Master thesis at DLR Cologne

Start your mission @ DLR in Cologne as a Master's Student in Aerospace Biology
DLR is the aerospace research center and space agency of the Federal Republic of Germany. Around 12,000 employees conduct joint research on a unique variety of topics in aeronautics, space, energy, transport, digitalization, and security. Our missions range from basic research to the development of innovative applications and products of tomorrow. Cutting-edge research needs excellent minds at all levels - especially more women - who can fully develop their potential in an inspiring environment. Start your mission with us.

Our group:
The Department of Applied Aerospace Biology, situated within the Institute of Aerospace Medicine, is currently offering an exciting opportunity for a highly motivated Master's student to join our dynamic team. Our group prides itself on its collaborative and interdisciplinary approach to research, creating a welcoming and supportive work atmosphere. We value teamwork, creativity and innovation and encourage open communication and knowledge sharing among our diverse team of scientists. Join us in this engaging and stimulating environment where you can contribute your skills and ideas to cutting-edge research in aerospace biology.

The project:
The project **"Mechanism of Action of Ketamine and HNK Derivatives"** aims to elucidate the molecular and cellular mechanisms underlying the proneuroplastic effects of ketamine and hydroxynorketamine (HNK) derivatives. These compounds have been shown to increase synapse number, enhance BDNF expression and elevate neuronal activity, suggesting strong effects on synaptogenesis and synaptic plasticity. Current evidence indicates that these effects are not primarily mediated via NMDA receptor inhibition, but rather involve enhanced glutamatergic signaling and downstream activation of AMPA-, mGluR2-, TrkB- and mTOR-dependent pathways. Understanding these mechanisms is of particular interest in the context of spaceflight, where microgravity and associated stressors may negatively affect neuronal connectivity, synaptic stability and cognitive performance.

By combining targeted pharmacological perturbations with time-resolved and high-resolution analyses in primary neuronal cultures, the project aims to systematically dissect the signaling cascades underlying these effects. Insights from this project could therefore contribute to developing strategies to preserve or enhance synaptic plasticity and brain health during long-duration missions in space.

The thesis will be conducted at DLR Cologne, focusing on the following objectives:

- **Primary cell culture:** Cultivation of murine primary hippocampal neurons
- **Pharmacological pathway analysis:** Investigation of HNK derivative treatment effects in combination with specific pathway modulators (Treatment of neurons with derivatives together with pharmacological inhibitors/agonists, Assessment of effects on proneuroplastic markers such as BDNF and neuronal activity, Readout: Western blot, immunofluorescence, microelectrode array (MEA))
- **Time-resolved mechanistic analysis:** Investigation of the temporal sequence of signaling events (Treatment followed by fixation or lysis at defined time points, Analysis of synaptic and signaling protein dynamics, Readout: Western blot, immunofluorescence, optionally proteomics)
- **Synaptic nanostructure analysis:** Assessment of structural synaptic plasticity (Treatment followed by fixation of neuronal cultures, Evaluation of spine morphology and synaptic marker localization, Readout: STED microscopy combined with custom-developed image analysis algorithms)

- **Image and data analysis:** Application of quantitative analysis pipelines for synaptic morphology and marker distribution, including automated or deep-learning-based approaches

The candidate:
The candidate should be curious, creative and motivated to learn new experimental and analytical approaches. A strong interest in neuronal cell biology and molecular neuroscience is essential. Experience or familiarity with mammalian cell culture and primary cell generation, Western blot and immunofluorescence techniques as well as hands-on experience with microscopy will be beneficial.

The project takes place in a highly interdisciplinary research environment at the German Aerospace Center, with strong exposure to neuroscience, molecular biology and advanced imaging and analysis technologies. Successful candidates should hold a B.Sc. or equivalent degree in biology, biotechnology, biochemistry, neuroscience or a related field.

Additional desirable qualifications include:
- Experience with pharmacological perturbation studies
- Experience with microscopy-based analysis and quantitative image or data analysis
- Experience with microelectrode array (MEA) recordings
- Proficiency in English

We offer:
- Supportive mentoring and career development plans
- An excellently equipped workspace and vibrant scientific environment
- An international and interdisciplinary team of scientists
- Opportunity to participate in cutting-edge aerospace biology research

Application:
Interested candidates should send their application (**letter of motivation, academic CV, contact details for references**) directly by email to Laura.Drouve@dlr.de, Christian.Liemersdorf@dlr.de and Patrick.Lau@dlr.de

Salary:
The Master's Student position is remunerated.

Start:
From September 2026