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We are now developing integrated neuropsychiatric systems and novel robotic support systems for humans in order to translate this discovery into viable applications for spinal-cord-injured people.
We focus our research on the molecular and biological mechanisms implicated in the pathological process that leads to Alzheimer’s disease, the most frequent age-related neurological disorder that impairs memory, thinking, and behavior.

More specifically, we use molecular and cellular biology, and protein engineering to identify novel mechanisms and molecules regulating the production of the amyloid-beta peptides, the causative agents of this disease. We have a particular interest in γ-secretase, because it is the founding member of an emerging class of intramembrane-cleaving proteases, but mainly because it catalyzes the final cleavage during the neuronal production of the toxic αβ peptides. Consequently, partially inhibiting or modulating its enzymatic activity is an attractive therapeutic strategy to safely treat Alzheimer’s disease.

Together, our fundamental discoveries on the neurobiological functions of γ-secretase are expected to have therapeutic implications to prevent or slow down the pathogenesis of Alzheimer’s disease.

**Research Interests**
- Molecular & cellular biology of Alzheimer’s disease
- γ-secretase
- Amyloid-beta peptides (Aβ)
- Intracellular cleaving
- Synaptic activity and plasticity
- Transgenic targets
- Translational research

**Selected Publications**

**More Info**
[http://fraering-lab.epfl.ch/](http://fraering-lab.epfl.ch/)
LABORATORY OF COMPUTATIONAL NEUROSCIENCE

LAB DESCRIPTION
We are a theory lab and use mathematical and computational methods to understand aspects of brain function. The activities in our laboratory focus on questions centered around temporal aspects of information processing in the brain: models of spiking neurons, spike-timing dependent learning rules, spatial representation, and plasticity in the hippocampus. Many PhD students in the lab have a background in physics, computer science, or theoretical biology.

In recent years, the lab has studied learning using rules of spike-timing dependent plasticity which are influenced by reward or other modulatory factors. Such learning rules can be used to show complex movements provided the neural network in the brain has a rich transient dynamics. Inhibitory plasticity can contribute to push the network into a stable reference state that can be the basis of learning and memory formation.

SELECTED PUBLICATIONS


Wulfram Gerstner
Full Professor

Simplified mathematical models of synaptic plasticity show how reward signals in the brain can lead to learning of complex behaviors.
The lab is interested in three main questions. Where and how are long-term memories stored in the brain? Why and how are memories lost during neurodegeneration such as in Alzheimer’s Disease? How can traumatic memories from the past be overcome?

To answer these questions, our lab focuses on the emerging field of neuroepigenetics. “Epi-genetic” mechanisms, i.e. modifications of the chromatin that regulate gene expression without changing the DNA sequence itself, have not only been shown to encode the fate of neurons and other cell types during development, but also to change in response to fluctuating environmental contingencies. With this Janus-faced property of being at once stable and dynamic, we hypothesize that epigenetic mechanisms harbor the potential to better explain the molecular processes that converge newly learned information into a stable memory trace. In extension, because epigenetic mechanisms are also amenable to environmental and pharmacological intervention, they might constitute a novel angle on how to counteract memory loss and resilient traumatic memories.

# Epigenetics
# long-term memories
# Traumatic memories
# Memory loss
# Neurodegeneration
# Alzheimer’s Disease

More info
http://graefflab.epfl.ch
Even after more than a century of research, the mechanisms of the simplest forms of human visual processing are largely unknown. For example, it remains still a mystery how humans perform such a simple task as spotting a pen on a cluttered desk. Our research aims to understand how and why humans can cope with visual tasks so remarkably well. Our main goal is to characterize the interplay between spatial and temporal integration processes. In our research, we use psychophysics, TMS, EEG, mathematical modelling, and clinical investigations in schizophrenic patients.

Main topics of research are: conscious and unconscious feature integration, contextual modulation, visual masking, and perceptual learning.

LAB DESCRIPTION

LABORATORY OF PSYCHOPHYSICS

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Main topics of research are: conscious and unconscious feature integration, contextual modulation, visual masking, and perceptual learning.
Our laboratory focuses on algebraic topology and its applications, primarily to the life sciences, in particular neuroscience. Homotopy theory and category theory are particular areas of expertise in pure mathematics of the research group. Our current collaborations in neuroscience concern homological analysis of Blue Brain-simulated microcircuits, category-theoretic models of brain function, and topological data analysis (TDa) applied to the classification of neuron morphology and to the study of Self-avoiding Walk models of neurons. We plan moreover to apply TDa to analyzing large data bases and images arising in clinical neuroscience.

In collaboration with UPBi, group members are also involved in research projects concerning applications of algebraic topology in breast cancer research, primarily TDa applied to RNA-seq data. We collaborate moreover with researchers in the EPFL Energy Center, on characterizing high performance crystalline porous materials.

**LAB DESCRIPTION**

- Homotopy theory
- Category theory
- Applications of algebraic topology especially to the life sciences

**Selected Publications**


**Research Interests**

- Homotopy theory
- Category theory
- Applications of algebraic topology especially to the life sciences

**More Info**

http://gr-he.epfl.ch
LAB DESCRIPTION
Research in the Lashuel laboratory focuses on applying chemical, biophysical, and molecular biology approaches to elucidate the molecular and structural basis of protein misfolding and aggregation and the mechanisms by which these processes contribute to the pathogenesis of neurodegenerative diseases including Parkinson’s disease, Alzheimer’s disease and Huntington’s disease. Current research efforts cover the following topics: (1) Elucidating the sequence, molecular and cellular determinants underlying protein aggregation, propagation and toxicity; (2) Developing innovative chemical approaches and novel tools to monitor and control protein folding, self-assembly and post-translational modifications in vitro and in vivo with spatial and temporal resolution; (3) Developing novel cellular and animal models of neurodegenerative diseases to validate novel therapeutic targets, and assess disease modifying strategies based on modulating protein aggregation and clearance.

SELECTED PUBLICATIONS


LAB DESCRIPTION

Our laboratory has two main lines of research: the principal one is to try to understand the cellular and molecular mechanisms of neuroenergetic coupling, namely the processes by which appropriate energy substrates are delivered to neurons where and when they are active. Our studies ongoing now for two decades have identified the interactions between neurons and glial cells (astrocytes) as the basis of neuroenergetic coupling. We are also interested in understanding the bases of neuroenergetic coupling in other aspects of brain function and dysfunction, such as learning and memory, the sleep-wake cycle, as well as neurodegeneration.

We are currently studying transcriptionally-regulated adaptations in the level of expression of certain genes of brain energy metabolism in relation to neuronal plasticity as observed during learning, the sleep-wake cycle and certain pathological conditions such as neuroinflammation and neurodegeneration. The second line of research is represented by a neurophotonics project, which was implemented through a joint effort with the Advanced Photonics Laboratory at the STI Faculty, to develop a new type of microscope using different optical modalities. On the theoretical level, Pierre Magistretti is also interested in the dialogue between neuroscience and psychoanalysis.

RESEARCH INTERESTS

# Neuroenergetics
# Neuro-glia interaction
# Neuroplasticity
# High-resolution optical imaging
# Digital holographic microscopy
# Cell dynamics
# Neurodegeneration
# Sleep
# Psychiatric disorders

MORE INFO

http://lndc.epfl.ch

SELECTED PUBLICATIONS


LAB ORATORY OF NEURAL MICROCIRCUITRY

LAB DESCRIPTION

The laboratory of Neural Microcircuitry (LNMC) adopts a multidisciplinary approach to investigate the structure and function of the neocortex, a brain region that is organized in repeating stereotypical neuronal microcircuits. It is our goal to derive the blue print of these microcircuits.

To study the neocortical microcircuit, we employ whole-cell patch clamp methodology in rodent neocortical slices. This technique allows us to obtain the electrophysiological profile of neurons, to study local connectivity between them, to fill them with dyes for subsequent 3D reconstruction of their morphologies and to aspirate their cytoplasm to reveal their individual gene expression profile. We are also using an automated patch clamp setup to characterize the kinetics of many different ion channels whose differential expression gives rise to the extremely diverse electrical characteristics of neurons.

The combination of these approaches enables us to derive the genetic basis for the electrophysiological and morphological diversity that we observe in the cell types composing the microcircuit.

The laboratory has also developed a multidisciplinary approach to study diseases such as autism. We use animal models to link autism-related behavioral alterations to changes at the genetic, synaptic, circuit and whole brain level.

RESEARCH INTERESTS

- Neurons
- Synaptic plasticity
- Neuronal microcircuits
- Neuronal coding
- Patch clamp
- Signal integration
- Single cell gene expression
- Ion channels
- Neuron morphology
- Modeling
- Autism

MORE INFO

http://markram-lab.epfl.ch

SELECTED PUBLICATIONS

Muralidhar S., Wang Y., Markram H. (2014) Synaptic and cellular organization of layer 1 of the developing rat somatosensory cortex. in Frontiers in Neuroanatomy 7:52


Henry Markram
Full Professor
The goal of the Laboratory of Sensory Processing is to obtain a causal and mechanistic understanding of sensory perception and associative learning at the level of individual neurons and their synaptic interactions within neuronal networks. Our experiments focus on active somatosensor processing of tactile percepts obtained from the mystacial whiskers of mice. We are currently working on several complementary areas of research:

1. Correlation of neuronal activity, brain states and behaviour in awake mice, including the analysis of sensory perception informed by the C2 whisker and reported through learned sensorimotor behaviours.

2. Basic operating principles and wiring diagrams of neocortical microcircuits, focusing on the mouse C2 barrel column.

3. Genetic analysis of the synaptic determinants of sensory perception and associative learning, through combination of optogenetics, viral manipulations and gene-targeted mice.


The Laboratory of Behavioral Genetics investigates the impact and mechanisms whereby stress and personality affect brain function and behavior, with a focus on the social domain and, particularly, on aggression and social hierarchies. Specifically, we investigate:

- The neurobiological mechanisms involved in the formation of social hierarchies, and their modulation by stress and anxiety. We are exploring the role of the mesolimbic system and mitochondrial function in motivation and social competition.
- The mechanisms whereby early life stress enhances risk to develop psychopathology, with a main focus on the emergence of pathological aggression. We investigate the role of glucocorticoids in determining different neurodevelopmental trajectories following exposure to early life adversity.
- The mechanisms whereby alterations in neurodevelopmental plasticity lead to psychopathology. We investigate the role of genes involved in the polysialylation of the neural cell adhesion molecule NCAM and the associated dysfunctions in gene expression and neural connectivity.

Experimental approaches in the lab include a combination of behavioral, neurobiological, neuroimaging, neurochemical, pharmacological, metabolic, genetic and optogenetic methods. Although the core of our work is carried out in rodents, we are currently translating our findings to humans using behavioral economics, experimental psychology and neuroimaging approaches.

**Research Interests**
- Stress
- Anxiety
- Psychopathology
- Social behaviors
- Social hierarchies
- Neuroendocrinology
- Neuroeconomics
- Glutamate receptors
- Mitochondrial function
- Mesolimbic system
- Cell adhesion molecules
- Neuroprotective strategies

**Selected Publications**

NERVE cells in the brain form intricate neural circuits, and communicate with each other by electrical and chemical signalling at synapses. The complexity of neuronal circuits is enormous. Most neurons receive information from tens of thousands of upstream neurons, while at the same time providing output information to thousands of downstream neurons, which can be located in many different brain areas. It is a long-term goal of Neuroscience research to understand how the complex synaptic connectivity in the brain is set-up during development, and how it enables the organization of behavior.

Our lab is interested in the interplay between genetically encoded signals, and experience-dependent plasticity as causative events in determining synaptic connectivity. We study neurons and circuits in different parts of the auditory system of the mouse brain. The ideal genetic accessibility of the mouse allows us to manipulate specific neuron populations, and to study the influence of specific proteins in synaptic plasticity and the refinement of synaptic circuits. In the past, we have begun to identify signalling pathways which guide the formation of specific neuron populations, and to study the influence of specific proteins in synaptic plasticity and the refinement of synaptic circuits. In the past, we have begun to identify signalling pathways which guide the formation of large excitatory synapses in the lower auditory system. We also study the plasticity of inhibitory synapses in the cortex, because the balance of inhibition and excitation determines highly plastic periods during brain development. Our results should, in the long term, advance our understanding of human psychiatric diseases, many of which are circuit diseases at the interface between genetic and experience-dependent influences during brain development.

SELECTED PUBLICATIONS
Han Y., Kaeser P.S., Südhof T.C., and Schneggenburger R. (2011). RIM determines Ca2+ channel density and vesicle docking at the presynaptic active zone. in Neuron 69:304-316.


LABORATORY OF SYNAPTIC MECHANISMS

Ralf Schneggenburger
Full Professor

Focus on synaptic plasticity and circuit wiring in the mouse brain.

LAB DESCRIPTION
Nerve cells in the brain form intricate neural circuits, and communicate with each other by electrical and chemical signalling at synapses. The complexity of neuronal circuits is enormous. Most neurons receive information from tens of thousands of upstream neurons, while at the same time providing output information to thousands of downstream neurons, which can be located in many different brain areas. It is a long-term goal of Neuroscience research to understand how the complex synaptic connectivity in the brain is set-up during development, and how it enables the organization of behavior.

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Blue Brain Project builds supercomputer models of the brain and uses them in *in silico* experiments that provide new insights into the brain. To do this we have created software tools that do not depend on the details of any particular brain and used them to model a “microcircuit” in the rat somatosensory cortex. We are now building similar mouse models, moving towards models of the whole mouse brain and ultimately the human brain.

In the last two years we have grown. The BBP and its tools make an important contribution to the Human Brain Project - selected in January 2014 as one of Europe’s two, billion-Euro FET Flagships. A new BlueGene/Q supercomputer, hosted at CSCS in Lugano, has given us the capability to run simulations on the scale of the whole mouse brain. We have moved to a new headquarters at the Biotech Campus in Geneva.

On the scientific front, we have built initial “course-grained” models of the whole mouse brain, begun to incorporate new features (e.g. the vasculature) in our models, and expanded our visualization capabilities. Most importantly of all, we have helped new groups to use BBP tools. An Italian group is currently using Blue Brain tools to model the cerebellum - a region outside the current scope of the BBP - and an Israeli group is using them to model human neurons.
Mission
The Center for Neuroprosthetics (CNP) capitalizes on its unique access to the advanced technologies and state of the art brain research at EPFL. We strive to develop new technologies that support, repair and replace functions of the nervous system. The development of neuroprostheses requires a fundamental understanding of the neurobiological mechanisms of the functions that should be replaced or repaired (perception, cognition or movement) and innovative technologies to record, process and translate signals into commands (for artificial limbs, bodies and robots), or to produce signals to activate the brain (for sensory and cognitive prostheses).

The impact of neuroprosthetics for the treatment of sensory loss and impaired mobility has already been demonstrated with cochlear implants and deep brain stimulation. With approximately a third of the population in Europe and the US afflicted by brain disorders, major advances in neuroprosthetics are necessary, including breakthroughs in cognitive neuroprosthetics for treating cognitive deficits such as those caused by Alzheimer’s disease or vascular stroke.

The CNP is part of the School of Life Sciences and the School of Engineering. It draws upon EPFL’s expertise in biology, theoretical and computational neuroscience, brain imaging, genetics as well as biomedical, electrical, mechanical engineering, signal analysis, micro- and nanotechnology. The Center is linked to the European Human Brain Project and the Swiss National Centers of Competence in Research in Robotics and in Psychiatric diseases. Together with Harvard Medical School and EPFL’s Institutes of Bioengineering and Neuroscience, CNP is part of the Bertarelli Program in Translational Neuroscience and Neuroengineering. It has strategic partnerships with Geneva University Hospital, Lausanne University Hospital, the Swiss Rehabilitation Clinic in Sion, and with the regional biomedical industry.

Laboratories

- **Prof Olaf Blanke** Bertarelli Foundation Chair in Cognitive Neuroprosthetics http://cnpo.epfl.ch
- **Prof Simone Courtes** International Paraplegic Foundation (IRP) Chair in Spinal Cord Repair http://courtine-lab.epfl.ch
- **Prof Dieter Hohlfeld** Medtronic Chair in Neuroengineering http://cnp.epfl.ch/ghezzilab
- **Prof Stéphane P. Lacour** Bertarelli Foundation Chair in Neuroprosthetic technology http://lsbi.epfl.ch
- **Prof Silvestro Micera** Bertarelli Foundation Chair in Neuroprosthetics Technology http://nhi.epfl.ch
- **Prof José Del R. Millán** Delfitech Foundation Chair in Non-Invasive Brain-Machine Interface http://cnbi.epfl.ch

Electronic dura mater (e-dura).

The soft elastomeric implant is prepared with a silicone rubber, stretchable thin-gold film interconnects, platinum-silicone composite electrode coating, and hosts a silicone microfluidic channel for in situ drug delivery. This surface electrode implant can be inserted below the natural dura mater to conform the very surface of the brain or the spinal cord.
DESCRIPTION

By bringing together internationally recognized neuroscientists active in cutting-edge research with research-oriented academic psychiatrists, the NCCR “SYNAPSY” aims to develop a translational program linking neuroscience and psychiatry with the aim of uncovering the neurobiological mechanisms underlying mental disorders. In addition to its scientific outcomes, the NCCR “SYNAPSY” will have an important clinical and societal impact: it will contribute to the emergence of a new generation of clinical psychiatrists with a strong neuroscientific background, and to the development of novel preventive and therapeutic approaches based on the understanding of biological mechanisms underlying mental disorders, which ultimately will improve the quality of life of patients.

GOALS

• Uncover neurobiological mechanisms underlying mental disorders
• Encourage academic careers for junior researchers/clinicians and women
• Contribute to destigmatize mental disorders
• Catalyze cutting-edge research to provide new approaches for patient care

RESEARCH PROJECTS

• Sensorimotor processes and bodily self-consciousness in schizophrenia
• Epigenetic programming of adult cognitive health through prenatal stress
• Sensory-motor processes and bodily self-consciousness in schizophrenia
• Epigenetic programming of adult cognitive health through prenatal stress

PARTICIPATING BMI RESEARCHERS

BLANC, OLA
Sensory-motor processes and bodily self-consciousness in schizophrenia

GRÄFF, JOHANNES
Epigenetic programming of adult cognitive health through prenatal stress

HERROG, MICHAEL
Endophenotypes of schizophrenia

HORVAT, PIERRE
Role of neuron-glia metabolic coupling in mood disorders

RANDI, CARMEN
Early life stress and psychopathology

SCHNURRBUCHER, RALF
Role of amygdala - striatum synapses in autism-related social deficits

MORE INFO

http://nccr-synapsy.ch

NATIONAL CENTER OF COMPETENCE IN RESEARCH (NCCR) SYNAPSY
AFFILIATED GRPS

PROF. JORG AUWERS
Laboratory of Integrative Systems Physiology – EPFL

The team of Dr. Auwers has been using molecular physiology and systems biology to understand signal coordination and metabolism in health, aging and disease. Mitochondria are organelles, that are derived from endo-symbiotic α-proteobacteria, which have become the seats of cellular energy harvesting through the process of oxidative phosphorylation (OXPHOS). Whereas the actual work of Johan Auwers was instrumental to elucidate how transcription control of mitochondrial activity, more recently, has affected a broad range of metabolic and cellular processes in various human tissues and organ systems: metabolism in health, aging and disease. Mitochondria are organelles, that are derived from endo-symbiotic α-proteobacteria, which have become the seats of cellular energy harvesting through the process of oxidative phosphorylation (OXPHOS). Whereas the actual work of Johan Auwers was instrumental to elucidate how transcription control of mitochondrial activity, more recently, has affected a broad range of metabolic and cellular processes in various human tissues and organ systems.

http://auwerx-lab.epfl.ch

PROF. AURÉL BÉLAIS
Learning Algorithms and Systems Laboratory – EPFL

Research at the Learning Algorithms and Systems Laboratory (LASA) aims at understanding the role of perception and action, of the standardised metabolic disturbances (2.5-3.5 g/24h) that are derived from endo-symbiotic α-proteobacteria, which have become the seats of cellular energy harvesting through the process of oxidative phosphorylation (OXPHOS). Whereas the actual work of Johan Auwers was instrumental to elucidate how transcription control of mitochondrial activity, more recently, has affected a broad range of metabolic and cellular processes in various human tissues and organ systems. The team of Dr. Auwers has been using molecular physiology and systems biology to understand signal coordination and metabolism in health, aging and disease. Mitochondria are organelles, that are derived from endo-symbiotic α-proteobacteria, which have become the seats of cellular energy harvesting through the process of oxidative phosphorylation (OXPHOS). Whereas the actual work of Johan Auwers was instrumental to elucidate how transcription control of mitochondrial activity, more recently, has affected a broad range of metabolic and cellular processes in various human tissues and organ systems.

http://lasa.epfl.ch

PROF. JIRI DELI
Hill Laboratory – Neural Systems and Neuroinformatics

The Hill Laboratory focuses on research in the areas of neural systems and neuroinformatics. One of the major strategies is to use a variety of biologically-morphic models to study the role of emergent phenomenology of networks and cell assemblies related to the neurocognitive plasticity in the central nervous system, from the neuronal scale to the whole-brain scale, with emphasis on the structural and functional organisation. Other interests include computational approaches to neural tissue interfaces including stimulated local field potentials (SLFP), electroencephalography (EEG) and transcranial magnetic stimulation (TMS). Prof. Deli leads work on the Human Brain Project’s Neuroinformatics Platform, a collaboration platform for engineering neuroscience data including novel and brain imaging data including multimodal brain imaging, machine learning, machine vision, datat and new image analysis methodologies. In addition, Prof. Deli serves as the Scientific Director of the International Neuroinformatics Coordinating Facility (INCF) and leads the Swiss INCF Node.

http://www.hill-lab.org

PROF. RICHARD FRACKOWIAK
Department of Clinical Neuroscience – University Hospital Lausanne

The research interest of Prof. Frackowiak interest has been the functional and structural architecture of the human brain in health and disease. He has pioneered the development and introduction of positron emission tomography and magnetic resonance imaging and prolonged a research program dedicated to understanding the organisation of human brain function, but his focus has been on plasticity and mechanisms for functional recuperation after brain injury and the pathophysiology of neural reorganisation. He has become interested in the use of fMRI-based neuroimmunology especially in the study of genetic influences on brain disease and in a search for biomarkers and endophenotypes of neurodegenerative disorders. Most recently he has introduced comprehensive image classification for diagnostic and treatment monitoring into clinical science and hence became interested in using modern informatics to promote the development of a better understanding classification and management of brain diseases, which he does in the Human Brain Project.

https://www.humanbrainproject.eu

PROF. SEAN HILL
Adjunct Professor at the BMI

The Hill Laboratory focuses on research in the areas of neural systems and neuroinformatics. One of the major strategies is to use a variety of biologically-morphic models to study the role of emergent phenomenology of networks and cell assemblies related to the neurocognitive plasticity in the central nervous system, from the neuronal scale to the whole-brain scale, with emphasis on the structural and functional organisation. Other interests include computational approaches to neural tissue interfaces including stimulated local field potentials (SLFP), electroencephalography (EEG) and transcranial magnetic stimulation (TMS). Prof. Deli leads work on the Human Brain Project’s Neuroinformatics Platform, a collaboration platform for engineering neuroscience data including novel and brain imaging data including multimodal brain imaging, machine learning, machine vision, datat and new image analysis methodologies. In addition, Prof. Deli serves as the Scientific Director of the International Neuroinformatics Coordinating Facility (INCF) and leads the Swiss INCF Node.

http://www.hill-lab.org

PROF. JOHN DONOGHUE
Brown Institute for Brain Science

John P. Donoghue also directs the Brown Institute for Brain Science in Rhode Island USA and is Professor of neuroscience at Brown University. His research is focused on the investigation how the brain learns through voluntary behavior. His translational approach allows him to develop innovative brain-computer interfaces for people with paralysis.

http://www.campusbristol.org/brrown/https://www.brown.edu/display/jdonoghu

PROF. ROLF GRUETER
Laboratory of functional and metabolic imaging (LIFMET) – EPFL

Our laboratory works at the multi-disciplinary interface of physiology, biomedicine, imaging sciences and informatics. We are applying novel approaches (metabolic modelling, single nucleotide polymorphisms, expression and often at the heart of many diseases. Our lab is mainly interested in the non-invasive measurement of metabolic processes in healthy and diseased subjects using approaches (metabolic modeling, among others), allowing to measure metabolic reactions in vivo in inaccessible regions, in the context of biophysical problems of interest in robust models of health and disease (a particular focus on in vivo imaging, among others), as well as with human volunteers. Our research interests include signal and function in the central nervous system, from the neuronal scale to the whole-brain scale, with emphasis on the structural and functional organisation. Other interests include computational approaches to neural tissue interfaces including stimulated local field potentials (SLFP), electroencephalography (EEG) and transcranial magnetic stimulation (TMS). Prof. Deli leads work on the Human Brain Project’s Neuroinformatics Platform, a collaboration platform for engineering neuroscience data including novel and brain imaging data including multimodal brain imaging, machine learning, machine vision, datat and new image analysis methodologies. In addition, Prof. Deli serves as the Scientific Director of the International Neuroinformatics Coordinating Facility (INCF) and leads the Swiss INCF Node.

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PROF. ROY WILSON
Wyss Center for Bio-and Neuro Engineering / Brown Institute for Brain Science

Since September 2014, John P. Donoghue is adjunct professor at the Brain Mind Institute at EPFL, and the director of the new center for Bio-and Neuro Engineering, located on Campus Biotech in Geneva, which will host more than 350 researchers devoted to research in areas such as neuro-engineering and regenerative engineering. The center will provide research platforms to translate technology to new medical devices, promote collaboration among the world’s leading scientific minds and also provide access to the financial and business expertise that can translate cutting-edge research into viable treatments. John P. Donoghue also directs the Brown Institute for Brain Science – (LasA) pushes the barriers that hinder robots from evolving from the fully predetermined industrial world to the unpredictable, human inhabited world. Interacting with humans and acting in our daily environment requires robots to display a flexibility and comportment that are derived from endo-symbiotic α-proteobacteria, which have become the seats of cellular energy harvesting through the process of oxidative phosphorylation (OXPHOS). Whereas the actual work of Johan Auwers was instrumental to elucidate how transcription control of mitochondrial activity, more recently, has affected a broad range of metabolic and cellular processes in various human tissues and organ systems.

http://www.lifmet.epfl.ch

PROF. ANNE HILL
Hill Laboratory – Neural Systems and Neuroinformatics

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Hill Laboratory – Neural Systems and Neuroinformatics

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The Translational Neural Engineering (TNE) Laboratory - EPFL

The goal of the Translational Neural Engineering (TNE) laboratory is to develop implantable neural interfaces and robotic systems to control real-time the function of disabilities (optical, visual, auditory, psychomotor, etc.). The TNE laboratory develops (1) novel technologies and methods originating from the idea that better understanding leads to better development from basic scientific knowledge in the field of neuroscience, with the idea that better understanding leads to better development of clinical solutions.

In 2016 we published the first examples of a biomedical arm neuroprosthesis in humans. We showed, for the first time, the possibility of clinical solutions. In 2014 we published the first example of a biodirectional arm neuroprosthesis in humans. We showed, for the first time, the possibility of clinical solutions. The idea that better understanding leads to better development from basic scientific knowledge in the field of neuroscience, with the idea that better understanding leads to better development of clinical solutions.

Our research interests are therefore at the intersection between robotics, control and learning in animals, and in return to take inspiration from brain-computer interfaces for robotics. Our approach to design intelligent neuroprostheses is based on the idea that better understanding leads to better development of clinical solutions.

The Biorobotics Laboratory – EPFL

The Biorobotics Laboratory – EPFL is dedicated to the design of novel robots capable of agile locomotion in complex environments. Our research focuses on developing soft robotics. Our approach to design intelligent neuroprostheses is based on the idea that better understanding leads to better development of clinical solutions.

The research at LMIS4 is focusing on three areas: cell chips, bioelectronic devices and nanofluidics. We pioneered a new microfluidics label-free cytometry method based on the measurement of electrical impedance of single cells. We further developed the new microfluidics label-free cytometry method based on the measurement of electrical impedance of single cells. We are developing microelectrode arrays for bioelectronic implants that are then used to develop new molecular therapies based on small peptides and patent-free drugs. Currently, we are developing a new animal models specifically in the zebrafish. These animal models are then used to develop new molecular therapies based on small peptides and patent-free drugs.

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The Schürmann laboratory focuses on the interface between computational modeling, experimentation and theory, with a particular emphasis on the interface between computational modeling, experimentation and theory. Key areas of research include techniques for modeling and simulating the structure of the brain and the brain's functional organization. The laboratory's research interests include the characterization and functional organization of brain networks at the systems level based on whole-brain connectivity measures. To that aim, we develop innovative algorithms for characterizing the dynamic connectivity of brain networks during cognitive tasks, and the alterations of brain networks during neurological conditions.

Our lab's mission is to advance our understanding of human brain function in health and disorder using non-invasive imaging techniques. The laboratory is involved in the launch of the Human Brain Project (HBP), which provides a crucial link between computational modeling and experimental evidence. The laboratory is actively involved in developing new methods for characterizing brain connectivity and function in health and disorder using non-invasive imaging techniques. To that aim, we develop innovative algorithms for characterizing the dynamic connectivity of brain networks during cognitive tasks, and the alterations of brain networks during neurological conditions.

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