University of Graz Summer Research Opportunities

Program areas	Placement Dates	Number of Spots (max.)	Requirements
Theoretical Physics The primary focus of the research in this group is the physics of strongly-interacting gauge theories. To explore this kind of quantum field theories we employ continuum methods, in particular, functional methods. Current research projects include: time-dependence of electron-positron pair production in ultra-strong laser fields (Sauter-Schwinger effect in strong-field quantum electrodynamics); physics of light and heavy mesons, in particular isospin breaking effects, time-like form factors and decays; ultraviolet completion of the Standard Model; and Dirac fermions in unimodular gravity.	12 weeks (beginning of May to the end of July 2024)	1	5.5 GPA min. 3 years of study at the home institution.
Mathematics Magnetic Resonance Imaging (MRI) is a very versatile medical imaging technique using magnetic fields to map different tissue parameters that are of diagnostic relevance. The mathematical model for the underlying physics is the Bloch equation, which is a system of ordinary differential equations. An interdisciplinary collaboration with medical imaging experts aims at using techniques of optimal control and inverse problems in order to compute optimized imaging protocols and image reconstructions. The offered summer research project will focus on the efficient numerical simulation of the Bloch equation and the optimization of specific aspects of the MRI process.	8 or 12 weeks (May - end of July 2024)	2	5.5 GPA min. 3 years of study at the home institution. **Solid programming skills, ideally in Julia**.
Chemistry - Environmental/Analytical Chemistry Research projects in environmental or food chemistry or environmental analytical chemistry where students will be working in an international research group and with modern analytical equipment such as mass spectrometry to do trace element analysis of natural waters, pilot whale livers or determination of mercury in oil pipelines.	12 weeks	1	5.5 GPA min. 3 years of study at the home institution and **some background in analytical chemistry.**

Chemistry - Medicinal Organic Chemistry Organic synthesis of biologically or fluorescently active compounds using standard or microwave-assisted synthesis techniques.	12 weeks (June - end of August 2024)	1	5.5 GPA min. 3 years of study at the home institution and **some experience in the field of organic synthesis.**
Chemistry - Physical Chemistry Scanning tunneling microscopy will be used to image surfaces with atomic resolution. Samples are studied either at room temperature and under ambient conditions or at cryogenic temperatures and under ultrahigh vacuum. Molecular adsorbates and assemblies will be studied on metallic surfaces, obtaining submolecular resolution and thus getting insight into the forces between individual molecules, molecular dynamics and/or reactions between different species on a surfaces. Single-molecule manipulation is used to get insight into electronic, mechanical, chemical or optical functions of single molecules.	12 weeks	1	5.5 GPA min. 3 years of **study of either chemistry of physics at the home institution as a major.**
Chemistry - Biocatalysis The focus of the project lies in the field of biocatalysis, a discipline at the crossroad between organic chemistry, biotechnology and molecular biology. In our lab, we thrive to develop sustainable methods to make the synthesis of important molecules greener. The project may involve the use of enzymes for biotransformations, the production of engineered enzymes to improve the efficiency of the biocatalyst, or the synthesis of reference compounds needed to analyze the target biotransformation.	12 weeks	2	5.5 GPA min. 3 years of study at the home institution. **<u>For students in the area of chemistry</u>: completed laboratory course in organic chemistry with focus on the synthesis of organic molecules under state-of-the-art and safe working conditions OR <u>for students in the area of molecular</u>**

			<u>biology/biochemistry</u>: completed laboratory course involving molecular cloning or biochemical assays.
Psychology - Neuroscience Visual search describes the search for a target object (e.g., a pen) in a set of other objects (e.g., some pens in a box) and is one of the key paradigms to investigate attentional processes. In our research, we use eye tracking to investigate how, for instance, memory or inhibition of return are involved in visual search and how the search process is affected by interruptions. During the research stay, the student will be involved in all stages of the research process (planning & conducting eye-tracking experiments, data (pre-)analysis, literature search & documentation).	8 weeks starting in May 2024	1	5.5 GPA min. 3 years of study at the home institution.
Molecular Biosciences Designing and testing new ion-conducting materials for fuel cells, batteries, and/or electolysers. These materials are based on lipid-like molecules (lipidoids) that form liquid crystal structures with ion-conducting properties. The projects will involve either i) chemical synthesis of the molecules and processing of the materials into membranes or ii) testing the conductivity properties of the materials using electrochemical methods, and testing their stability under the operating conditions of energy devices.	12 weeks	2	5.5 GPA min. 3 years of study at the home institution and **some background in organic or physical chemistry**.
Psychology - Biological Psychology & Neuroscience Neuroscientific, psychological, and physiological investigations into the effects of four week-long running interventions in a young sample of the normal population (magnetic resonance imaging methods, behavioral measurements, electrocardiography). Students will be involved at every stage of the project, i.e. the organization of the intervention units, diligent data management, maintenance of the social media presence, recruitment of test persons as well as actively running. If the timing is right, students will also be involved in the preparations and	12 weeks	2	5.5 GPA min. 3 years of study at the home institution and **an affinity to neuroscience and running. Students are expected to run along with the test person**

planning for other upcoming projects (e.g. dancing intervention)			**during the testing.**
Human Movement Science - Kinesiology We would appreciate your support in our research projects on flexibility-enhancing methods such as stretching, foam rolling, and strength training. You would get in touch with various biomechanical measurement methods such as dynamometry, ultrasound, 3D motion caption, and several more. During your research stay you would be part of our research team and your support in the laboratory as well as in the data analysis would be requested.	8 weeks (May & June 2024)	2	5.5 GPA min. 3 years of study at the home institution and **a good knowledge of anatomy**.
Chemistry - Physical Chemistry, Advanced X-ray scattering The research topic one will deal with artificial intelligence data analysis of X-ray measurements from crystalline thin films and nanosctructures. No prior experience with AI is necessary, but willingness to work in an X-ray lab and program in python is needed (both can be learned on the job). A second topic goes beyond data analysis by using AI controlled X-ray diffraction for adaptive optimal measurement strategies.	8 weeks	2	5.5 GPA min. 3 years of study at the home institution.
Molecular Biosciences You will be working on structural and functional analysis of biotechnologically relevant enzymes and bacterial surface-exposed proteins e.g. S-layers proteins. In our research, we use integrative structural biology approach: molecular biology, structural biology and computational analysis. The incoming researcher will participate in ongoing research tasks, such as protein cloning, protein expression from bacterial or mammalian cells, protein purification, protein crystallization and or electron microscopy screening, protein structure prediction and in depth computational analysis.	8 or 12 weeks	2	5.5 GPA min. 3 years of study at the home institution.
Human Movement Science - Kinesiology and Public Health Work in a project about the effects of endurance training in individuals with cerebral palsy and in a project about maternal exercise in pregnant women with Type 1 diabetes.	12 weeks (May - end of July 2024)	1	5.5 GPA min. 3 years of study at the home institution.
Biology - Zoology Our research group focuses on soil biology. We investigate the biodiversity, functional anatomy, phylogeny and behavioural aspects of arthropods living in the soil.	8 weeks	2	5.5 GPA min. 3 years of study at the home

Research activities for incoming students will include observational studies on living material, molecular genetic lab work and advanced microscopic investigations.			institution and an interest in zoology.
Mathematics The goal of this project is to numerically investigate the influence of stochasticity to stability and pattern formation of reaction-diffusion systems (RDS) arising from biology. Turing instability in RDS is an important phenomenon in biology as it allows, in many cases, to explain how patterns emerge. On the other hand, the impact of stochastic noise in many realistic situations is unavoidable. Recent studies show that random noise does not only destabilize systems, but can also stabilize unstable systems when having suitable intensities/frequencies. Due to this, it is conjectured that random noise can also lead to emergence of patterns. This project aims to numerically confirm this conjecture through numerical simulations of RDS with random noise.	8 weeks (May - June or June - July 2024)	1	5.5 GPA min. 3 years of study at the home institution and **programming skills with Matlab or Python as well as a basic understanding of finite difference or finite element methods.**
Mathematics The goal is to study an opinion formation model and, in particular, we will focus on the socalled epistemic bubbles and echo chambers. These two phenomena play a fundamental role especially when we consider a network in the society that links the individuals. The goal of the project is to write a mathematical description for the processes of opinion formation for N agents; investigate the mathematical properties of the model and run numerical simulations. Eventually a description at the macroscopic level could be also investigated.	8 or 12 weeks (May - July 2024)	2	5.5 GPA min. 3 years of study at the home institution.
Psychology - Visual Neuroscience Our research focuses on the subjective aspects of visual perception. We study how the poor visual information that enters our eye is being transformed into our actual visual experience of the world. To answer this question, we use visual illusions combined with a variety of cognitive neuroscience methods: eye tracking, EEG, fMRI, and non-invasive brain stimulation. The lab rotation will consist of conducting a small research project, which will include	12 weeks	1	5.5 GPA min. 3 years of study at the home institution and **some programming skills.**

help in designing and conducting an experiment, analyzing the data and writing a short report. The exact topic and methods will depend on the student's interest and on the exact project start date and duration, which are negotiable. More information and relevant publications can be found at: https://neurovision.uni-graz.at/en/			