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| 1 | CEIPEX RESEARCH TOPIC LEVEL2: Experimental biophotonics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 2 | RESEARCH GROUP: <b>Experimental Biophotonics (R. Chmelik)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 3 | TOPICS/FOCUS:<br><b>FAST-4D hiQPI : Fast, Accurate, Scalable Time-lapse 4D Holographic Incoherent-light-source Quantitative Phase Imaging.</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 4 | SUMMARY<br>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 optimized. The resulting 4D reconstruction pipeline will be applied to biological samples such as organoids and highly motile cells (e.g., sperm) and may be complemented by segmentation and cell-tracking algorithms to extend its applicability in biological research. |
| 5 | RG WEBPAGE: <a href="https://biophotonics.ceitec.cz/">https://biophotonics.ceitec.cz/</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |