

IMPRS for Synapses and Circuits PhD Program



IMPRS
for Synapses and Circuits
INTERNATIONAL MAX PLANCK
RESEARCH SCHOOL



Why IMPRS?

Training in the International Max Planck Research School for Synapses and Circuits (IMPRS-SC) gives you the opportunity to be immersed in a highly creative, collaborative environment that builds on the latest technological advances to deliver fundamental new insights about neural circuits.

- **Scientific Excellence:**

Scientists in the IMPRS-SC program have the resources they need to do great science as evidenced by student publications.

- **Outstanding Reputation and Track Record:**

The Max Planck name is recognized globally as the leading non-profit research organization. IMPRS-SC graduates are successfully employed in science careers in academia and industry.

- **Unique Mentorship:**

In addition to mentorship from experienced faculty, graduate students are part of the MPFI Mentorship Program, where they choose a postdoc mentor to guide them through their early careers.

- **Innovative Training Opportunities:**

Traditional comprehensive coursework is supplemented with hands-on technical workshops led by world experts, including Nobel laureates.

- **Student Support:**

IMPRS-SC values its students. Students receive relocation reimbursement, assistance integrating into the program, mental health resources, work-life balance in a family-friendly environment, student representation in the program steering committee, and much more.

Student Highlights



When I was considering graduate schools, the collaborative space that was cultivated was a major factor drawing me to MPFI because I knew how much more I could learn because of it. I could work with experienced scientists using leading-edge techniques to address important questions."

Daniel Wilson Ph.D., IMPRS Program Alumnus
Currently Postdoctoral Fellow at Harvard Medical School



I am very thankful to my supervisor for all the support and understanding during the last few years, so I could focus on my ambitious project and take care of my family at the same time. I also felt privileged to work at an institute like MPFI that supports and invests in the development of novel methods."

Ye Sun Ph.D., IMPRS Program Alumna
Currently Bio-EM Application Scientist at ZEISS

- ✶ Scholl, B., **Wilson, D.E.**, Jaepel, J., and Fitzpatrick, D. (2019). Functional Logic of Layer 2/3 Inhibitory Connectivity in the Ferret Visual Cortex. *Neuron* 104, 451-457.e3.
- ✶ **Wilson, D.E.***, Scholl, B.**, and Fitzpatrick, D. (2018). Differential tuning of excitation and inhibition shapes direction selectivity in ferret visual cortex. *Nature* 560, 97-101.
- ✶ **Wilson, D.E.**, Smith, G.B., Jacob, A.L., Walker, T., Dimidschstein, J., Fishell, G., and Fitzpatrick, D. (2017). GABAergic Neurons in Ferret Visual Cortex Participate in Functionally Specific Networks. *Neuron* 93, 1058-1065.
- ✶ Scholl, B., **Wilson, D.E.**, and Fitzpatrick, D. (2017). Local Order within Global Disorder: Synaptic Architecture of Visual Space. *Neuron* 96, 1127-1138.
- ✶ **Wilson, D.E.**, Whitney, D.E., Scholl, B., and Fitzpatrick, D. (2016). Orientation selectivity and the functional clustering of synaptic inputs in primary visual cortex. *Nat Neurosci* . 19, 1003-1009.



Publication-inspired artwork featured on the cover of *Nature Neuroscience*

- ✶ **Sun, Y.**, Smirnov, M., Kamasawa, N., Yasuda, R. (2021). Rapid Ultrastructural Changes in the PSD and Surrounding Membrane after induction of structural LTP in Single Dendritic Spines. *Journal of Neuroscience* 41, 33, 7003-7014.
- ✶ **Sun Y.**, Thomas C., Mikuni T., Guerrero-Given D., Yasuda R., Kamasawa N. (2020) Correlative Ultrastructural Analysis of Functionally Modulated Synapses Using Automated Tape-Collecting Ultramicrotome and SEM Array Tomography. In: Wacker I., Hummel E., Burgold S., Schröder R. (eds) Volume Microscopy. *Neuromethods*, vol 155. Humana, New York, NY.
- ✶ Mikuni, T., Nishiyama, J., **Sun, Y.**, Kamasawa, N., and Yasuda, R. (2016). High-Throughput, High-Resolution Mapping of Protein Localization in Mammalian Brain by In Vivo Genome Editing. *Cell*. 165, 1803-1817.
- ✶ Kamasawa, N., **Sun, Y.**, Mikuni, T., Guerrero-Given, D., and Yasuda, R. (2015). Correlative Ultrastructural Analysis of Functionally Modulated Synapses Using Automatic Tape-Collecting Ultramicrotome - SEM Array Tomography. *Microscopy and Microanalysis* 21, 1271-1272.

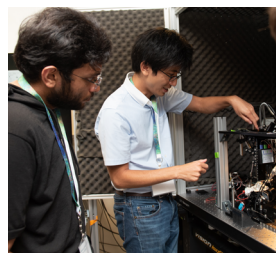
Training

Our Ph.D. students are immersed in a world-class neuroscience training environment working alongside scientists at the forefront of neuroscience research. All students in IMPRS for Synapses and Circuits are enrolled in the degree-granting partner Integrative Biology-Neuroscience (IBNS) Ph.D. program at Florida Atlantic University (FAU), South Florida's oldest public university. A comprehensive interdisciplinary neuroscience curriculum is offered by the IBNS Ph.D. program, which students usually complete in the first two years after admission.



International Network of Scientists

In addition to the flourishing neuroscience campus in Jupiter, Florida, which includes MPFI, FAU and the UF Scripps Institute, IMPRS-SC students are part of a much larger network of leading neuroscientists through the Max Planck Society and Max Planck Neuroscience. IMPRS provides many unique opportunities for students to establish meaningful relationships within this network and to take full advantage of the unmatched resources of the Max Planck Society. Students are encouraged and provided funding to participate in jointly organized advanced scientific training workshops led by world experts, symposia, and extended research stays with other Max Planck Institutes.



Beyond classwork and training in the lab, IMPRS students participate in technical workshops. For the past three days, we have been discussing electrophysiological theory with world experts. Students can then try these techniques under the guidance of scientists who use these methods every day. It's a really fantastic opportunity!"

Hidehiko Inagaki Ph.D.
IMPRS-SC Faculty Mentor



Career Development

IMPRS-SC Ph.D. students receive well-rounded professional development and career education to excel in the changing landscape of scientific careers. IMPRS travel grants empower students to attend meetings, courses, and career workshops to enrich their training and prepare for their career trajectory.

Mentoring Program

IMPRS-SC students benefit from unique mentorship programs. In addition to the guidance and mentorship provided by the faculty advisor and thesis committee members, each IMPRS Ph.D. student chooses a postdoctoral mentor from MPFI that they meet with periodically for advice throughout the entire period of their studies. This mentorship program also hosts semimonthly meetings to discuss relevant soft skills or work-life balance topics, followed by a social outing.

By the Numbers

Diverse IMPRS student body:

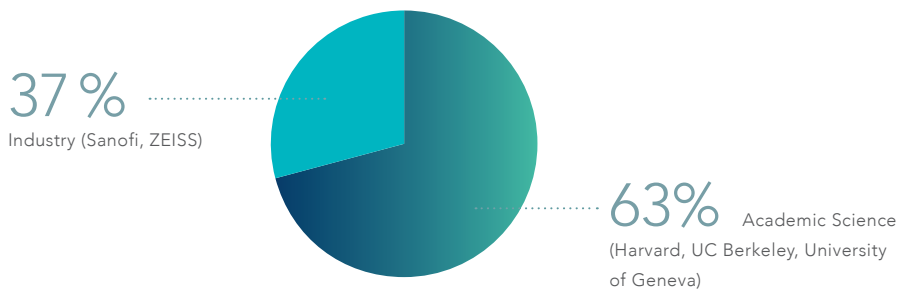


IMPRS student publications:



Successful employment outcomes:

Our 8 graduates are employed in





Part of a larger
network:

15

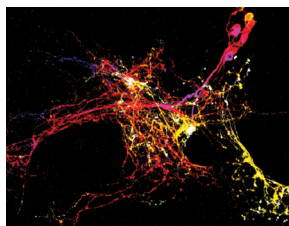
MPNeuro IMPRS programs

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We got to interact with a Nobel laureate, Dr. Erwin Neher! I asked him questions about my own research. I would never, ever have imagined that the Nobel laureate who invented the technique of patch clamp, and identified single channels, was going to be helping me with my own project, recommending papers, and techniques to apply to my own project."

Goksu Oz
IMPRS-SC Ph.D. Student

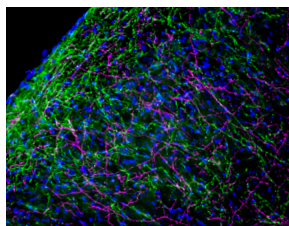
Our Science



MPFI **SALIL BIDAYE**

Neuronal control of locomotion

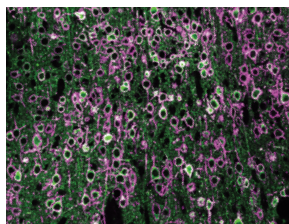
The Bidaye Lab studies the neural circuit logic of locomotor decisions using the fruit-fly (*Drosophila melanogaster*) as a model system and a combination of techniques including behavioral assays, optogenetics, multiphoton imaging, and electrophysiology.



FAU **RANDY BLAKELY**

Molecular basis and modeling of neuropsychiatric disorders

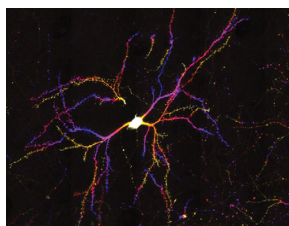
The Blakely Lab explores genetic and biochemical mechanisms involved in the function of brain synapses and circuits and how changes in these mechanisms give rise to the risk for brain disorders.



MPFI **MCLEAN BOLTON**

Disorders of neural circuit function

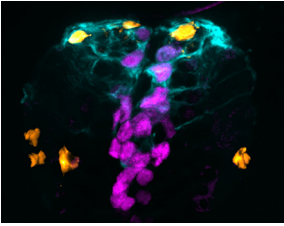
Research in the Bolton Lab employs electrophysiological and imaging techniques to study alterations in circuit structure and function in mouse models of neurological and psychiatric disorders.



MPFI **DAVID FITZPATRICK**

Functional architecture and development of cerebral cortex

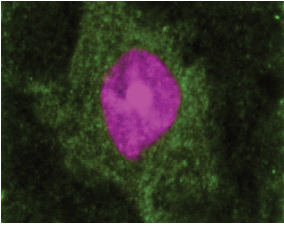
Research in the Fitzpatrick Lab utilizes state-of-the-art in vivo imaging techniques to probe the functional synaptic architecture of circuits in primary visual cortex.



FAU LAURA FONTENAS

Myelinating glial cell plasticity

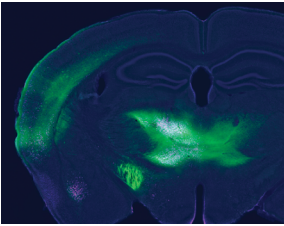
The focus of the Fontenas Lab is myelinating glial cell development and plasticity. Using zebrafish as a model, the lab investigates the function of motor exit point glia under physiological and demyelination conditions.



FAU TANJA GODENSCHWEGE

Cellular basis of neurological diseases

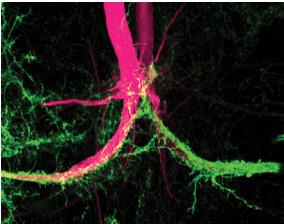
The Godenschwege Lab characterizes the cellular and molecular mechanisms underlying neuronal disorders and diseases, and the interrelation between metabolism disorders and neurodegenerative diseases.



MPFI HIDEHIKO INAGAKI

Neural dynamics and cognitive functions

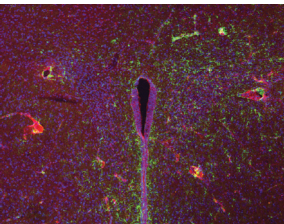
The main goal of Inagaki Lab is to develop a cellular and network-level understanding of how internal states, such as internal drives and urgency, modify dynamics in the frontal cortex to influence cognitive functions.



FAU RODNEY MURPHEY

Developmental neuroscience

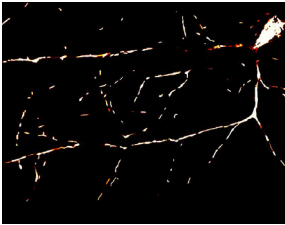
The Murphey Lab is primarily interested in the assembly of synaptic circuits and the molecules that guide this process. It focuses on how well-known axon guidance systems like netrin/frazzled serve in both axon guidance and synapse assembly.



FAU NING QUAN

Neuroimmunology

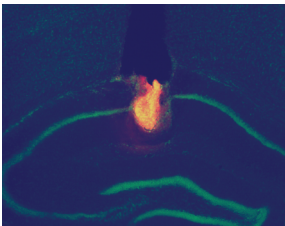
The foci of the Quan Lab research are to study communications between the immune system and the nervous system, and to study the functions of inflammatory cytokines in the central nervous system.



MPFI VIDHYA RANGARAJU

Neuroenergetics

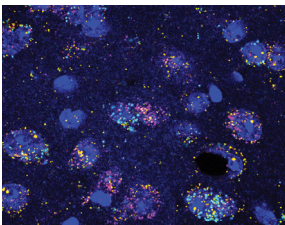
The Rangaraju Lab is interested in how neurons, with their unsurpassed morphological complexity, manage their energy landscapes. They focus on the proteins that comprise and regulate mitochondria and the other energy supplies.



FAU ROBERT STACKMAN

Neurobiology of learning and memory

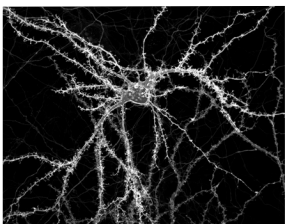
Research in the Stackman Lab uses a combination of behavioral, electrophysiological, chemogenetic, and imaging techniques to understand how neurons in the mouse hippocampus and interconnected regions support memory formation.



MPFI SARAH STERN

Integrative neural circuits and behavior

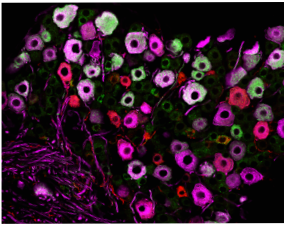
The Stern Lab studies how learning mechanisms and diverse environmental stimuli alter innate brain circuits to drive both adaptive and maladaptive behavioral outcomes.



MPFI LIN TIAN

Molecular biotechnology for neural dynamics and therapeutics

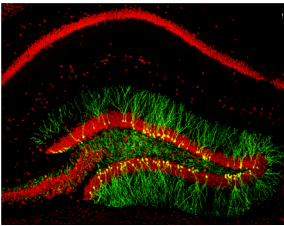
The Tian Lab develops cutting-edge optical and molecular tools to explore neural signaling in real time, advancing the understanding of neural dynamics, neuropsychiatric diseases, and informing targeted therapies.



FAU **LAWRENCE TOLL**

Opioids, pain, and drug abuse

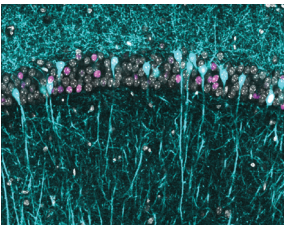
The Toll lab uses models of acute, chronic and migraine pain, as well as imaging studies to identify novel analgesics and to understand pain circuitry in the brain and spinal cord. They use drug abuse models to identify potential substance abuse medications and identify their mechanisms of action.



FAU **HENRIETTE VAN PRAAG**

Regulation of adult hippocampal neurogenesis

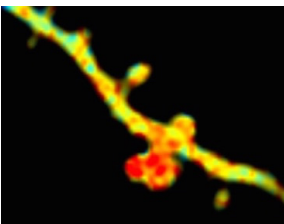
Research in the Van Praag Lab pertains to the development and function of new neurons in the dentate gyrus of the hippocampus, a brain area that is essential for learning and memory.



MPFI **YINGXUE WANG**

Neuronal mechanisms of episodic memory

The Wang Lab integrates electrophysiological, imaging, and optogenetic approaches with computational modeling to reveal the circuit underpinnings of the sequential neuronal activity underlying our ability to remember, think, and plan.



MPFI **RYOHEI YASUDA**

Neuronal signal transduction

The Yasuda Lab is interested in the operational principles of signaling networks in dendritic spines by developing techniques to image the activity of various proteins in single dendritic spines using 2pFLIM in combination with new biosensors.

Selected Publications

Authored by IMPRS Ph.D. students

nature

- **Wilson, D.E.***, Scholl, B.*, and Fitzpatrick, D. (2018). Differential tuning of excitation and inhibition shapes direction selectivity in ferret visual cortex. *Nature*, 560, 97–101.
- **Lee, K-S.**, Huang, X., Fitzpatrick, D. (2016). Topology of ON and OFF inputs in visual cortex enables an invariant columnar architecture. *Nature*, 533, 90–94.

nature neuroscience

- **Wilson, D.E.**, Whitney, D.E., Scholl, B., and Fitzpatrick, D. (2016). Orientation selectivity and the functional clustering of synaptic inputs in primary visual cortex. *Nat Neurosci*, 19, 1003-1009.

nature | methods

- Marvin J. S., Scholl B., **Wilson D. E.**, Podgorski K., Kazemipour A., Müller J. A., Schoch S., Quiroz F., Rebola N., Bao H., Little J. P., Tkachuk A. N., Cai E., Hantman A. W., Wang S. S., DePiero V. J., Borghuis B. G., Chapman E. R., Dietrich D., DiGregorio D. A., ... Looger L. L. (2018). Stability, affinity, and chromatic variants of the glutamate sensor iGluSnFR. *Nature Methods*, 15(11), 936–939.

scientific reports

- **Naraine, A. S.**, Aker, R., Sweeney, I., Kalvey, M., Surtel, A., Shanbhag, V., & Dawson-Scully, K. (2022). Roundup and glyphosate's impact on GABA to elicit extended proconvulsant behavior in *Caenorhabditis elegans*. *Scientific Reports*, 12(1), 13655.



- Inagaki H.K.*, Chen S.*, Ridder M.C., Sah P., Li N., **Yang Z.**, Hasanbegovic H., Gao Z., Gerfen C.R., Svoboda K. (2022). A midbrain-thalamus-cortex circuit reorganizes cortical dynamics to initiate movement. *Cell*, 185(6), 1065-1071.e23.
- Mikuni, T., Nishiyama, J., **Sun, Y.**, Kamasawa, N., and Yasuda, R. (2016). High-Throughput, High-Resolution Mapping of Protein Localization in Mammalian Brain by In Vivo Genome Editing. *Cell*, 165, 1803–1817.

ScienceAdvances

- **Tu, X.**, Jain, A., Parra Bueno, P., Decker, H., Liu, X., & Yasuda, R. (2023). Local autocrine plasticity signaling in single dendritic spines by insulin-like growth factors. *Science Advances*, 9(31) eadg0666.

JNeurosci

THE JOURNAL OF NEUROSCIENCE

- **Sun, Y.**, Smirnov, M., Kamasawa, N., Yasuda, R. (2021). Rapid Ultrastructural Changes in the PSD and Surrounding Membrane after induction of structural LTP in Single Dendritic Spines. *Journal of Neuroscience*, 41(33) 7003-7014.
- Stawarski, M., **Hernandez, R. X.**, Fegghi, T., Borycz, J. A., Lu, Z., Agarwal, A. B., Reihl, K. D., Tavora, R., Lau, A., Meinertzhagen, I. A., Renden, R., & Macleod, G. T. (2020). Neuronal Glutamatergic Synaptic Clefts Alkalinize Rather Than Acidify during Neurotransmission. *The Journal of neuroscience*, 40(8) 1611–1624.
- Colgan, L. A., Parra-Bueno P., Holman, H. L., **Tu, X.**, Jain, A., Calubag, M. F., Misler, J. A., Gary, C., **Oz, G.**, Suponitsky-Kroyter, I., Okaz, E., & Yasuda, R. (2023). Dual regulation of spine-specific and synapse-to-nucleus signaling by PKCδ during plasticity. *The Journal of Neuroscience*, 43(30) 5432-5447.

Neuron

- Scholl B.*, **Tepohl C.***, Ryan M.A., Thomas C.I., Kamasawa N., Fitzpatrick D. (2022). A binocular synaptic network supports interocular response alignment in visual cortical neurons. *Neuron*, 110, 1-12.
- Sedigh-Sarvestani M., **Lee K.-S.**, Jaepel J., Satterfield R., Shultz N., Fitzpatrick D. (2021). A sinusoidal transformation of the visual field is the basis for periodic maps in area V2. *Neuron*, 109(24), 4068-4079.e6.
- Scholl, B., **Wilson, D.E.**, Jaepel, J., and Fitzpatrick, D. (2019). Functional Logic of Layer 2/3 Inhibitory Connectivity in the Ferret Visual Cortex. *Neuron*, 104, 451-457.e3.
- **Lee, K.-S.**, Vandemark, K., Mezey, D., Shultz, N., and Fitzpatrick, D. (2019). Functional Synaptic Architecture of Callosal Inputs in Mouse Primary Visual Cortex. *Neuron*, 101, 421-428.E5.
- M.A., Rowan*, Bonnan, A.* **Zhang, K.***, Amat, S.B., Kikuchi, C., Taniguchi, H., Augustine, J.G., and Christie, J.M. (2018). Graded Control of Climbing-Fiber-Mediated Plasticity and Learning by Inhibition in the Cerebellum. *Neuron*, 99, 999-1015.e6.

Student Benefits

IMPRS-SC provides a competitive financial package

- **Competitive Stipend:**

The annual IMPRS-SC student stipend begins at \$40,530 with yearly increases through year 5 of the program.

- **Health Insurance Subsidy:**

Florida Atlantic University covers 85% of the student health insurance plan premium.

- **Relocation Assistance:**

Up to \$6,000 provided to assist with qualifying relocation expenses for eligible students.

- **Travel Grants Program:**

A \$5,000 IMPRS travel grant allowance supports travel to conferences, courses, and career workshops.





Living in Palm Beach County

47 miles of coastline

78 degrees average year-round temperature

200+ performing arts organizations and museums

31,000 acres of nature preserves

250+ miles of biking and hiking trails



Important Dates

Application period:

September 1 – December 1

Contact info:

mpfi.org/IMPRS | imprs@mpfi.org



Scan QR code
for further info
and to apply

