

Topic Proposal

Doctoral study program: Life Sciences

Supervisor: doc. Mgr. Lukas Trantirek, Ph.D.

Topic title¹: *Dynamic polymorphism of non-canonical nucleic acids in the intracellular space*

Annotation:

i-Motifs (iMs) are four-stranded DNA structures that form at cytosine (C)-rich sequences in acidic conditions *in vitro*. Recent research utilizing the anti-iM antibody (iMab) (1) and *in-cell* NMR (2) has demonstrated the presence of iMs within the human genome and live cells. Additionally, *in-cell* NMR studies provided evidence that iMs formation is influenced by the cell cycle-dependent characteristics of the intracellular environment. This project aims to explore the connections between cell cycle-dependent iM formation, alterations in intracellular space properties, and the regulation of gene expression controlled by promoters containing iM-forming sequences. Methodologically, the project integrates molecular biology and biophysical techniques with *in-cell* NMR spectroscopy.

Recommended literature:

1. Višková et al. *In-cell NMR suggests that DNA i-motif levels are strongly depleted in living human cells.* *Nat Commun.* **2024** Mar 5;15(1):1992.
2. Zanin et al. *Genome-wide mapping of i-motifs reveals their association with transcription regulation in live human cells.* *Nucleic Acids Res.* **2023** Sep 8;51(16):8309-8321.

Research area:

Regulation of gene expression, in-cell NMR spectroscopy of proteins and nucleic acids

Keywords: DNA i-motif; G-quadruplex; gene regulation; *in-cell* NMR spectroscopy

Funding of the PhD candidate:

Dynamic polymorphism of non-canonical nucleic acids in the intracellular space, Czech Science Foundation (07/2024-06/2027)

Requirements for candidate:

Cell biology, DNA cloning, and/or NMR spectroscopy

Information about the supervisor:

The number of supervised students: 3 , 7 graduates

Publications: 80