

Regulation of activity-dependent transcription in the nervous system

Summary

Neural plasticity, the ability of the nervous system to adapt in response to stimuli, underlies memory. Neuronal activity leads to a rise in intracellular calcium, ultimately leading to changes in transcription of specific target genes. Neuronal activity-regulated genes play a crucial role in the formation of neuronal plasticity, and dysregulation of this process gives rise to various nervous system disorders. The aim of this project is to study molecular mechanisms involved in activity-regulated transcription in the nervous system using genome-wide approach and also focusing on the neurotrophin brain-derived neurotrophic factor (BDNF).

Research field:	Chemistry and biotechnology
Supervisor:	Prof. Dr. Tönis Timmusk
Availability:	This position is available.
Offered by:	School of Science Department of Chemistry and Biotechnology
Application deadline:	Applications are accepted between June 01, 2025 00:00 and June 30, 2025 23:59 (Europe/Zurich)

Description

The research

During development, a surplus of neurons is produced, and only those with proper synaptic connections and adequate trophic support survive. The molecular bases of trophic interaction are neurotrophic factors that are secreted in limited amounts from target cells. One of the key regulators of neuronal survival and synaptic connectivity is brain-derived neurotrophic factor (BDNF), a member of the neurotrophin family. BDNF promotes neuronal survival and differentiation and regulates activity-dependent synaptic plasticity. Decreased BDNF and its receptor TrkB levels and activity are implicated in various pathologies, including neuropsychiatric and neurodegenerative disorders.

Neural plasticity, the ability of the nervous system to adapt structurally and functionally in response to stimuli, underlies memory and long-term behavioural changes. Neuronal activity leads to a rise in intracellular calcium, ultimately leading to changes in transcription of specific target genes. Neuronal activity-regulated genes (nARGs) play a crucial role in the formation of neuronal plasticity, and dysregulation of this process gives rise to various nervous system disorders. An essential part of the nARG expression are activity-dependent enhancers, distal DNA regions that positively regulate gene transcription.

BDNF is among the best-studied nARGs and polymorphisms of the BDNF gene are associated with impairments in human cognition. Mammalian BDNF gene consists of at least eight 5' non-coding exons and one coding 3' exon. The expression of each 5' exon is under the control of a separate promoter, which contribute to complex regulation of BDNF gene expression. While the proximal promoters have been well characterized, there are only few enhancers characterized in BDNF transcriptional regulation.

The aim of this project is to study molecular mechanisms involved in activity-regulated transcription in the nervous system using genome-wide approach and also focusing on the neurotrophin BDNF.

Applicants should fulfil the following requirements:

- a master's degree in life sciences (preferably in gene technology, biology or medicine)
- a clear interest in the topic of the position
- excellent command of English
- strong and demonstrable writing and analytical skills
- capacity to work both as an independent researcher and as part of a team
- capacity and willingness to provide assistance in organizational tasks relevant to the project

The following experience is beneficial:

- Experimental and theoretical knowledge in molecular and cell biology

- Working knowledge of statistics
- Light microscopy, confocal fluorescence microscopy
- Cell cultures, including cultures of primary neurons and glia
- Animal experiments (rats, mice)

We offer:

- 4-year PhD position
- The chance to do high-level research in molecular neuroscience
- Opportunities for conference visits, research stays and networking with foreign and Estonian universities and research centers in the field of molecular and cell biology and neuroscience

About the department

- the Lab. of Neurobiology is part of the Department of Chemistry and Biotechnology (DCB), Tallinn University of Technology. DCB has all the required infrastructure for the project implementation, including fully equipped facilities for animals with stereotactic injection equipment, cell and tissue culture, biochemistry and molecular biology, microscopy, proteomics, histology, and other rooms. DCB also offers infrastructure support for analytical, organic and computational chemistry.

Additional information

For further information, please contact Prof Tõnis Timmusk tonis.timmusk@taltech.ee
or visit <https://taltech.ee/en/departments-chemistry-biotechnology>



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