Elitenetzwerk Bayern

Snippets of the Research

RESEARCH PROJECT

“Deep brain imaging through enhanced transparency”

LAURA PERALES

Elite Graduate Program “Biomedical Neuroscience”

TUM Munich, 2026

A closer look into the brain

Laura Perales is a student in the Elite Graduate Program "Biomedical Neuroscience" at the Technical University of Munich. She is driven by her passion for understanding how the brain thinks and reacts. She spent five months on the beautiful Japanese island of Okinawa on a research internship at the Okinawa Institute of Science and Technology, working on improving optical methods to study neuronal activity in living brains.

Exploring neurons while they think

The fundamental question for neuroscientists is how the brain works. To answer this, the ideal approach is to observe neurons in action while the brain is actively functioning. This has become feasible through a special type of microscopy called two-photon microscopy. When combined with calcium imaging, this technique allows neurons to literally "light up" as they become active and communicate with one another.

This approach is particularly valuable because it enables researchers to monitor communication between individual neurons at the cellular level. By observing neuronal networks in action, researchers can gain insights into how the brain processes stimuli, learns, and drives behavior. However, a significant limitation remains: imaging deeper regions of the brain is still a major challenge.

In microscopy, light must travel to the structure of interest, in this case, a neuron, and back to the detector. Ideally, this path should be perfectly straight. In the brain, however, light encounters fluids, cells, and membranes with different refractive indices which bend and scatter light. This scattering weakens the signal and reduces image clarity at increasing depths.

Helping light travel deeper through the brain

During her internship, Laura investigated methods to make brain tissue more transparent to light. While working on the intersection of optics, chemical engineering, and biology, she tested biocompatible compounds designed to slightly increase the refractive index of cerebrospinal fluid. By aligning the fluid's optical properties more closely with those of surrounding cells and membranes, these compounds reduce light scattering and allow for deeper penetration. Using two-photon calcium imaging in behaving mice, this approach could allow researchers to observe neural activity in the brain deeper than ever before.

More on the Elite Graduate Program:

[Elite Network: Elite Graduate Programs]

[Elite Graduate Program "Biomedical Neuroscience"]