

**Specialized PhD in Neuroscience**

**University of Bern**

**Graduate programs**

*Graduate School for Cellular and Biomedical Sciences (incl. BENEFRI)*

*Graduate School for Health Sciences*

Academic year 2024-2025

**1-Description**

The Specialized PhD in Neuroscience program supports training for doctoral students in neuroscience during their doctorate. It includes a basic training in neuro-physiology, with an optional neuro-anatomy course, and provides an up-to-date teaching in current areas of neuroscience research and techniques through the BENEFRI Neuroscience Workshop and the BENEFRI Hands-on Workshop, respectively.

The BENEFRI Neuroscience program is integrated into the course offered by both the Graduate Schools of Health Science (GHS) and Cell Biology (GCB) including the BENEFRI program between the University of Bern and the University of Fribourg.

The theoretical and practical teaching are organized in the Universities of Bern and Fribourg and include external international-standing lecturers from Swiss or European academic institutions.

**2-Program**

The Specialized PhD in Neuroscience requires a total of 25 ECTS. The mandatory neurophysiology exam, attendance of the BENESCO lecture series and participation in the workshops account for 19 ECTS. The remaining 6 ECTS can be obtained through additional lectures, courses, journal clubs, acquired techniques etc (see below) that have to be outlined together with the thesis supervisor to provide a customized curriculum for each student.

***2.1-Mandatory Courses and Exams.***

**a-Neuro-Physiology**

The program requires that students pass an oral exam in neuro-physiology (4 ECTS). As candidates might have previous training/educational background in neuroscience, they can decide if they need to attend neurophysiology lectures that are on-going in Bern. The neuroscience lectures (6 lectures in English) within the Physiology course (organised by the Department of Physiology, Bern) for the Masters in Biomedical Engineering can be followed in this case.

**Duration** Self-learning – 1 year

**Credits** 4 ECTS – oral examinations

**Location** Examinations in Bern or Fribourg

**Schedule** Spring and Autumn

Topics in Functional Neuroscience (Neurophysiology/Neurobiochemistry)

Synaptic transmission

Neurotransmitter and receptor systems

The visual system

The auditory system

The somatosensory system

Spinal control of movement

Brain control of movement

Synaptic mechanisms of memory (LTP and LTD)

Wiring the brain (growth cones, synapse formation in the endplate, apoptosis, activity-dependent synaptic rearrangement in the visual system)

Brain rhythms (EEG, binding problem, sleep)

A list of recommended literature is provided on the BENEFRI Neuroscience website: https://physiologie.unibe.ch/Benefri/examination.aspx

**b-Neuro-ethics-Scientific integrity (GCB) – 1 ECTS**

**c-Scientific writing (GCB) – 1 ECTS**

**d-BENESCO lecture series – 2 ECTS (see Annex 2 for description)**

**e-BENEFRI workshops**

***BENEFRI Neuroscience Workshop.*** (http://www.physio.unibe.ch/benefri/workshop2020.aspx)

This is a three-day block course organized in Bern and Fribourg once a year that usually highlights 6 different areas of neuroscience.

The aim of these courses is to give doctoral students a broad insight into many areas of neuroscience during the 3-4 years of their dissertation. The doctoral students also actively participate in these workshops by presenting their work (short presentations or posters). 2 ECTS points are awarded for each workshop. Participation in at least three of these workshops (6 ECTS in total) is mandatory for program completion. The ECTS points are recognized by the GCB and the GHS in their curricula.

**Duration** 3 days (Lectures)

**Credits** 2 ECTS

**Location** Lectures in Bern or Fribourg

**Schedule** January/February 2023 – 3 time attendance (2+2+2 ECTS)

***Hands-On Neuroscience Workshop.***

The Current Techniques in Neurosciences workshop will cover experimental, technical and

analytical approaches in neurosciences. The first day includes focused lectures on multiples aspects of current techniques in neurosciences. The second and third day are dedicated to hands-on practice under supervision in one of the host laboratories. Students are required to attend the lectures at least once, and perform 2 hands-on sessions (5 ECTS in total).

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| **Day 2: Hands-on I (see annex: List of host labs)** | | | | |
| 9.00-10.00 | Advances courses on topic | In-depth review of concept and recent upgrades & advances | Host |  |
| AM | Hands-on experiment |  | Host | - |
| PM | Hands-on experiment & data analysis |  | Host | - |
| **Day 3: Hands-on II** | | | | |
| AM | Hands-on experiment |  | Host | - |
| PM | Hands-on experiment & data analysis |  | Host | - |
| Examination | One paper to prepare and discuss with the host over the 2 days (Journal club) | | Host | Journal club |

**Duration** 1 day (Lectures, see below) + 2 days (Hands-on)

**Credits** Multiple choice questions (Day 1- 1 ECTS) and Journal club (Day 2 & 3 – 2 ECTS)

**Location** Lectures in Bern or Fribourg, Hands-on in host laboratories in Bern or Fribourg

**Schedule** June 2023 – 1 time attendance of the lecture + 2 times attendance of the hands-on (1+2+2 ECTS)

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| **Day 1: Lectures** | | | | |
|  | Lectures | Topics | Lecturer (suggestions only) | Exam |
| 1 | Recombinant DNA, manipulating genes & genomes | Cloning DNA  Transgenic animals | Prof. A. Adamantidis | MCQ |
| 2 | Stereotaxy & In vivo techniques (*incl. electrophysiology*) | Gene delivery strategies  Tracking neural activity in vivo  Manipulating neural activity in vivo | PD Dr C. Gutierrez Herrera | MCQ |
| 3 | Omics techniques | From transcripts to phosphorylation | TBD | MCQ |
| 4 | Ultra-structural microscopy | Cellular morphology  Labelling methods  Mapping circuits | Prof. B. Zubler- Prof. B. Engelhardt- | MCQ |
| 5 | Functional microscopy | Markers of activity  Vizualizing proteins functions  Optical manipulations | PD Dr S. Sachidhanandam | MCQ |
| 6 | Human brain imaging | Hd-EEG, PET, SPECTR, MEG, fMRI | Prof. Dr. R. Wiest- TBC | MCQ |
| 7 | Neural basis of behaviors | Structure-function relationship during innate and learned behaviors (cognition, fight/flight, sleep, reward).  Wearables devices (human) | Dr S. Ciocchi | MCQ |
| 8 | Animal models of brain diseases | Alzheimer’s Disease, Parkinson’s Disease, epilepsy, etc. | Dr M. Baud, Prof. Th. Nevian | MCQ |
| 9 | Computational neuro | Modelling | Prof . A. Tzovara  Prof. W. Senn / Prof JP Pfister | MCQ |

***Host labs (see Annex 1).***

The hands-on workshop is granted at the request of the doctoral students by the Host (contact in the table). Interest in others labs at the Universities of Bern and Fribourg that are not included in this list can be proposed by the doctoral students and granted by the Program Committee of the Specialized Neuroscience Program.

**2.2-Optional courses and exams**

The program proposes a series of courses with credits optional to the doctoral students. These are offered at the Universities of Bern and Fribourg and include multiple topics. Note that courses outside this curriculum can also be included in the program at the request of the doctoral students and granted by the Program Committee.

**a-Neuro-Anatomy**

The program allows for students to follow a neuro-anatomy course (3 ECTS), together with medical students. Students can then sit for an oral exam in neuroanatomy (4 ECTS), which is held together with the neurophysiology exam.

**Duration** Self-learning – 1 year

**Credits** 3+4 ECTS – oral examinations

**Location** Examinations in Bern or Fribourg

**Schedule** Spring and Autumn

**Program** The neuro-anatomy courses can be attended either in Bern or Fribourg. In Bern the course is organized by the Anatomy Department (Dr. Kati Hänssgen - kati.haenssgen@unibe.ch), as part of the training for medical students. It is conducted in German from April to May (5x1.5hrs). In Fribourg it is organized by the Anatomy Department and is conducted in German/French from February to April (5x3hrs).

Topics in Structural Neuroscience (Neuro-anatomy)

Neurons and glia cells

Early brain and spinal cord development

General organisation of the spinal and cranial nerves

Organisation of the mammalian spinal cord

General organization of the brainstem

Hippocampal and cortical organization

Topography of the sensory systems (visual, auditory, vestibular, somatosensory)

Topography of the motor pathways

Cerebellum

The hypothalamus and the limbic system

Brain lateralization und language

Blood supply of the brain

**b- Other optional courses - lectures, journal clubs, experimental techniques or conferences (6 ECTS)**

The composition of these 6 ECTS has to be determined together with the thesis supervisor, and approved by the Program Committee. Experimental techniques that have to be acquired to perform the thesis project can count towards the ECTS. The list of techniques, skills and courses and corresponding ECTS is indicated in the BENEFRI curriculum (see https://physiologie.unibe.ch/Benefri/curriculum.aspx).

**Eligibility**

The prerequisite for participation in the BENEFRI Neuroscience Program in Bern is admission to one of the two Graduate Schools - GCB or GHS. Admission to the program is granted at the request of the doctoral student by the Program Committee of the Specialized Neuroscience Program consisting of two representatives from the Universities of Bern and Fribourg without any additional evaluation or selection of the doctoral students or their projects.

The program is opened to students with background in Neuroscience including Neurology, Psychiatry, Physiology, Anatomy, Biology, Neuropsychology.

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| **Annex 1: List of host labs** | | | | |
| **PI** | **Location** | **Details** | **Contacts** |  |
| Prof A Adamantidis | ZEN, UNIBE  Dept of Neurologie Inselspital, Bern | System neurosciences, in vivo electrophysiology, single-/multi-fiber photometry, 2P-imaging, optogenetics, sleep, cognitive behaviors (mice) | antoine.adamantidis@dbmr.unibe.ch | Main contact for ZEN, Dept Neurologie, UNIBE |
| PD S Sachidhanandam | Institute of Physiology, Bern | Sensory perception, in vivo electrophysiology, 2P-imaging, head-fixed behaviour (mice) | shankar.sachidhanandam@unibe.ch | Main contact for Institute of Physiology, UNIBE |
| PD C. Gutierrez Herrera | ZEN, Inselspital, Bern | Neuron-astrocytes, micro-endoscopes, in vivo electrophysiology (EEG, LFP, EOG, Unit) (mice) | carolina.gutierrez@dbmr.unibe.ch |  |
| Dr M. Baud | ZEN, Inselspital, Bern | Mouse model of epilepsy, EEG recording in human & mice, in vivo electrophysiology (Neuropixel), optogenetics, pharmacology | maxime.baud.neuro@gmail.com |  |
| Prof K. Schindler | Dept of Neurologie, Inselspital, Bern | Epilepsy, modelling and intervention, design and use of chronic neuro-devices | Kaspar.schindler@insel.ch | Main contact for Neurologie, Inselspital & NEUROTEC @SITEM |
| Dr M. Schmidt | ZEN, Inselspital, Bern | Mouse model of narcolepsy, sleep-metabolism in mouse & human, fiber photometry, EEG (mice) | markus.schmidt@insel.ch |  |
| Dr G. Tinkhauser | Dept of Neurology, Inselspital, Bern  ZEN, UNIBE | DBS in human subjects with Parkinson’s Disease (human data) | gerd.tinkhauser@insel.ch |  |
| Dr V. Pernet | ZEN, Inselspital, Bern |  | vincent.pernet@insel.ch |  |
| Prof. A. Chan  PD Dr A. Salmen  PD Dr R Hoepner | ZEN, Dept of Neurologie, Inselspital, Bern | Mice model of neuro-immune disorders (EAE), cell culture, behaviour (mice) | andrew.chan@insel.ch |  |
| Prof S. Ciocchi | Institute of Physiology, Bern | In vivo electrophysiology, neural correlates of anxiety behaviour (mice) | stephane.ciocchi@unibe.ch |  |
| Prof Th Nevian | Institute of Physiology, Bern | Animal model of pain, electrophysiology, 2P-imaging, optogenetics (mice) | thomas.nevian@unibe.ch |  |
| Prof W Senn | Institute of Physiology, Bern | Computational neuroscience | walter.senn@unibe.ch |  |
| PD JP Pfister | Institute of Physiology, Bern | Computational neuroscience | jeanpascal.pfister@unibe.ch |  |
| PD S. Kleinlogel | Institute of Physiology, Bern | Optogenetics tool development, Visual processing, vision restoration (mice) | sonja.kleinlogel@unibe.ch |  |
| Prof G Rainer | Fac Sciences & Medicine | Treeshrew animal model, electrophysiology, behavior, neuromodulation (rats, Treeshrews) | gregor.rainer@unifr.ch | Main contact for Faculty of Medicine, UNIFRI |
| Prof M. Prsa | Fac Sciences & Medicine | Sensori-motor integration, cortical circuits, 2-P imaging, electrophysiology (mice) | mario.prsa@unifr.ch |  |
| Prof. B. Rasch | Dept of Psychology | Human EEG recording, cognitive tasks, sleep (human) | bjoern.rasch@unifr.ch | Main contact for Dept of Psychology, UNIFRI |
| Dr. S. Proulx | Theodor Kocher Institute, UNIBE, Bern | Imaging neurovascular structure, neuro-immune functions (mice) | steven.proulx@tki.unibe.ch |  |
| Prof. B. Engelhardt | Theodor Kocher Institute, UNIBE, Bern | Brain blood barrier, 2-P imaging (mice) | britta.engelhardt@tki.unibe.ch | Main contact for Theodor Kocher Institute, UNIBE |
| Prof F. Mast | Institute of Psychology, UNIBE, Bern | Cognitive psychology, perception and methodology, virtual reality (Human) | fred.mast@unibe.ch | Main contact for Institute of Psychology, UNIBE |
| Prof. K. Henke | Institute of Psychology, UNIBE, Bern | Learning and memory, sleep-dependent learning, EEG, close-loop electrophysiology (Human) | henke@unibe.ch |  |
| Dr. L Tarokh | UPD, UNIBE, Bern | Sleep, cognition, mood disorders in adolescents, EEG, depression (Human) | leila.tarokh@upd.unibe.ch |  |
| Prof S. Walther | UPD, UNIBE, Bern | brain stimulation, multimodal brain imaging, motor behaviour, nonverbal communication in psychosis and affective disorders | sebastian.walther@upd.unibe.ch | Main contact for UPD, UNIBE |
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| **Annex 2: List of courses** | | | | |
| **Reference** | **Course** | **Details** | **Contacts** |  |
| Prof A Adamantidis | BENESCO lecture series | Lectures in Basic and Translational Neurosciences covering diverse topics including systems neurosciences, cognition, sleep/consciousness, mechanisms of brain pathologies (every Friday 12-13h)  Lecturers: National & International Speakers - see year program on Benesco.ch | antoine.adamantidis@dbmr.unibe.ch | Main contact for ZEN, Dept Neurologie, UNIBE |
| PD S Sachidhanandam | Basics in Physiology | Topics include membrane and action potentials, synaptic transmission, somatosensation, vision + learning and memory, audition + vestibular systems and olfaction, motor control. | shankar.sachidhanandam@unibe.ch | Main contact for Institute of Physiology, UNIBE |
| Prof G Rainer | Behavioural methods in Neuroscience | The course Behavioural methods in neuroscience is an introduction to laboratory methods used for behavioural and associated functional studies in humans and animals. It focuses on measurement, analysis and interpretation of behavioural parameters such as behavioural choice or reaction time, as well as functional parameters such as electroencephalographic recordings. The course is conducted in 7 modules of four hours each, and takes place in specialised la­boratories. | gregor.rainer@unifr.ch |  |
| Prof G Rainer | Central nervous system regeneration and repair | The course Central nervous system regeneration and repair provides the conceptual back­ground necessary for understanding major approaches for helping the brain recover from neural pathologies. The importance of behavioural characterization, functional measurements as well as therapeutic interventions such as psychopharmacology or electrical brain stimulation is illustrated by relevant examples drawn from clinical and basic science. | gregor.rainer@unifr.ch |  |
| Dr G Cuccu | Introduction to neuroscience (part of the Master in Digital Neuroscience) | The course covers the basic concepts of neuroscience, from how neurons communicate to brain anatomy and function, and how brain function arises from computations accomplished by the brain. | giuseppe.cuccu@unifr.ch |  |
| Animal handling  BVET approved |  |  |  |  |
| Learned experimental techniques |  |  |  | See BENEFRI website |
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