

CEIPEX MU TOPIC 8A

Položka / Field	Obsah / Content
NAME	prof. RNDr. Robert Vácha, PhD.
CEIPEX RESEARCH TOPIC LEVEL2	Structural Biology: Protein-protein and protein-membrane interaction
NAME OF THE RESEARCH GROUP	Interaction Protein-Protein and Protein-Membrane
TOPIC	Lipid nanoparticles in drug delivery
ABSTRACT	With nearly 10 million lives claimed annually, cancer remains one of the leading causes of mortality worldwide, highlighting the urgent need for more effective treatments. One promising strategy involves mRNA-based cancer immunotherapy vaccines, which require a drug delivery system capable of reliably reaching the cytosol. Developing such delivery systems is challenging: they must ensure cytosolic delivery and therapeutic efficacy while maintaining safety, long-term stability, and compliance with scalable manufacturing standards—including high mRNA loading efficiency and uniform particle size. This project will investigate the intermolecular protein interactions that control key properties of protein-RNA liquid droplets, including size, stability, and loading capacity, as well as their responsiveness to environmental cues such as pH, temperature, or ionic strength. Using a combination of computational and biophysical approaches, the project aims to elucidate design principles for tuning the delivery systems based on protein droplets toward controlled release and selective targeting. The outcomes are expected to yield mechanistic insights and provide a foundation for the rational design of next-generation responsive delivery vehicles.
WEBPAGE OF THE RESEARCH GROUP	https://vachalab.ceitec.cz/