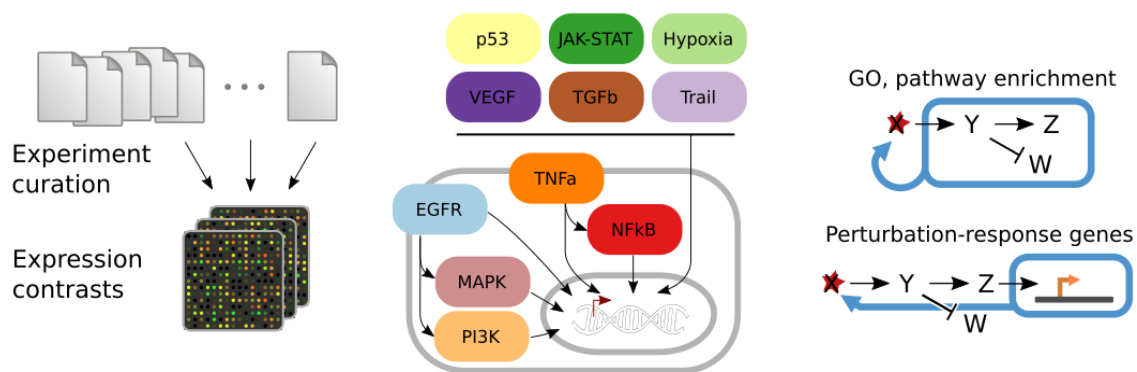


## Master Thesis Opportunity in Molecular Medicine: AI-Powered Signaling Pathway Inference from RNA Sequencing Data (computational)

Are you ready to dive into the exciting intersection of **artificial intelligence** and **molecular biology**? Join our cutting-edge research group for a **Master's Thesis in Molecular Medicine** where **AI meets RNA sequencing**!



### The Challenge:

Inferring signaling pathway activity from RNA sequencing data is crucial for understanding cellular behavior in health and disease. We have previously used **linear modeling** to tackle this (Schubert et al. 2018: [doi.org/10.1038/s41467-017-02391-6](https://doi.org/10.1038/s41467-017-02391-6)), but now we're taking it to the next level with **AI** and **Foundational Models**. Our aim is to revolutionize how we predict and interpret signaling pathways, leveraging the immense power of **deep learning** to decode biological processes.

### Your Role:

In this thesis project, you'll investigate **state-of-the-art AI-based Foundation Models** on their ability not to predict unseen perturbations, but how well they can infer the signaling state of a cell. You will then compare their output to known perturbations, to evaluate the performance increase compared to classical linear models. This should serve as the basis of a **novel AI-based tool to accurately infer cell signaling**.

### What You'll Gain:

- Expertise in **artificial intelligence** and **machine learning** applied to **molecular biology**.
- Hands-on experience with **Foundational Models** for **RNA sequencing analysis**.

If you're excited to bridge the gap between these two fields, please contact Asst. Prof. Michael Schubert ([m.schubert@i-med.ac.at](mailto:m.schubert@i-med.ac.at)) stating your background, skills, and when you are planning to work on your thesis project!

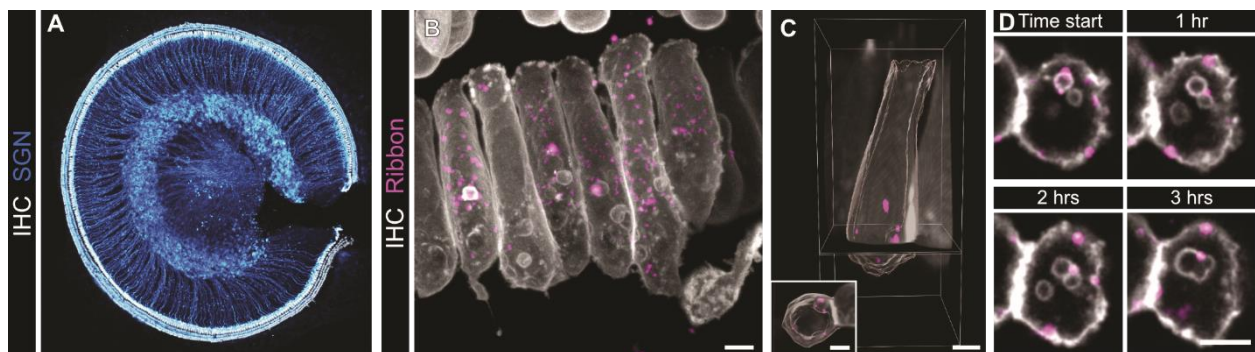
## Unraveling the role of synaptic autophagy in inner ear development

Sound perception in mammals takes place in the cochlea. Here, auditory inner hair cells (IHCs) convert acoustic stimuli into a chemical signal to activate spiral ganglion neurons (SGNs). The IHCs connect to the afferent SGN via specialized synapses, so called “ribbon synapses”, which are optimized for the temporally precise and tonic release of glutamate. This continuous signal transduction is facilitated by an extremely high metabolism at the IHC synapse and poses a challenge to the maintenance of presynaptic homeostasis. At conventional synapses, this balance is maintained by presynaptic autophagy: a tightly regulated process by which excess or dysfunctional proteins and organelles are cleared from the axonal terminal. It is likely that a similar involvement of autophagy is present at the presynapse of IHCs, especially since disruptions in autophagy-associated proteins have been linked to specific types of hearing loss.

In this project, we aim to investigate the correlation between synapse maturation, synaptic activity and autophagic degradation in developing IHCs. We will use novel live-cell imaging techniques that have been developed by our lab specifically for the *in situ* tracking of IHC synapses within the three-dimensional structure of the organ of Corti. We aim to create a spatio-temporal map of the presynaptic autophagic flux in IHCs, in combination with the tracing of autophagosome dynamics in real time. You will get hands-on experience with all steps of the experimental pipeline:

Primary tissue culture (organotypic culturing of the sensory epithelium of mice) • 3D multi-color live-cell imaging • Immunohistochemistry

- Super-resolution microscopy
- Data analysis: confocal and time-lapse image processing, particle tracking, colocalization



We are looking for enthusiastic, naturally curious, and motivated MSc students to join our Auditory Neuroscience lab. Do you have an eye for microscopy and does a deep dive into the development of the inner ear sound good to you? Come and help us out on this exciting new project!

Project: Master internship + thesis

Start date: March/April 2025 Duration:  $\pm$  6 months

Official title: Unraveling the role of presynaptic autophagy in cochlear inner hair cell ribbon synapse development

Lab website: <https://cavx.at/group-vogl/>

Contact: [roos.voorn@i-med.ac.at](mailto:roos.voorn@i-med.ac.at) or [christian.vogl@i-med.ac.at](mailto:christian.vogl@i-med.ac.at)

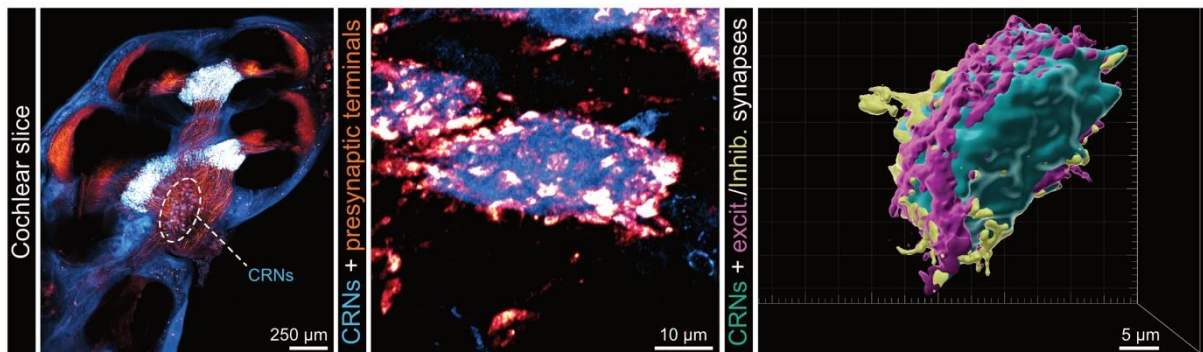
## Auditory startle reflex: a cross-species analysis of cochlear root neurons in the peripheral auditory pathway

It is a phenomenon known to all of us: An intense unexpected sound elicits a reflective movement away from its source, coined as the *auditory startle reflex*. This reflex is a widespread occurrence amongst mammals. While the behavioral output is already in use to investigate cognitive, sensory and mental disorders in human and animals (Fawcett et al., 2023) a systematic anatomical, morphological and functional description of its neural basis, the so-called *cochlear root neurons* (CRNs), between species is lacking to date.

In this project, we therefore opt to characterize CRNs across multiple mammalian species regarding their anatomical localization within the peripheral auditory pathway, their cellular architecture, molecular make-up as the basis for excitability, as well as their afferent and efferent connectome. This study will be conducted using a mixture of whole-tissue chemical clearing protocols, fluorescence-based labelling techniques, high-resolution light microscopy based large volume imaging and 3D reconstructions for analysis.

You will acquire the following core techniques:

- Acute dissection of the peripheral auditory pathway (mouse, rat, gerbil, potentially human)
- Neuronal tracing using injection of lipophilic fluorescent dyes
- Immunohistochemical labeling techniques
- Whole-tissue chemical clearing approaches (iDisco, CUBIC)
- Confocal microscopy
- Large volume light-sheet fluorescence microscopy
- 3D volume reconstructions



If you are interested in basic neuroscience research and would like to obtain expertise in state-of-the-art imaging as well as analysis techniques, contact us!

Project: Master internship + thesis

Start date: March/April 2025

Duration:  $\pm$  6 months

Official title: Unraveling the role of presynaptic autophagy in cochlear inner hair cell ribbon synapse development

Lab website: <https://cavx.at/group-vogl/>

Contact: [jan-frederik.ahrend@i-med.ac.at](mailto:jan-frederik.ahrend@i-med.ac.at) or [christian.vogl@i-med.ac.at](mailto:christian.vogl@i-med.ac.at)

**Open PhD position (f/m/d) at the Department of Pediatrics III (Pediatric Cardiology, Pulmonology, and Cystic Fibrosis), Medical University of Innsbruck, Austria.**

**The job**

The offered PhD position is part of a FWF-funded Principal Investigator project bound to the Tenure Track position for Pediatric Cardiology (metabolic cardiognostics) (KLIF1036, NCT04764305). The project focuses on regulatory processes on the molecular level in patients with complex congenital heart disease before, and after Fontan operation, esp. on translational multi-omics regulatory analyses with network establishment aiming at risk stratification for the development of Fontan-associated comorbidities: Understanding Fontan through molecular and cellular approaches - Fontanology (<https://fontanology.org/>) (doi: 10.3390/ijms25105416, doi: 10.1038/s41598-020-65852-x).

Based on the outlined research, an expansion of the currently binational to a multinational multicenter study with the aim of implementing a European registry on omics research in these patients will be part of the PhD task, as will be the implementation of an interventional study-arm on the use of middle chain triglycerides in those patients (doi: 10.3390/metabo13080932).

The applicant ideally will be enthusiastic about working with large-scale datasets, and motivated in conducting statistical analyses using sophisticated methods. He/she will be an integral part of our multidisciplinary team. Good communication skills (English, German), independence, and a sense of proactivity and responsibility are required.

**Your profile**

- ☑ Master's degree in a relevant subject such as molecular medicine, biology, biochemistry, biostatistics, bioinformatics, or equivalent
- Interested in research on cardiometabolic disease
- Motivated to learn new tasks and being able to work independently
- Skilled in programming statistical software
- Experience in programming in high-performance computing environments is a plus
- Strong team player with excellent interpersonal and clear communication skills
- Keen to be engaged in a multi-disciplinary team
- Evidence of scientific rigor as documented by first author peer-reviewed publications
- Fluent in English both oral and written
- Proactivity and responsibility are mandatory

**We offer**

- Immediately available 75% PhD position for 4 years
- An interesting research project using cutting-edge statistical methods
- Integration into a supportive and interdisciplinary research environment
- International collaborations
- For a 75% post, annually gross salary about € 33.432

**Venue**

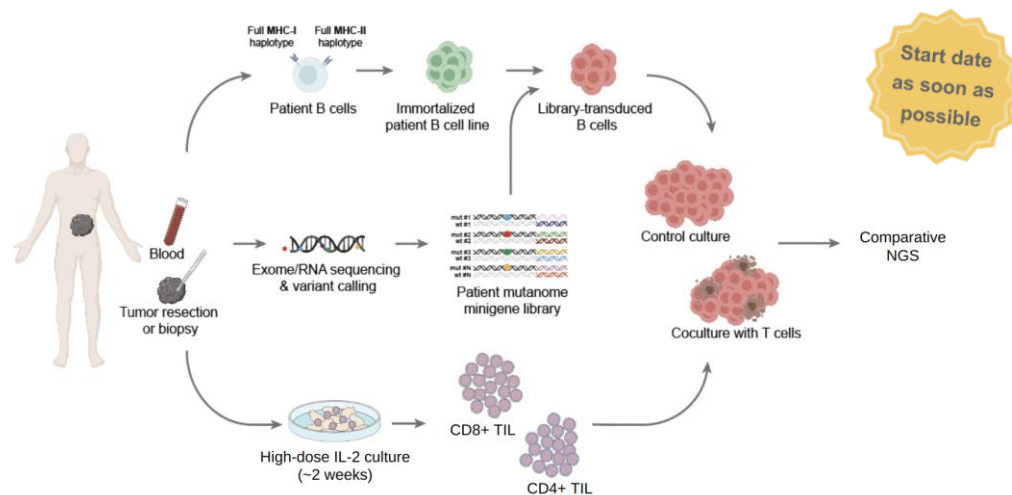
Innsbruck is a both historic and modern university town of 130.000 inhabitants, in the heart of the alps, combining urban comfort and country idyll. It is an excellent base for numerous outdoor activities such as skiing, hiking or biking.

**Contact**

To apply: Please e-mail your CV, a letter of motivation, and names and contact information for 2-3 references to: Ass.-Prof. PD Dr. Miriam Michel, e-mail: [miriam.michel@i-med.ac.at](mailto:miriam.michel@i-med.ac.at)

## Master Thesis Opportunity in Molecular Medicine: Adoptive Cell Therapy and T-Cell Epitope Recognition (computational)

Are you passionate about cutting-edge cancer research and bioinformatics? Join our research group for a **Master's Thesis in Molecular Medicine**, focusing on **Adoptive Cell Therapy!**



### The Challenge:

Adoptive cell therapy involves enriching and reinfusing T-cells into cancer patients, but identifying which T-cells target specific cancer-related neoantigens remains a "black box." In research with our experimental collaborators, we sequence cancer patients' genomes to identify potential neoantigens and T-cell receptor (TCR) sequences. These neoantigens are then tested in a **co-culture system** with T-cells harboring patient-specific TCRs, allowing us to understand which neoantigens are recognized and eliminated by which T-cells.

### Your Role:

We are a **bioinformatics-focused research group** using the **R programming language** to develop tools that analyze data from these co-culture experiments. The goal of this Master's thesis project is to **further develop and optimize these tools** to analyze and interpret the intricate relationships between neoantigens and TCRs, contributing to advancements in personalized cancer therapies.

### What You'll Gain:

- Hands-on experience with bioinformatics and cancer immunotherapy.
- Develop skills in R programming and data analysis for immunological applications.
- Contribute to the advancement of precision medicine in cancer treatment.

If you're excited to bridge the gap between cancer immunology and bioinformatics, please contact Asst. Prof. Michael Schubert ([m.schubert@i-med.ac.at](mailto:m.schubert@i-med.ac.at)) stating your background, skills, and when you are planning to work on your thesis project!

## 2x Master Thesis Announcements

Are you excited about decision-making?

Interested in interspecies modeling of psychiatric conditions?

**The Passecker Lab** is seeking enthusiastic Master Students interested in pushing the frontiers of decision-making research. The lab studies the neuronal basis of Decision-Making and Reinforcement Learning in both health and disease. More information about the lab can be found at <https://lab.ipassecker.com/> or through the [Institute of Neurobiochemistry](#) of the Medical University Innsbruck, Austria

### **The Projects:**

We offer two new collaborative and highly multidisciplinary projects **with partners of the University of Innsbruck**. Both projects aim to establish and test new decision-making paradigms in our highly flexible and scalable behavioral toolbox system. A system that allows the investigation of AI or human-based decision tasks in rodents for increased translational validity to investigate neurobiological foundations of decision-making. The first project aims to establish a new paradigm on how subjects overcome short-term negativity for higher long-term gains. The second project investigates how we can increase the inter-species modelling of inductive biases.

### **Background & Environment:**

We are looking for students holding a BSc in biology, psychology, computer science, or a related subject. The ideal candidate should be highly motivated, creative, detail-oriented, have initiative and innovation abilities and oral and written communication skills in English. Previous experience with coding/comp. modeling or animal-based research is advantageous, but not required.

You can expect:

- A fun, multicultural and collaborative team.
- A multidisciplinary working atmosphere for gaining hands-on experience alongside your studies;
- The chance to develop your skills in planning and designing a research project;
- To get familiarized with the modern techniques currently used in behavioral, systems and computational neuroscience;
- Support and guidance for next steps in your career.

**Applications** for the above should be sent to [johannes.passecker@i-med.ac.at](mailto:johannes.passecker@i-med.ac.at) and include a 1) full CV, 2) a short motivation letter stating your research interests, experience and potential career goals. **Starting Date:** positions are open until filled during 2024, starting date is negotiable. Date of issue: 01.02.2024

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