

# Department of Neurology

## Division of Molecular Neurology

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### Head of Division

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### Research focus

- Neurodegenerative diseases
- Translational neurosciences
- Clinical research and development

### Structure of the Division

- Professorships: 2  
Personnel: 20
- Doctors (of Medicine): 7
  - Scientists: 3 (thereof funded externally: 2)
  - Graduate students: 7

### Clinical focus areas

- Outpatient clinical and research center for neurodegenerative movement disorders
- Center of the National Network for Parkinson's disease and European Huntington's disease Center
- Rare genetic movement disorders (Center for rare movement disorders)
- Atypical Parkinson diseases

### Research

The Division of Molecular Neurology focusses on the cellular, functional, and pathological alterations in neurodegenerative diseases. By applying modern stem cell technologies, important insights are achieved by patient based translational approaches. The academic outpatient service provides state-of-the-art care for patients with neurodegenerative movement disorders with particular focus on diagnostic work-up, treatment, and participation in national and international clinical studies. These activities are embedded in numerous international disease specific clinical trial activities. Furthermore, by applying medical engineering methods, an objective and optimized monitoring of patients with movement disorders is developed in the framework of the interdisciplinary research net-

work of the FAU (EFI-Moves; compare own report).

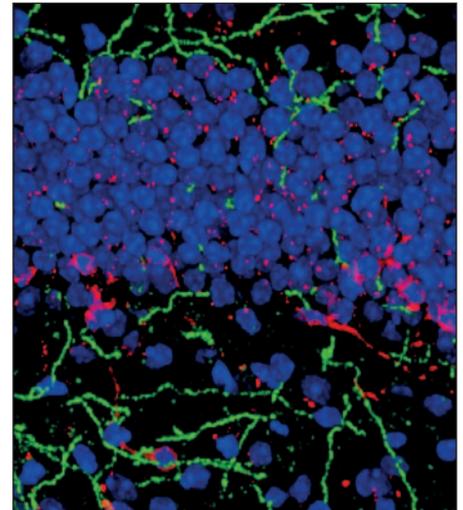
### Neurodegenerative diseases

The scientific focus of the Division of Molecular Neurology emphasizes on stem cell biology and neurodegenerative mechanisms in the context of the sporadic Parkinson-Syndrom, multiple systems atrophy, Huntington's disease, and the hereditary spastic paraplegia. Neuroregenerative mechanisms with particular interest in the generation of new neurons and glial cells in the adult brain (adult neuro and gliogenesis) are analyzed by using cell culture approaches, such as induced pluripotent stem cells and transgenic models of the corresponding disease. In a complementary approach, neurodegenerative mechanisms underlying the interplay of intra- and extracellular  $\alpha$ -synuclein are analyzed in detail in order to better understand the molecular mechanisms underlying the pathogenesis of Parkinson's disease and Lewy-Body-Dementia. The interaction between neurodegenerative and inflammatory pathomechanisms within the central nervous system (CNS) has become an additional major focus.

### Translational neuroscience

The Division is interested in the molecular biology of adult neural precursor and stem cells which are resident within the adult forebrain, however moving more and more towards methods to generate induced pluripotent stem cells (iPSC), derived from human fibroblasts of the skin. Adult neurogenesis is severely altered in the context of numerous neurodegenerative diseases. Mounting evidence indicates that impaired adult neurogenesis may be one of the most important cell biological events linked to non-motor-symptoms like depression, cognitive impairment, and olfactory dysfunction in Parkinson's disease. Furthermore, we extended our program to characterize myelin producing oligodendrocytes, particular affected in multiple systems atrophy, showing a severe dysfunction of these cells. Moreover, cell and molecular techniques have been established to delineate and modify pathological mechanisms associated with protein aggregation of  $\alpha$ -synuclein in synucleinopathies. Finally, a biobank for patient specific iPSC and its progeny is being established in the framework of the Bavarian Network ForIPS (compare own report). These translational research projects are embedded in multiple interdisciplinary networks.

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Serotonergic fibers (green) in the dentate gyrus of the hippocampus get in close contact to developing young neurons (red); cell nuclei in blue

### Clinical research and development

The outpatient clinic for movement disorders (in particular Parkinson's disease, multiple systems atrophy, Huntington's disease, and hereditary spastic paraplegia) is offering state-of-the-art diagnostic procedures and long-term care for patients and their caregivers. In particular, the scientific focus targets disease modifying strategies. In close collaboration with the departments of Neurology and of Neurosurgery, a deep brain stimulation program for movement disorders has been implemented. Automated motion and gait analysis systems for stationary and mobile diagnostics have been developed in close collaboration with the Pattern Recognition Lab (Faculty of Engineering) and a local industry partner.

In this context, a novel rehabilitation sports group for Parkinson's disease has been implemented for the long-term improvement of mobility of patients with movement disorders and in order to test novel interventional approaches. Furthermore, an interdisciplinary network comprising the Faculty of Engineering (Pattern Recognition Lab) and the Institute of Sport Science and Sport (Faculty of Humanities, Social Sciences, and Theology) has been funded by the Emerging Fields Initiative. This interdisciplinary research examines the role of physical activity associated with sensory interference for postural stability in Parkinson's disease. Furthermore, a spin off company, Portables Healthcare Technology, has been founded in order to develop these technologies further for clinical application.



Rehabilitation sports group UK Erlangen

## Teaching

The Division of Molecular Neurology participates within the academic teaching activities of clinical neurology, Molecular Medicine, and medical technology.

We supervise Bachelor's, Master's, MD and PhD theses. The neuroscience GK (GRK 2162 "Neurodevelopment and vulnerability of the central nervous system"; compare own report) has successfully started.

## Selected publications

Gassner H, Marxreiter F, Kohl Z, Schlachetzki J, Eskofier B, Winkler J, Klucken J. Gait and cognition in Parkinson's disease: cognitive impairment is inadequately reflected by gait performance during dual task. *Front Neurol* 2017, 8:550

Schlachetzki J, Barth J, Marxreiter F, Gossler J, Kohl Z, Reinfelder S, Gassner H, Aminian K, Eskofier B, Winkler J, Klucken J. Wearable sensors objectively measure gait parameters in Parkinson's disease. *PLoS One* 2017, 12(10): e0183989

Regensburger M, Türk M, Pagenstecher A, Schroeder R, Winkler J. VCP-related multisystem-proteinopathy presenting as early-onset Parkinson's disease. *Neurology* 2017, 89(7):746-748

Marxreiter F, Gaßner H, Borozdina O, Barth J, Kohl Z, Schlachetzki J, Thun-Hohenstein C, Volc D, Eskofier BM, Winkler J, Klucken J. Sensor-based gait analysis of individualized improvement during apomorphine titration in Parkinson's disease. *J Neurol* 2018, 265(11):2656-2665

Minakaki G et al. Autophagy inhibition promotes SNCA/alpha-synuclein release and transfer via extracellular vesicles with a hybrid autophagosome-exosome-like phenotype. *Autophagy* 2018, 14(1): 98-119

Schlachetzki J, Prots I, Jenhan T, Chun H, Kaoru S, Gosselin D, Winner B, Glass C, Winkler J. A monocyte gene expression signature in the early clinical course of Parkinson's disease. *Sci Rep* 2018, 8(1):10757

## International cooperations

Prof. Dr. F. H. Gage, Laboratory of Genetics-Gage, The Salk Institute for Biological Studies, La Jolla: USA

Prof. Dr. B. Bloem, Radboud University Medical Center, Nijmegen: The Netherlands

Prof. Dr. E. M. Masliah, Department of Neurosciences, University of California, San Diego, La Jolla: USA

Prof. Dr. G. Wenning, University Hospital of Innsbruck, Innsbruck: Austria

Prof. Dr. R. Krüger, University of Luxembourg, Luxembourg: Luxembourg