**Overseas Summer Undergraduate Research Opportunities Programme in Science (UROPS) at Shanghai Jiao Tong University (SJTU) 2025 (in-person)**

**Programme Overview**

Zhiyuan College of Shanghai Jiao Tong University (SJTU) is offering FoS students the opportunity to take part in a summer research programme as part of FoS' Overseas Summer Undergraduate Research Opportunities Programme in Science (UROPS).

Note that this programme is **NOT** the Summer Research Internship found here.

Zhiyuan College is dedicated to cultivate curiosity-driven future scientists by transforming students' curiosities into an aspiring learning and creative activities, enhancing students' higher academic pursuits, stronger challenge spirits and more initiative cooperation consciousness, cultivating them to be future scientific leaders with critical thinking, knowledge integration, communication and collaborations, as well multicultural understanding and global perspectives.

The available projects cover a wide range of topics and fields of research. The list of projects available can be found at the end of this document. Students are welcome to contact the supervisors for more information.

**Location**

The programme takes place in Shanghai, China.

**Dates**

The exact period of exchange should be discussed between the student and the supervisor. Due to the minimum duration requirement and the NUS academic calendar, the period of exchange should be 10 to 12 weeks long and fall within the NUS Special Term: **12 May 2025 – 1 August 2025**.

**Credit Transfer**

Students will be assessed according to SJTU's assessment criteria and receive a transcript issued by the institution.

This programme may be mapped to a 4-unit UROPS course code or a 4-unit FoS dummy exchange course code (counts towards unrestricted electives).

More information on course mapping and credit transfer will be released to students accepted into the programme.

Do note that additional assessment may be required from the student by the NUS department for transferring of credits to a UROPS course. Not all UROPS course code can be counted towards major requirements. Please check what requirements the UROPS will count towards and if you are unsure, please check with your department.

Students can transfer a total of 12 units from a maximum of 2 overseas summer/winter programmes without having to pay NUS tuition fee during their course of study. Any additional units mapped will be subjected to NUS Special Term fees.

**Eligibility Criteria**

NUS students must:

- Be a full-time Faculty of Science student, with a primary major in science
- Have a clean disciplinary record
- Have completed 4 – 6 semesters in NUS by the start of the programme (i.e. current Year 2 and Year 3 students)
- Have a minimum GPA of 3.75
- Not be intending to graduate at the end of AY2024/2025 Semester 2
- Not be called up for National Service during the programme dates. A deferment letter will not be provided.

An internal offer does not guarantee your placement in the programme. Your admission outcome is at the discretion of the partner institution.

**Number of Places**

There are 5 places available.

**Programme Cost**

Students do not need to pay NUS Special Term fees or tuition fees to SJTU if they do not exceed the credits transfer limit stated under the section "Credit Transfer" above. However, students are responsible for their own airfare, accommodation, meals, personal expenses, etc.

Estimated cost (*Please note that the figures provided are only estimates*)

| Item | Cost |
|---|---|
| Return Airfare | SGD500 |
| Accommodation | SGD3,000 |
| Food and Transport | SGD2,000/month |

**Financial Assistance**

Click here to find out more about the various financial assistance schemes offered by FoS. This programme is eligible for the NASA Enhancement Bursary and the Science Student Overseas Exposure Fund (SSOEF).

Information on financial aid application will be sent to students accepted into the programme later.

Other financial assistance schemes offered by NUS can be found here.

**Programme Application Procedure and Deadline**

Login to EduRec and submit your application under External Study Type "Research Attachment/Internship/ Industrial Attachment", External Study Setup ID: **03157**. Please refer to the Guide for Student Programme Application before starting your application.

Application Deadline: **Monday, 3 February 2025, 11:59pm Singapore Time**

**Documents required (upload into your online application in EduRec):**

1. Latest NUS unofficial transcript
2. Curriculum Vitae – Highlight any prior research experience that you may have to support your application
3. Personal Statement – Indicate your choice of project, your area of research interest and why you are interested in the mentioned project

Note:

- Admission into the programme is at the discretion of SJTU

If you face difficulties uploading the documents, submit the required documents via SCI UG Queries (category: SAP) by **3 February 2025, 11:59pm Singapore Time**.

Applications would be **deemed incomplete if the required documents are incomplete or not submitted** by the stipulated deadline, and therefore disqualified from the application.

To be fair to students who abide by the deadline, incomplete or late application will strictly not be considered.

**Insurance**

All students travelling overseas for activities or purposes approved, endorsed, organised, sponsored or authorised by NUS will be covered by the NUS Student Travel Insurance Policy. Click here for more information.

Exclusions to the NUS Student Travel Insurance may apply. Students are to ensure that they have sufficient travel insurance coverage, and may consider purchasing additional travel insurance if required.

**Contact**

If you have any questions, please submit your enquiry via SCI UG Queries (category: SAP).

*Updated: 21 January 2025*

| # | Professor | Field of Research | Project Title | Project Description | Pre-requisites | Department | Email Address |
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| 1 | Xuyang LU | integrated circuits | Design of RF class EF amplifier or Analog-to-Digital Converters | Depend upon your background in either analog circuit or RF circuit, I will guide through the design process of a radio-frequency E/F amplifier or to design a basic A-to-D converter | Has a background in integrated circuits with knowledge in analog circuit, power electronics, and/or RF circuit. | University of Michigan- Shanghai Jiao Tong University | xuyang.lu@sjtu.edu.cn |
| 2 | Kun LIU | Experimental particle physics | Tracking reconstruction using machine learning | The DarkSHINE experiment aims to search for dark matter mediators through high repitation electrons hinting on target. Effective tracking reconstruction of charged particles is essential for enhancing sensitivity. This project intends to integrate machine learning techniques into the DarkSHINE tracking reconstruction process and will compare these results with those obtained from commonly used standard reconstruction methods. | Programming experience: C++ or python | Tsung-Dao Lee Institute | kun.liu@sjtu.edu.cn |
| 3 | Xianyu TAN | Astronomy | Exoplanet spectroscopic modeling | We will calculate synthetic spectra of exoplanets based on the results of state-of-the-art three-dimensional atmospheric models of hot Jupiters. The goal is to understand how the spectra are influenced by the strong winds, inhomogeneous temperature, and chemistry of hot Jupiters. | Electromagnetism courses, basic level of computational skill with Python | Tsung-Dao Lee Institute | xianyut@sjtu.edu.cn |
| 4 | Fabo FENG | Exoplanet | Investigating the Impact of Stellar Encounters on Planetary Disk Evolution and Planet Formation | Planet formation typically occurs within star clusters, where stellar flybys and encounters play a significant role. The tidal perturbations resulting from these encounters can induce structures within the protoplanetary disks, such as spiral arms and warped regions. This project aims to quantify the impact of these stellar encounters on planetary formation by identifying past encounter events involving planet-forming disks, using Gaia catalog data. Specifically, the student will identify potential close encounters by integrating the orbits of stars based on the initial positions and velocities provided by Gaia. The student will then investigate how these encounters influence disk evolution using analytical models. Ultimately, the student will address whether the observed substructures in planetary disks are the result of past encounters and evaluate the role such encounters play in planet formation. | python, basic statistics, linear algebra, English | Tsung-Dao Lee Institute | ffeng@sjtu.edu.cn |
| 5 | Yosuke MIZUNO | Black hole astrophysics, plasma astrophysics, numerical astrophysics | Numerical investigatation of horizon-scale images in low-angular momentum accretion flows onto a rotating black hole | Using general relativistic radiation transfer calculaiton code, we calculate the time series of horizon-scale images from three dimensional magnetohydrodynamic simulation data of low-angular momentum accretion flows onto a rotating black hole. We try to understand the image morphology, time variation, and polarimety from different angular momentum accretion flows. | Computational skills: programming language (IC, Python), UNIX system, some basic physics | Tsung-Dao Lee Institute | mizuno@sjtu.edu.cn |
| 6 | Shu LI | Particle Physics; Artificial Intelligence; Particle Detection and Electronics; Deep Machine Learning; Dark Matter; Higgs Boson; High Energy Collider; LHC; CERN | Artificial Intelligence assisted research on Particle Physics with the highest energy collisions | This project aims to perform a thorough study on the particle physics beyond Standard Model new phenomena utilizing the state-of-art Monte Carlo Generators and CERN Large Hadron Collider proton-proton collision data. AI assisted approach with deep machine learning techniques enpower such researches to achieve the unprecedented precision and sensitivities to the infinity. | basic computing and programing skills are required; basic knowledge about particle physics and particle detection techniques are advantageous but not mandatory. | Tsung-Dao Lee Institute | shuli@sjtu.edu.cn |
| 7 | Hualin MEI | Particle Physics; Neutrino Astronomy; Cosmic Ray Physics; Search for New Physics | Development of 3D Particle Detectors Based on Scintillators | Based on an array of pixelated plastic scintillators and wavelength-shifting optical fibers, combined with silicon photomultipliers and multi-channel readout electronics, a three-dimensional particle tracking detector with superior angular resolution has been constructed. This detector is capable of the following measurements:<br><br>Providing independent muon angular measurement data to verify the reconstruction algorithms of the "HaiLing" neutrino telescope.<br>Investigating hadronic interactions within extensive air showers triggered by cosmic rays.<br>Utilizing the low-background environment of the deep sea to search for new physics beyond the standard model (such as particles with fractional charges, magnetic monopoles).<br>Relying on the "HaiLing" neutrino telescope array to conduct measurements of geoneutrinos. | Has a foundation in undergraduate university physics, possesses certain programming skills, and is proficient in using basic physical experimental tools such as oscilloscopes. | Tsung-Dao Lee Institute | mei.hualin@sjtu.edu.cn |

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| 8 | Songliang CHEN | Artificial Intelligence and Machine Learning: Developing algorithms and architectures for neural networks. Optics and Photonics: Application of light-based technologies in computational systems. Interdisciplinary Research: Integration of optical physics with computer science to advance neural computation. | Development of Algorithms for Optical Neural Networks | This project aims to explore the development and optimization of algorithms for optical neural networks (ONNs), a cutting-edge field at the intersection of optics and artificial intelligence. Unlike traditional electronic neural networks, ONNs leverage the properties of light to perform computations, offering advantages in speed, energy efficiency, and scalability. Students will work on designing and simulating algorithms that enhance the performance and functionality of ONNs. The focus will be on: Implementing efficient learning methods for ONNs. Exploring new architectures for better accuracy and generalization. Investigating the integration of ONNs with classical neural networks to address hybrid computing challenges. This research offers a hands-on opportunity to delve into computational methods, simulate ONNs using Python-based frameworks, and contribute to the development of innovative solutions for next-generation neural networks. | Programming Skills: Proficiency in Python, including experience with scientific computing libraries (e.g., NumPy, TensorFlow, or PyTorch). Basic Knowledge in Neural Networks: Familiarity with the fundamentals of deep learning and backpropagation. Understanding of Optics: Basic concepts in optics and photonics (e.g., wave propagation, interference) are desirable but not mandatory. Mathematical Background: Comfort with linear algebra, calculus, and numerical methods. | The University of Michigan-SJTU Joint Institute | sungliang.chen@sjtu.edu.cn |
| 9 | Hong ZHU | computational materials science, solid electrolyte | Tuning the ionic conductivity of lithium halide compounds | Lithium halide compounds are promising solid electrolytes with good combinations of lithium ionic conductivity, stability and compatibility with electrodes. By combining high-throughput simulations and machine learning, we will systematically investigate the critical factors to enhance the ionic conductivity for Li halides, e.g., the anion superlattice, the anion charge, critical phonon modes, etc. | Some backgrounds in materials science, chemistry, physics or machine learning | The University of Michigan-SJTU Joint Institute | hong.zhu@sjtu.edu.cn |
| 10 | Qiang WU | molecular genetics and 3D genomics | Precise and predictable 3D genome editing | This project aims to precision engineering 3D genome to understand gene regulation. | deep understanding of genome and geometry | Shanghai Center for Systems Biomedicine | qiangwu@sjtu.edu.cn |
| 11 | Di ZHANG | Materials | Research on butterfly wing-inspired cosmetic materials | The variety of butterfly species can be observed from their various vivid colored wings, prompting a classification of the butterfly wings. Our classification focused on distinguishing their wing structures based on variations in specialized regions, which produce five distinct categories. The classification enables proper selection of butterfly wings for replication and understanding the interaction of the structures with light, resulting in wing coloration. This project will focus on conducting research on multifunctional cosmetic powders inspired by butterfly wing scales. | Physics, Optics, Chemistry | Schoole of Material Science and Engineering | zhangdi@sjtu.edu.cn |
| 12 | Liang LIU | Physics, Condensed matter physics, Spintronics, THz detections, Nano-fabrications. | THz detection based on nonlinear Hall effect in quantum materials | Nonlinear Hall effect (NLHE) offers a novel approach to probe symmetry and topological properties in quantum materials, promising innovative applications including THz detection and envery harvesting. The project aims to explore and develop terahertz (THz) rectifiers based on the nonlinear Hall effect in quantum materials. Building on the principles demonstrated in recent research, our goal is to harness the unique properties of these materials to create efficient THz rectifiers. The nonlinear Hall effect, particularly as induced by Berry curvature dipoles in quantum materials, offers a promising approach for rectifying THz signals. This phenomenon allows for the conversion of THz waves into direct current, which can be utilized for various applications such as energy harvesting, communication, and sensing. Our project will involve selecting suitable quantum materials that exhibit strong nonlinear Hall effect responses in the THz range. We will then design and fabricate rectifiers utilizing these materials, optimizing their structure and composition to maximize rectification efficiency. Through experimental validation and theoretical modeling, we will evaluate the performance of the rectifiers, focusing on key metrics such as rectification efficiency, bandwidth, and response speed. Our ultimate goal is to develop THz rectifiers that can efficiently convert THz radiation into usable electrical energy, paving the way for novel applications in the THz regime. This project leverages the latest advancements in quantum materials and nonlinear Hall effect research, aiming to contribute to the growing field of THz technology and its diverse applications. | 1. Interest in Quantum Mechanics and Solid State Physics: A keen interest in learning more about quantum mechanics and solid state physics, particularly in the context of electronic properties of materials. Curiosity About Terahertz Technology: An interest in terahertz (THz) radiation and its potential applications, with a willingness to learn more about this technology. Openness to Learning Material Science: A willingness to explore material science principles, especially related to semiconductors and emerging quantum materials. Basic Laboratory Experience: Some exposure to laboratory environments, even if it's through school experiments or basic research projects. Enthusiasm for Semiconductor Devices: An interest in learning about semiconductor devices and their operation, particularly rectification processes. Basic Computer Skills: Familiarity with basic computer applications and a willingness to learn programming skills (e.g., Python) if needed for data analysis. Interdisciplinary Mindset: A willingness to work in an interdisciplinary environment, integrating knowledge from physics, engineering, and materials science. Access to Learning Resources: Availability of learning resources within the university, such as libraries, online courses, and faculty expertise, to support the research interest. These prerequisites emphasize the importance of research interest, curiosity, and a willingness to learn and collaborate. They aim to make the project accessible to undergraduate students who are passionate about exploring new areas of research and are eager to contribute to the field of THz rectifiers based on the nonlinear Hall effect in quantum materials. | School of Physics and Astronomy | liul21@sjtu.edu.cn |
| 13 | Feng HE | ultrafast physics | ultrafast electron dynamics in molecules and atoms probed by attosecond laser pulses | By numerically simulating the time-dependent Schroedinger equation, we investigate the ultrafast electron movement in atoms and molecules exposed to strong lasers. We care how electrons "talk" with each other in attosecond time scales. | have taken the course of quantum mechanics. | School of Physics and Astronomy | fhe@sjtu.edu.cn |
| 14 | Junting HUANG | experimental particle physics | Data Analysis on the PandaX Veto Detector | analyze the data coming from the PandaX veto detector; study muons events and coincident events between the veto and the TPC | knows python or C++ | School of Physics and Astronomy | junting@sjtu.edu.cn |

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| 15 | Min CHEN | optics, plasma physics | muon acceleration by laser plasma wakefield | We plan to find an effective scheme for trapping and stable acceleration in a laser driven plasma wakefield. Plasma wakefield can support GV/cm acceleration field which is three orders larger than convention accelerators. For this, the plasma wakefield is thought to be the next generation of accelerator structure. It has attracted worldwide interests in recent years. You will learn the fundamental knowledge of wakefield acceleration and see the experimental facilities, including the hundreds TW laser, laser and electron beam lines, and many kinds of diagnositic devices. | classical electrodynamics | School of Physics and Astronomy | minchen@sjtu.edu.cn |
| 16 | Wei KU | emergence in quantum systems | Dynamical nature of quantum information | This project aims to connect the static-looking quantum information to the underlying connection to the dynamic of different time scales. | quantum mechanics / linear algebra | School of Physics and Astronomy | weiku@sjtu.edu.cn |
| 17 | Sihua HOU | organic chemistry, natural product chemistry, and medicinal chemistry | Synthesis of Natural Product Taxol | The synthesis of Taxol (also known as paclitaxel), a complex and biologically active natural product originally derived from the bark of the Pacific yew tree (Taxus brevifolia), has been a major challenge in the field of organic chemistry due to its intricate structure and the stereochemical complexity. Taxol has been developed as an anticancer drug, particularly effective in the treatment of ovarian, breast, and lung cancers. Taxol contains a highly oxygenated diterpenoid skeleton with several fused rings, a benzene ring, and an ester group. It also features a unique side chain at C13, which is crucial for its biological activity. The synthesis of Taxol, whether through total synthesis or semi-synthesis, remains an important achievement in organic chemistry. Although total synthesis is valuable for understanding the chemistry of complex molecules, the semi-synthetic approach is now the preferred route for large-scale production due to its practicality and efficiency. | Working on the total synthesis of Taxol is an ambitious and highly challenging endeavor that requires a broad range of skills, knowledge, and resources. The complexity of Taxol's structure demands deep expertise in various areas of chemistry. Below are the key prerequisites for tackling the total synthesis of Taxol: 1. Strong Foundation in Organic Chemistry Synthetic Organic Chemistry: Mastery of advanced synthetic techniques is crucial, particularly in complex molecule construction. You'll need expertise in functional group transformations, stereoselective reactions, and regioselective reactions. Reaction Mechanisms: A deep understanding of reaction mechanisms is critical. You should be familiar with a variety of mechanisms such as radical, nucleophilic substitution, electrophilic addition, and organocatalysis. 2. Advanced Stereochemistry Control of Stereochemistry: Taxol has several stereocenters, and controlling stereochemistry at each step is essential for achieving the correct molecular configuration. Expertise in stereoselective synthesis, diastereoselectivity, and enantioselectivity is vital. Chirality and Resolution: Familiarity with methods to resolve chirality, including the use of chiral auxiliaries or catalysts, is important. 3. Complex Multistep Synthesis Design Retrosynthetic Analysis: Ability to perform retrosynthetic analysis to break down the complex structure of Taxol into simpler, more manageable fragments. This involves recognizing key disconnections and identifying synthetic intermediates. Designing Efficient Pathways: Due to the complexity of Taxol's structure, you must design efficient, high-yielding synthetic routes, and anticipate potential pitfalls such as side reactions or low yields | School of Pharmaceutical Sciences | housihua@sjtu.edu.cn |
| 18 | Hua WU | Organic synthesis | Development and application of cyclizative rearrangement strategy | Committed to applying the cyclizative rearrangement strategy developed by our research group to the construction of heterocycles and editing of existing heterocycles | Interested in synthetic organic chemistry and heterocyclic compounds construction | School of Pharmaceutical Sciences | hua.wu@sjtu.edu.cn |
| 19 | Liufu DENG | Immunology, Biology, Basic Medical Sciences | Tumor Immune Mechanisms and Translational Research | Research on New Mechanisms and New Targets in Tumor Immune Regulation | Possessing some knowledge of immunology | School of Pharmaceutical Sciences | dengliufu@sjtu.edu.cn |

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| 20 | Yu ZHANG | Earth Sciences, Marine Science, Environmental Sciences, Biogeochemistry, Marine Ecology, Climate Change Science | Study of high hydrostatic pressure on microbial transformation of particulate organic matter (POM) | Particulate organic matter (POM) constitutes the core component of the marine biological pump, serving as the principal vehicle for transporting organic carbon generated by surface primary producers into the deep sea. Throughout its descent through marine water columns, POM is subject to microbial transformation, leading to continuous alterations in its composition, which has direct implications for the carbon cycle and carbon sequestration within marine ecosystems. High hydrostatic pressure (HHP), a defining characteristic of deep-sea environments, exerts significant control over microorganisms' physiological and biochemical activities. However, due to limitations in research methodologies and the scarcity of in situ data, the mechanisms and extent to which HHP influences the microbial transformation of POM remain a critical gap in our ability to accurately evaluate the carbon storage potential across the oceanic depth spectrum. To this end, the project will employ deep-sea environmental simulation technologies to investigate the regulatory mechanisms of HHP on POM transformation at both microbial community and single-species levels: 1) The mechanism of HHP on POM transformation is investigated at the microbial community level; 2) The mechanism of HHP on POM transformation is investigated at the single species level; 3) In situ observations are integrated to evaluate POM transformation comprehensively fluxes at different water depths. Furthermore, deep-sea in situ experimental technologies will be utilized to collect observational data, enabling a comprehensive assessment of POM transformation fluxes at varying depths. This research aligns with national strategic needs, particularly in the context of global climate change and the earth's carbon neutrality goals. This project aims to provide foundational data and scientific insights for optimizing models and enhancing the predictive accuracy of marine carbon cycling processes by focusing on the frontier scientific question of accurately evaluating oceanic carbon storage and sequestration capacity across full-ocean depths. | None | School of Oceanography | zhang.yusjtu@sjtu.edu.cn |
| 21 | Xinshu ZHANG | ocean engineering | Design of new wave buoy | Design and test of novel wave buoy | Fluid dynamics, tele communication | School of Ocean and Civil Engineering | xinshuz@sjtu.edu.cn |
| 22 | Honglin WANG | Basic Medicine | Discovery and Pre-clinical Studies of Anti-Psoriasis Small Compounds | Psoriasis is a chronic inflammatory skin disorder affecting 2-3% of the general population. Importantly, psoriasis is not fatal but incurable, which means patients must live with the annoying disease throughout their lifetime. Natural compounds have become an important source for new drug discovery, and there is growing international interest in lead compounds found in plants. Therefore, it is an effective way to screen active anti-psoriasis natural products derived from plants, and to derivatize natural products to determine their structures, improve efficacy, specificity, and reduce toxicity. In this program, we also aim to perform preclinical studies. Deciding whether a drug is ready for clinical trials (the so-called move from bench to bedside) involves extensive preclinical studies that yield preliminary efficacy, toxicity, pharmacokinetics, and safety information. Wide doses of the drug are tested using in vitro (test tube or cell culture) and in vivo (animal) experiments, and it is also possible to perform in silico profiling using computer models of the drug-target interactions. | An excellent team spirit; Good English communication and writing skills; Basic knowledge of cell biology and immunology; Experience in working with animal models is preferred. | School of Medicine - Shanghai General Hospital | honglin.wang@sjtu.edu.cn |
| 23 | He ZHU | Prostate tumor | Mechanism and intervention of neutrophil histone serotonin induced by neuroendocrine prostate cancer driver gene MYCN to shape liver metastasis microenvironment | 1 adult tissue stem cells from hematopoietic system and prostate in tissue development and tumorigenesis . 2.tumor microenvironment with a focus on cancer-associated fibroblasts and nerves .3.development of novel targeted therapy for castration-resistant and metastatic prostate cancer. | Be honest and trustworthy, have a good academic style, and have no record of cheating in exams, plagiarizing others' academic achievements or other violations of laws and disciplines; The health condition shall meet the medical examination standards stipulated by the Ministry of Education; National universities outstanding undergraduate students in the third year (2025 graduates, double first-class universities or the top 10% of the fourth national discipline assessment is preferred); Excellent academic performance: the top 20% of the total scores in the first three years are interested in academic research work, and have outstanding scientific research performance or potential scientific research ability. | School of Medicine - Renji Hospital | zhuhecrane@sjtu.edu.cn |
| 24 | Bin LI | immunology | CarTreg therapy | developing new CarTreg therapy for treating inflammatory diseases | basic immunology | School of Medicine | Binli@shsmu.edu.cn |
| 25 | Jian ZHANG | Pharmaceutical Science | AI-driven drug design and discovery | Development of drug design methods by large-scale data and AI algorithm and its applications on anti-cancer targets | Computational Biology or Chemistry | School of Medicine | jian.zhang@sjtu.edu.cn |
| 26 | Miaomiao ZHU | Differential Geometry, Geometric Analysis, Nonlinear Partial Differential Equations | Minimal surfaces and H-surfaces | We investigate some geometric analysis aspects for minimal surfaces and H-surfaces. Also, some numerical analysis aspects will be explored. | Functional Analysis, Real Analysis, Complex Analysis, Differential Geometry, Partial Differential Equations | School of Mathematical Sciences | mizhu@sjtu.edu.cn |

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| 27 | Congming LI | Theoretical Analysis of Solutions to Partial Differential Equations | Liouville theorems and related problems | This project focuses on the a priori estimates, especially the asymptotic estimates, of solutions. By innovatively improving and developing the method of moving planes, the methods of global and local integral inequalities, and the level set method, we conduct research on Liouville-type theorems for several types of equations. | Real Analysis, Functional Analysis, Partial Differential Equations | School of Mathematical Sciences | congming.li@sjtu.edu.cn |
| 28 | Fei TAO | Synthetic biology | Carbon-negative production of bio-plastics | Develop efficient light-driven cell factory for the production of biodegradable plastics such as PLA and PHA. | Biology | School of Life Sciences and Biotechnology | taofei@sjtu.edu.cn |
| 29 | Yaojun TONG | Genome editing, synthetic biology | Develop a versatile CRISPR-Cas13-based RNA modulation toolkit for E. coli | The project aims to develop a versatile RNA modulation toolkit based on the CRISPR-Cas13 system for Escherichia coli (E. coli). The toolkit will enable precise and efficient regulation of RNA expression in E. coli, allowing researchers to control gene activity at the RNA level. By harnessing the RNA-targeting abilities of Cas13, this tool will offer a flexible approach to studying gene function, fine-tuning metabolic pathways, and optimizing industrial bioprocesses in E. coli. | Have basic knowledge of Microbiology, molecular biology, and CRISPR. Have experience on experiments of DNA cloning and microbe handling. | School of Life Sciences and Biotechnology | yaojun.tong@sjtu.edu.cn |
| 30 | Xianting DING | Proteomics; AI for biomedical engineering applications | AI assisted proteomics and big data modeling in biology | We have generated very big data based on clinical samples using proteomics. We need to build up disease descriptive and predictive models based on big clinical data with AI. | familiar with big data; background or interested in bioinformatics | School of Life Sciences and Biotechnology | dingxianting@sjtu.edu.cn |
| 31 | Hongjiang WEI | EE and BME | Non-invasive brain stimulation via temporally interfering stimulation | Brain modulation softwares and strategies implementation | Python, UI design | School of Life Sciences and Biotechnology | hongjiang.wei@sjtu.edu.cn |
| 32 | Hui LYU | data science, bioinformatics, statistics | Rare disease diagnostic program development with foundation models | using deep learning to analyze clinical and genetic information | working knowledge of data analysis of deep learning | School of Life Sciences and Biotechnology | huilu@sjtu.edu.cn |
| 33 | Zhen CHENG | AI in atmospheric environment | Diffusion model for air pollution diffusion | deep learning for air quality modeling | good programming skill | School of Environmental Science and Engineering | chengz88@sjtu.edu.cn |
| 34 | Yanbin ZHAO | Environmental Health | Screening of environmental risk factors for Alzheimer's disease | This research aims to identify potential environmental chemical pollutants linked to Alzheimer's disease by integrating Genome-Wide Association Studies (GWAS) with predictive toxicology. By analyzing GWAS datasets to uncover genetic susceptibility factors and using predictive toxicology to model interactions between these factors and environmental pollutants, the study seeks to pinpoint specific chemicals that may contribute to Alzheimer's disease. This approach leverages large-scale data analytics to bridge genetic predisposition and environmental exposures, providing insights into potential mechanisms and targets for intervention. | Students should have a foundation in genetics, toxicology, or bioinformatics, with experience in analyzing large-scale datasets. Proficiency in programming languages like R or Python and familiarity with bioinformatics and toxicology prediction tools are encouraged. Additionally, students should be able to critically review scientific literature, work collaboratively in interdisciplinary teams. | School of Environmental Science and Engineering | zhaoyanbin@sjtu.edu.cn |
| 35 | Baowen ZHOU | Green Hydrogen, Solar water splitting | Ga(X)N Nanowires/Si for Solar Generation from Water Splitting | National Key Research and Development Program of China | Chemistry, Energy, Materials, and Applied Thermal Physics | School of Environmental Science and Engineering | zhoubw@sjtu.edu.cn |
| 36 | Jing WANG | Soft Electronics and Mechanics | Multi-modal Haptics Sensing for Biologically Inspired Slippery Surfaces | Natural species have exhibited various intriguing interfaces on their skins with a wide range of slipperiness or friction. Inspired by such surfaces, many non-stick slippery surfaces have emerged in the past decade, impacting the field of consumer electronics, biomedical devices, and infrastructures for their excellent anti-fouling properties. However, with the development of Metaverse in VR and AR, identifying such surfaces remains a challenge for the lack of their frictional and haptics information. Herein, in this project, we will explore and develop effective haptics sensing devices for these slippery surfaces and corresponding natural surfaces. Further, databases of different surfaces will be established, and AI-tools will be introduced for effective and efficient identification. In the end, we anticipate that such haptics devices will open up new opportunities for marine species recognition, coating testing, and Metaverse enhancement. | Electrotechnics and electronics; Solid Mechanics; Engineering Materials; AI algorithms | School of Environmental Science and Engineering | juw6@sjtu.edu.cn |
| 37 | Shanying ZHU | Distributed optimization over networks and multi-agent systems | Distriuted online resource optimization | Distributed Online Resource Optimization is a field focused on efficiently managing and allocating online resources across neighboring nodes over networks. It involves distributed algorithms and strategies to balance resource usage, enhance performance, and ensure fast convergence, where nodes can only communicate with their neighbors without any global information. | Algebra, Convex Optimization | School of Electronic Information and Electrical Engineering | shyzhu@sjtu.edu.cn |
| 38 | Yun LIN | Artificial Intelligence, Software Engineering | LLM-driven automatic programming | This project is to explore how to automatically edit a code project with given requirement and specification, based on the technique of state-of-the-art LLM. | - Proficient in Python or Java; - Proficient in either Tensorflow, Keras, or PyTorch framework. | School of Electronic Information and Electrical Engineering | lin_yun@sjtu.edu.cn |
| 39 | Guoxing CHEN | Computer Security | Enhancing Security and Privacy through Confidential Computing: Innovations and Applications | Confidential computing is an emerging paradigm aimed at protecting data in use by leveraging hardware-based Trusted Execution Environments (TEEs). This project explores the design, implementation, and optimization of confidential computing systems to address critical security and privacy challenges in modern applications. | Programming Proficiency, Cryptography Basics, Operating Systems and Systems Security | School of Electronic Information and Electrical Engineering | guoxingchen@sjtu.edu.cn |
| 40 | Jian PANG | CMOS Circuits for Wireless Communications | CMOS Millimeter-Wave Circuits Design for Wireless Communications | Learning the theory of CMOS millimeter-wave circuits. Learning the design procedure of CMOS millimeter-wave circuits | CMOS Analog Circuits, High-Frequency Electronic Circuit | School of Electronic Information and Electrical Engineering | pangjian@sjtu.edu.cn |
| 41 | Quanshi ZHANG | Artificial Intelligence | Interpretable Machine Learning | Explaining Inference Patterns Encoded by Neural Networks with Theoretically Guaranteed Faithfulness | Basic knowledge about deep learning | School of Electronic Information and Electrical Engineering | zqs1022@sjtu.edu.cn |

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| 42 | Zhe LIU | Robotics | 1.Large Language Model Enhanced Multi-robot cooperative planning and coordination<br>2.Multi-Robot Reinforcement Learning with Memory | 1.This project mainly focuses on the task scheduling, cooperative path planning and local motion coordination of large-scale robot groups with hundreds or even thousands of mobile robots, aiming for robotic logistic applications. Both the traditional optimization methods and learning models will be used for task/traffic prediction and task and path planning, and the potentials of Large Language Model in solving the multi-robot planning issues will be fully exploited.<br>2.This project mainly focuses on implementing the reinforcement learning approaches to improve the ability of multi-robot systems in complex environments. We will exploit how to make the robot has memory about its previous observations as well as previous behaviours. The robots can share their memory and can learn from the others' memory. | Basic deep learning and LLM knowledges, or can learn them very quickly. | School of Electronic Information and Electrical Engineering | liuzhesjtu@sjtu.edu.cn |
| 43 | Jianping HE | Artificial Intelligence, Control Theory, Robotics | Safe Control of Robotic Arms via Diffusion Models and Inverse Reinforcement Learning | This project aims to enhance the generalizability and safety of robotic operations in dense contact environments. Leveraging inverse reinforcement learning, diffusion models, and safety control algorithms, we construct a three-stage theoretical and technical framework: "reward function extraction - robotic arm trajectory generation - robotic arm safety constraints". The project is divided into three main parts: (1) automatic extraction of reward functions based on inverse reinforcement learning, (2) robotic arm trajectory planning based on diffusion models, and (3) safety control of robotic arms based on control barrier functions. The project will be validated through experiments in simulated home and office environments, demonstrating the effectiveness of our learning and control techniques. | Interested students should be proficient in Python/C++ programming, basic knowledge of artificial intelligence and have basic knowledge of robot control. In addition, proficiency in English writing and speaking is mandatory. | School of Electronic Information and Electrical Engineering | jphe@sjtu.edu.cn |
| 44 | Huibin QIU | Chemistry, Materials | Micellar brush via surface-initiated living self-assembly | In this project the students will learn how to prepare micellar brushes through surface-initiated living crystallization-drivenself-assembly of several block copolymers. They will also be taught how to use these micellar brushes to produce H2 by electrolysis of water. | Physical Chemistry, polymer chemistry & physics | School of Chemistry and Chemical Engineering | hbqiu@sjtu.edu.cn |
| 45 | Xueqing GONG | physical chemistry and computational chemistry | Computational modeling of heterogeneous catalysis | Theoretical study of the heterogeneous catalysts and catalytic reactions by using density functional theory calculations and AI methods | none | School of Chemistry and Chemical Engineering | xqgong@sjtu.edu.cn |
| 46 | Xiaodong ZHUANG | 2D materials for energy storage and conversion devices | Synthesis of conjugated two-dimensional polymers | 2D polymers are new rising 2D materials, including 2D COFs, 2D MOFs and others. We will conduct the rational synthesis of 2D polymers and study their structures and opto-electronic properties. | with self-motivation | School of Chemistry and Chemical Engineering | zhuang@sjtu.edu.cn |
| 47 | Xiaohong HUO | Asymmetric catalysis; Mimicase catalysis | Bimetallic catalysis in stereodivergent synthesis | Transition-metal-catalyzed reactions have been demonstrated to be one of the most powerful tools for the synthesis of functional molecules in the fields of biological, pharmaceutical, and material science.1 The traditional mono-metal catalytic pathway generally relies on the interaction of the metal catalyst with one substrate, thereby lowering the energy barrier for bond formation with another unactivated substrate. Although the community has witnessed impressive progress with mono-metal catalysis and its extensive utility in industry, one challenge is that mono-metal catalysis usually fails to promote reactions incorporating two inert substrates. Recently, bimetallic catalysis, wherein two metal catalysts activate two inert substrates has emerged as a powerful approach to enable chemical reactions that are inefficient or were impossible previously (Figure 1a).2 In addition, a large bimetallic catalyst library can be easily created through the combination of two different chiral metal catalysts, which is beneficial for stereocontrol in asymmetric synthesis.3 Furthermore, bimetallic catalytic systems consisting of two distinct chiral metal catalysts are able to provide a general and predictable route for the stereodivergent synthesis of target products bearing two stereocenters if each chiral metal catalyst can control the configuration of one stereocenter.4 | Chemistry | School of Chemistry and Chemical Engineering | huoxiaohong@sjtu.edu.cn |
| 48 | Xuzhou YAN | Organic synthesis; Supramolecular chemistry; two-dimensional materials | Toughening Graphene Films by Mechanical bonds | The fabrication of high-performance graphene films has aroused considerable attention due to their potential for practical applications. However, developing both stretchable and tough graphene films remains a formidable challenge. To address this issue, mechanical bond is expected to comprehensively improve the mechanical properties of graphene films. Under external force, the mechanical bond cross-link undergoes intramolecular motion, increasing the interlayer slip distance between graphene nanosheets. The obtained stretchable and tough graphene films are suitable for applications as flexible electrodes and stretchable electronics. | The pre-requisite of this project is to design and synthesize mechanically interlocked molecules (MINs) with specific functional groups. There are abundant functional groups on graphene surface, including carboxyl, hydroxyl, and epoxy groups. To cross-link MINs with graphene nanosheets, their functional groups need react effectively. | School of Chemistry and Chemical Engineering | xzyan@sjtu.edu.cn |
| 49 | Xizhong CHEN | AI for Science | Generative AI for Drug Formulation Microstructure Design | Microstructural characteristics and particle interactions are fundamental to the performance of pharmaceutical products, influencing properties such as flowability and dissolution kinetics. Traditional methods to address these complexities are often inefficient, requiring extensive experimental validation and suffering from information loss. In the present project, we will develop S2VGAN (2D slice-informed 3D Generative Adversarial Networks with UNet architecture), a novel system that synthesizes and optimizes drug formulation microstructures with remarkable efficiency and precision. | Some programming skills; High motivations | School of Chemistry and Chemical Engineering | chenxizh@sjtu.edu.cn |

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| 50 | Shuyu ZHANG | Organic electrochemistry; Organic synthesis | Application of Alternating Current Electrolysis in Organic Synthesis | Organic electrochemistry is an interdisciplinary field that merges organic chemistry with electrochemistry. It utilizes the electrons to replace the use of oxidants or reductants, earning the reputation as "one of the most effective, direct, and clean methods for achieving redox reactions." Alternating current (AC) electrolysis further broadens the boundaries of organic electrosynthesis. Characterized by polarity alternation and periodic reversal, it enables reactions that are difficult to achieve under traditional electrochemical conditions. This project aims to develop an AC electrolysis approach based on a carbon/nickel electrode system that fully utilizes the characteristic of polarity reversal and the properties of different electrodes, and applies it to the synthesis of intermediates of important natural products. | Completion of courses in organic chemistry, physical chemistry, and a solid foundation in organic chemistry experimentation. Candidates should also possess a high level of interest in scientific research. | School of Chemistry and Chemical Engineering | zhangsy16@sjtu.edu.cn |
| 51 | Jian YE | Biomedical engineering and AI | Development of AI models for SERSome metabolomics analysis | Metabolomics hold significant promise for the early diagnosis of diseases, which can identify specific biomarkers associated with disease onset. For more rapid and sensitive metabolomics analysis of the biofluids, SERSome (Cell Reports Medicine, 2024) technique has been recently proposed with advantages of low-cost, ultra-high throughput and single-molecule sensitivity. However, the complexity and volume of SERSome data pose significant analytical challenges. This project will focus on developing reliable AI models specialized for comprehensive SERSome metabolomics analysis. Deep learning architectures (e.g., convolutional neural networks, U-net) can extract latent feature information from massive data. By integrating cutting-edge AI methods with metabolomics, this project will pave the way for transformative advancements in early disease diagnosis and precision medicine. | (1) Background in artificial intelligence and clinical diagnosis; (2) Prerequisite of programming skills using Python and AI modelling using PyTorch; (3) Enthusiasm to advancing the in vitro diagnostics (IVD) techniques | School of Biomedical Engineering | yejian78@sjtu.edu.cn |
| 52 | Zhouhan LIN | Artificial Intellengence, Large Language Models, Natural Language Processing | New LLM Pretraining Scheme based on Self-supervised Learning | We are going to explore new paradigms in training large language models, by using various approaches in generative models. | familiar with machine learning basics, Transformer model, PyTorch. Prelimary understanding on some generative models such as GAN, VAE, VQ-VAE, diffusion models, NADE, etc. | School of Artificial Intelligence | hantek@sjtu.edu.cn |
| 53 | Jiang LU | Plant - pathogen interaction, plant inate immunity, grape - viticulture, plant molecular breeding | Towards to understanding the molecular mechnism of plant immunity against pathogens | During the infection of plant pathogen, an array of interactions between the pathogen and the host plant take place. This research is to focus on the molecular interactions between grapevine and oomycete pathogen Plasmopara viticola. | Biology, molecular biology | School of Agriculture and Biology | jiang.lu@sjtu.edu.cn |
| 54 | Ziyun WU | Biological aging, microorganism | Mechanism of lifespan extension by metformin in budding yeast Saccharomyces cerevisiae | Metformin is a well-known anti-aging compound that extends lifespan across various organisms. In this project, we will employ a high-throughput method to measure the chronological lifespan of yeast and identify potential genes that could counteract the longevity effects of metformin. | None | School of Agriculture and Biology | wuziyun@sjtu.edu.cn |
| 55 | Xiangwen GAO | Electrochemical Energy Storage | Achieving solid-state batteries with ultrahigh energy density based on sulfur conversion reaction | Traditional lithium-ion batteries have problems such as low energy storage density, high cost, and thermal runaway safety hazards. This project aims to develop sulfur-based solid-state batteries with high-capacity conversion cathode materials that can also achieve high safety, wide temperature operation range, and low cost. This project will use machine learning to quickly screen highly active atom-precision catalysts through high-throughput calculation methods and establish a gene database of transformation reaction catalysts; use multi-dimensional interface control engineering to improve transformation reaction kinetics; develop integrated high spatial and temporal resolution X-ray series images/diffraction to reveal the battery failure mechanism. | The student should have basic knowledge in materials, electronics, physics, chemistry or other related disciplines. The student should abide by academic ethics, be honest and trustworthy, and have a rigorous academic style, good communication, expression skills and teamwork spirit. | Global Institute of Future Technology | xiangwen.gao@sjtu.edu.cn |
| 56 | Daishun LING | Chemical biology ; Biomaterials ; Biomedical imaging | Chemical Design of Intelligent Biosensors for Medical Applications | Magnetic Resonance Imaging (MRI) offers distinct advantages, including non-ionizing radiation, high soft tissue resolution, and no depth penetration limitations, making it widely utilized in biomedical research. Recent advancements in high-field MRI technology have notably improved signal-to-noise ratio and spatial resolution, rendering it a powerful tool for disease diagnosis and therapy. This project aims to design and construct a series of intelligent MRI nanosensors responsive to different metal ions or biomolecules using chemical assembly strategies, establishing a novel technology for real-time dynamic monitoring of disease biomarkers in biological system based on high-field MRI. | Students majoring in chemistry, materials science, biomedical engineering, medicine, pharmacy, and related fields. | Frontiers Science Center for Transformative Molecules | dsling@sjtu.edu.cn |
| 57 | Ruohe YIN | Plant science, agriculture, horticulture | How plants deal with drought under strong sunlight?- Crosstalk between drought and sunlight in plants | Plant growth and productivity are challenged by various abiotic stresses. Drought and strong sunlight are two typical abiotic stresses. In nature, plants under drought are frequently also exposed to strong sunlight, suggesting the possible communications between these two environmental factors. Our experimental data indicate that plants use strong light as a warning signal for water-deficiency. In this project, we plan to use molecular and biochemical approaches to unravel the underlying mechanisms. | Interested in plant science and with good communication skills. | Department of Plant Science | ruohe.yin@sjtu.edu.cn |
| 58 | Zhangxin CHEN | Nanoelectronic devices, Nanomaterials | Black phosphorus field-effect transistors | Study on the fabrication and characteristics of high-quality phosphorene and its field-effect transistors | nanomaterials | Department of Micro/Nano Electronics | chen.c.x@sjtu.edu.cnc |

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| 59 | Weilong ZHENG | Artificial Intelligence, Brain-Computer Interfaces, Neural Decoding | Decoding Visual Perception from EEG Signals | Our visual experience in daily life is dominated by dynamic change. Decoding such dynamic information from brain activity can enhance the understanding of the brain's visual processing system. As a signal which directly reflects brain activity, electroencephalography (EEG) has been demonstrated to be a reliable and promising indicator of human mental state. In this project, we will investigate decoding visual perception using EEG and eye movement signals with diffusion models. Based on the existing research and datasets, the study aims to reconstruct vivid images or videos stimuli from brain activity. | 1. Interested students should have basic knowledge of machine learning and programming skills in Python. 2. Experience on Diffusion Model is preferred. | Department of Computer Science and Engineering | weilong@sjtu.edu.cn |