

# Deep dive into the cardiac cell: tracking molecular movement to unravel intracellular diffusion barriers

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## Summary

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*This is an interdisciplinary project combining physics and biology to study the intracellular environment in the heart muscle. Through development of cutting edge experimental and data analysis approaches, it is expected to reveal intracellular environment properties that govern molecular movements and have a major impact on shaping cardiac physiology. Supervisor: Marko Vendelin. Co-supervisor: Rikke Birkedal Nielsen.*

Research field:	Earth sciences
Supervisors:	Rikke Birkedal Nielsen Prof. Dr. Marko Vendelin
Availability:	This position is available.
Offered by:	School of Science Department of Cybernetics
Application deadline:	Applications are accepted between May 03, 2021 00:00 and May 31, 2021 23:59 (Europe/Zurich)

## Description

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To be able to produce large mechanical work and do it consistently, mammalian cardiac muscle cells evolved into highly organized systems. Structures responsible for mechanical work, providing energy, and regulating it through electrical stimulation, are all positioned close to each other to minimize diffusion distances. Yet, the experimental evidence points towards severe restrictions of molecular movement in the heart muscle cell. The physical basis for that is not fully understood and is the aim of this research topic. The specific aim is identification of diffusion obstacles by locating them in the cell. As molecular diffusion is the basis for many processes in the cell, understanding where diffusion is restricted would have major implications for intracellular physiology by allowing us to quantitatively analyze all the major energy transfer and signaling pathways.

Here, you will design new methods to study diffusion inside the cell. You will be able to leverage on our experience and extend fluorescence correlation spectroscopy based methods by applying cutting edge data analysis and targeted experimental approaches. Your task will be to design the protocols for experiments and data analysis, perform experiments, and analyze the measurements. As the microscopes are programmed using our in-house developed microscope platform, you will be able to design automated experimental protocols for your studies leading to high-quality data collection. This will allow you to describe in detail the intracellular environment with a high spatial precision.

This project is one of the main research lines in our interdisciplinary laboratory combining biologists and physicists. We have the expertise required for this challenging work and will be able to help to resolve the problems and teach you all the necessary skills.

The project is financed through a grant awarded to the laboratory by the Estonian Research Council.

Supervisor: Marko Vendelin

Co-supervisor: Rikke Birkedal Nielsen

### **Applicants should fulfil the following requirements:**

- MSc in physics, mathematics, or a related field
- Experience with programming in Python
- Highly proficient in spoken and written English

### **The following experience is beneficial:**

- Experimental and/or theoretical biophysics
- Programming in C++
- Working knowledge of SQL
- Working knowledge of statistics
- Working knowledge of stochastic processes



- Light microscopy, confocal fluorescence microscopy
- Working with cells
- Working in wet lab



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