

MSCA PF/GF 2026: LIST OF TOPICS DESCRIPTIONS AND SUPERVISORS

FACULTY	INSTITUTE/DEPARTMENT	RESEARCH TOPIC (PROJECT)	DESCRIPTION OF RESEARCH TOPIC (approx. 60 words)	SUPERVISOR (+ e-mail)	CONTACT PERSON (+e-mail)
Faculty of Science	Parasitology	Cytoskeleton of eukaryotic common ancestor	This project takes advantage of the existence of "living fossils"—excavate flagellates that have retained the cytoskeletal construction scheme of the last eukaryotic common ancestor (LECA). We will describe the protein building blocks of this cytoskeleton using cutting-edge microscopy, proteomics, and bioinformatics, with the hope of identifying novel cytoskeletal proteins. The ultimate goal is to reconstruct the cytoskeletal protein inventory of LECA, offering insights into the origins of eukaryotic cell architecture.	Vladimír Hampl (vlada@natur.cuni.cz, https://www.protistologie.cz/hampllab/)	Vladimír Hampl (vlada@natur.cuni.cz, +420325873911)
Faculty of Science	Department of Cell Biology	Synergistic targeting of cancer cell motility and metabolism to prevent metastasizing	Metastasis is the leading cause of cancer mortality, yet prevention remains limited. Metastatic cells exhibit metabolic flexibility, relying on glycolysis and oxidative phosphorylation to fuel migration and colonization. This project explores a novel approach by combining migrastatic agents, which inhibit migration, with metabolic inhibitors that disrupt key pathways sustaining metastasis. We hypothesize dual targeting will reduce metastatic burden and improve efficacy.	Prof. Jan Brábek, PhD., brabek@natur.cuni.cz	Prof. Jan Brábek, PhD. (brabek@natur.cuni.cz)
Faculty of Science	Department of physical and macromolecular chemistry	sustainable energy development	I focus on designing advanced materials for sustainable energy technologies. My work includes developing catalytic and membranes for electrochemical CO ₂ reduction, hydrogen production, and related energy-conversion processes. I aim to understand structure–property relationships, improve materials performance, and create efficient systems that support a clean and carbon-neutral energy future.	Rui Gao (gaoru@natur.cuni.cz)	Rui Gao (gaoru@natur.cuni.cz)
Faculty of Science	Department of Experimental Plant Biology	Evolutionary constraints and evolution of plant organellar RNA polymerases	This project investigates how RNA polymerases in plant organelles evolved from bacterial and phage ancestors and which evolutionary constraints shaped their structure and function. By combining comparative genomics, phylogenetics, and structural analyses, the study aims to identify conserved and divergent features underlying transcriptional specialization in chloroplasts and mitochondria across plant evolution.	Dr. F. Vanessa Loiacono (vanessa.loiacono@natur.cuni.cz)	Dr. F. Vanessa Loiacono (vanessa.loiacono@natur.cuni.cz)
Faculty of Medicine in Pilsen	Biomedical Center	Mitochondrial heritage and disease	Mitochondria and mitochondrial mtDNA are inherited down the maternal lineage. Quality of oocytes is crucial for the health of offspring. The project will simulate risk factors that jeopardize the mitochondrial genome in oocytes. We hypothesize that increased mtDNA mutation in oocytes burdens mitochondrial health of offspring. The mouse model will be used for transgenerational studies, with implications to human medicine.	Jan NEVORAL (jan.nevoral@lfp.cuni.cz)	Jan NEVORAL (jan.nevoral@lfp.cuni.cz)
Faculty of Pharmacy	Department of Biochemical Sciences	Molecular Determinants of Anthracycline Cardiotoxicity: Differential DNA and Chromatin Responses in Cancer and Cardiac Cells as a Basis for Rational Cardioprotection	This project aims to elucidate the molecular basis of anthracycline cardiotoxicity by dissecting differential DNA damage, chromatin remodeling, and transcriptional responses in cancer versus cardiac cells. Particular emphasis will be placed on TOP2B-driven genomic injury and chromatin perturbation in cardiomyocytes. By defining cell-type–specific regulatory mechanisms, the project will establish a mechanistic framework for rational, targeted cardioprotective strategies without compromising anticancer efficacy.	Prof. Tomáš Šimůnek (simunek@faf.cuni.cz)	Anna Opitz (opitza@faf.cuni.cz)
Faculty of Pharmacy	Department of Organic and Bioorganic Chemistry	Covalently anchored lipids as a new paradigm of biological matter: synthetic and biophysical reconstruction of architecturally programmed membrane asymmetry	Biological membranes are assumed fluid and self-assembled, yet the corneocyte lipid envelope challenges this paradigm through covalently anchored ultralong lipids. This project will synthesize bespoke lipid analogues and reconstruct minimal asymmetric systems to uncover how covalent anchoring programs molecular organization, protein coupling, and interfacial mechanics. It will establish covalently structured lipid interfaces as a new frontier in membrane biology and bioinspired materials.	Prof. Kateřina Vávrová (katerina.vavrova@faf.cuni.cz)	Anna Opitz (opitza@faf.cuni.cz)
Faculty of Pharmacy	Department of Organic and Bioorganic Chemistry	Photoactivatable lipids to uncover hidden coupling between antimicrobial peptides and the skin permeability barrier	This project will develop bifunctional, photoactivatable lipids to capture transient interactions between antimicrobial peptides and structurally specialized skin lipid interfaces. Combining precision synthesis, photo-crosslinking, and advanced biophysics, it will test the hypothesis that permeability and antimicrobial barriers are molecularly coupled through direct lipid–peptide interactions. This work will redefine the skin barrier as an integrated physicochemical and biological defense system.	Prof. Kateřina Vávrová (katerina.vavrova@faf.cuni.cz)	Anna Opitz (opitza@faf.cuni.cz)
Faculty of Pharmacy	Department of Organic and Bioorganic Chemistry	Membrane remodeling beyond bilayers: emergence of covalently anchored multilamellar architectures in the human skin barrier	This project will uncover how canonical lipid bilayers remodel into noncanonical multilamellar architectures stabilized by covalent anchoring in the skin barrier. Using precision synthesis of ultralong lipids, reconstruction of minimal systems, and advanced biophysics including solid-state NMR, it will define mechanisms driving architectural transitions, interfacial stability, and protein coupling. It will establish membrane remodeling as a fundamentally programmed structural transformation.	Prof. Kateřina Vávrová (katerina.vavrova@faf.cuni.cz)	Anna Opitz (opitza@faf.cuni.cz)
Faculty of Pharmacy	Department of Pharmaceutical Chemistry and Pharmaceutical Analysis	Functional Phthalocyanines and BODIPY Dyes for Advanced Theranostics	We invite highly motivated postdoctoral researchers to prepare a joint proposal dealing with synthesis and study of phthalocyanines or BODIPY dyes for photodynamic therapy or fluorescence sensing. Our group focuses also on self-assembly of phthalocyanines into unique J-dimers and conjugates of dyes with oligonucleotides. We offer strong expertise in synthesis and photophysics within a collaborative and supportive academic environment.	Assoc. Prof. Veronika Nováková (veronika.novakova@faf.cuni.cz)	Anna Opitz (opitza@faf.cuni.cz)
Faculty of Pharmacy	Department of Organic and Bioorganic Chemistry	Deciphering the Structure–Activity Relationships of Topobexin: Design and Synthesis of Isoform-Selective Inhibitors of Topoisomerase II as Potential Anticancer or Cardioprotective Agents	This project aims to elucidate the structure–activity relationships of topobexin, the first selective inhibitor of topoisomerase II beta (TOP2β). The core of the project will focus on the design of topobexin analogues and related compounds with alpha- or beta-isoform selectivity, followed by their synthesis. Both in vitro and in vivo biological properties of the newly synthesized analogues will be systematically evaluated to further inform and refine the design of subsequent compounds.	Assoc. Prof. Jaroslav Roh (jaroslav.roh@faf.cuni.cz)	Anna Opitz (opitza@faf.cuni.cz)

FACULTY	INSTITUTE/DEPARTMENT	RESEARCH TOPIC (PROJECT)	DESCRIPTION OF RESEARCH TOPIC (approx. 60 words)	SUPERVISOR (+ e-mail)	CONTACT PERSON (+e-mail)
Faculty of Mathematics and Physics	Department of Distributed and Dependable Systems	Extracting Formal Models of Software from Code to Discover Bugs and Vulnerabilities	The development life cycle of a software system includes many steps, from collecting requirements and creating high-level design models to implementation, testing, and the first release. Then follows long-term maintenance and extending of the software system with new features. Consequently, the system becomes very complex, typically diverges from original design models, and some bugs (e.g., security vulnerabilities) may be introduced. Issues like that apply to legacy software, but also to programs generated with the help of LLM-based tools ("vibe coding"). We believe that a remedy may be to extract models in some formal languages from the code, and then validate (analyze) the models to discover bugs and vulnerabilities. The goal of this specific project is to create a tool for automated extraction of models in Alloy, or in similar high-level formal languages, from program code written in mainstream programming languages such as Java. Models should contain the necessary information, and they should be precise enough, to facilitate discovery of vulnerabilities such as violations of access control. The process of extraction will also involve some combination of static code analysis with dynamic (runtime) analysis of program behavior.	doc. RNDr. Pavel Parížek, Ph.D. (parizek@d3s.mff.cuni.cz)	doc. RNDr. Pavel Parížek, Ph.D. (parizek@d3s.mff.cuni.cz)
Faculty of Mathematics and Physics	Department of Distributed and Dependable Systems	Synthetic Models of Enterprise Applications for Empirical Evaluations of Software Engineering Research	Development of efficient and scalable techniques for validation, testing and debugging of large software systems is an important field (topic) of software engineering research. In this context, a significant challenge is empirical evaluation on realistic benchmarks and case studies. While there exist collections of reproducible bugs in open-source software projects, such as the collections Defects4J and BugsC++, most of the included projects are libraries and infrastructure frameworks. Benchmarks resembling enterprise business applications of realistic size and complexity are used quite rarely in published research. One reason is the proprietary nature of such applications. Business companies are very reluctant to share their enterprise applications even under non-disclosure agreements. The goal of this project is to create a set of synthetic applications that represent large enterprise systems with long-running computations (services). Since many large real-world enterprise applications involve data manipulation, the synthetic applications (models) should capture their typical characteristics, including usage of complex database queries (e.g., in SQL) and various data-processing frameworks. Availability of such benchmark suite would facilitate more large-scale empirical evaluations, in particular for testing and debugging techniques.	doc. RNDr. Pavel Parížek, Ph.D. (parizek@d3s.mff.cuni.cz)	doc. RNDr. Pavel Parížek, Ph.D. (parizek@d3s.mff.cuni.cz)
Faculty of Mathematics and Physics	Department of Surface and Plasma Science	Ultra-low-frequency waves generated by magnetopause oscillations	This project analyzes magnetospheric ultra-low-frequency waves (from mHz to a few Hz) and magnetopause oscillations using multi-satellite observations. Detailed timing analysis and wave propagation calculations are planned, along with the synthesis of data acquired within the magnetosphere. The aim is to improve our understanding of energy transfer from the solar wind to the magnetosphere, particularly during major magnetic storms, and to identify the underlying physical processes and transport mechanisms.	prof. RNDr. František Němec, Ph.D. (frantisek.nemec@matfyz.cuni.cz)	prof. RNDr. František Němec, Ph.D. (frantisek.nemec@matfyz.cuni.cz)
Faculty of Pharmacy	Department of Pharmacology and Toxicology	Understanding the mechanisms of drug resistance in lung and breast tumors and their modulation to develop novel therapies	Lung and breast cancers are the most prevalent cancer types. Using innovative techniques and advanced models, we will unravel the intricate mechanisms of resistance against the drugs used for these malignancies. Subsequently, the possibility of hitting these novel therapeutic targets will be explored. In turn, the project will open new avenues for the therapy of pharmacoresistant patients.	Assoc. Prof. Jakub Hofman (jakub.hofman@faf.cuni.cz)	Anna Opitz (opitza@faf.cuni.cz)
Faculty of Mathematics and Physics	Institute of Particle and Nuclear Physics	Investigation of top quark production at the Large Hadron Collider	We invite highly motivated postdoctoral researchers to prepare a joint proposal focusing on the production of top quarks at the Large Hadron Collider. Our group focuses on the measurement of top-antitop differential cross sections and on the investigation of the production of four top quarks at the ATLAS experiment. The exact topic of the proposal will be agreed with the supervisor. We offer strong expertise on collider physics within a collaborative and supportive academic environment.	Peter Berta (peter.bera@matfyz.cuni.cz)	Peter Berta (peter.bera@matfyz.cuni.cz)