

CEIPEX BUT TOPIC 10

Položka / Field	Obsah / Content
CEIPEX RESEARCH TOPIC LEVEL 1	Advanced Nano & Micro technologies
CEIPEX RESEARCH TOPIC LEVEL 2	Experimental biophotonics
NAME OF THE RESEARCH GROUP	Experimental Biophotonics (RG-1-03)
SUPERVISOR	Prof. Radim Chmelík
POTENTIAL CO-SUPERVISOR	Dr. Daniel Zicha
PROPOSED RESEARCH TOPIC TITLE	FAST-4D hiQPI: Fast, Accurate, Scalable, Time-lapse 4D Holographic Incoherent-light-source Quantitative Phase Imaging
RESEARCH TOPIC DESCRIPTION	The goal of this project is to optimise and accelerate algorithms for reconstructing 3D refractive index distributions from hiQPI data, thereby enabling time-resolved (4D) high-fidelity hiQPI imaging of both weakly and strongly scattering samples. The main outcome will be software with a user-friendly graphical interface, capable of rapidly reconstructing large-scale hiQPI time-lapse z-stacks, taken under various light propagation conditions. To achieve this, different reconstruction strategies will be explored and compared, including physics-driven algorithms, AI-based approaches, and hybrid methods. In parallel, the experimental parameters required to acquire hiQPI z-stacks with sufficient information content will be systematically explored and optimised. The resulting 4D reconstruction on the pipeline will be applied to biological samples such as organoids and highly mobile cells (e.g., sperm) and may be complemented by segmentation and cell-tracking algorithms to extend its applicability in biological research. Reference: Micháľková, I., Kollárová, V., Špaček, M. & Chmelík, R. Dataset-driven holographic incoherent-light-source optical diffraction tomography applied to red blood cells. J. Phys. Photonics 8 (2026) 025048. doi:10.1088/2515-7647/ae7ad2.
KEYWORDS	quantitative phase imaging; optical diffraction tomography; coherence-gating; inverse problem; volumetric data processing; AI-enabled algorithm acceleration; cell motility; live-tissue dynamics; cancer research and theranostics
WEBPAGE OF THE RESEARCH GROUP	https://www.ceitec.eu/experimental-biophotonics/rg3