UNNC – SIMM, CAS Doctoral Training Partnership

It's essential that you have contacted the UNNC and/or SIMM supervisors before applying.

Formal applications should follow the instructions in 'How to apply' section.

Research areas

- Pharmaceutical science and related fields

Available PhD topics

PhD topic	**Study on the Interaction Between Gut Microbial Metabolites and GPCRs Associated with Intestinal Diseases**
SIMM Supervisor	Prof. Jia DUAN
UNNC Supervisor(s)	Dr Loh Teng-Hern Tan Prof. Dr Learn-Han Lee Dr Jodi Woan-Fei Law
Short introduction & description of PhD project	The gut microbiome plays a crucial role in enhancing host immunity, food digestion, intestinal endocrine function, drug metabolism, and influencing the production of host metabolites. Dysregulation of the gut microbiota and its metabolites is closely associated with the onset and progression of various intestinal diseases, such as inflammatory bowel diseases (IBD) represented by ulcerative colitis (UC) and Crohn's disease (CD), as well as colorectal cancer. The prevalence of these diseases poses a significant threat to global public health. Therefore, in-depth research into the pathogenesis of intestinal diseases and the identification of novel intervention strategies are of great scientific significance and social value for alleviating the burden of these diseases. In the gut, microbial metabolites and G-protein coupled receptors (GPCRs) are two key molecular entities. GPCRs play a crucial role in cellular signal transduction, while gut microbial metabolites, as intermediates in metabolic networks, participate in the synthesis and transformation of substances and regulate physiological functions. These metabolites can interact with intracellular signaling pathways through GPCRs, modulating energy metabolism, hormone secretion, and cellular functions, thereby profoundly impacting gut metabolic homeostasis. Therefore, systematically identifying the interactions between gut microbial metabolites and GPCRs associated with intestinal diseases, and elucidating their regulatory mechanisms, will contribute to a better understanding of the pathophysiological processes of gut diseases and provide a scientific basis for disease intervention.

	GPCRs play a central role in the regulation of intestinal diseases. For example, the activation of receptors such as Sphingosine-1-phosphate receptor 1 (S1P1) and C-C Motif Chemokine Receptor 9 (CCR9) can influence downstream signaling pathways, playing a critical role in the regulation of intestinal inflammation. S1P1 receptor agonists, such as Fingolimod, have been shown to improve intestinal inflammation and alleviate IBD symptoms in clinical studies. Mogamulizumab, an anti-CCR9 antibody, has been evaluated in clinical trials for the treatment of IBD. It reduces the aggregation of immune cells in the gut by inhibiting the CCR9 receptor, thereby alleviating intestinal inflammation. These cases highlight the significant role of GPCRs as drug targets in the treatment of intestinal diseases. At the same time, microbial metabolites in the gut, as important regulatory factors in metabolic networks, have gained increasing attention for their regulatory effects on GPCRs. For instance, the interaction between Enterococcus-derived tyramine and the α2A-adrenergic receptor (ADRA2A) can activate G-protein signaling in intestinal stem cells (ISCs), inhibiting ISC proliferation and exacerbating colitis. On the other hand, the secondary bile acid LCA, produced by gut microbes, can alleviate colitis by activating TGR5. Although numerous studies have been conducted on the interactions between specific GPCRs and small molecule metabolites, there remains a lack of comprehensive systematic screening and identification of the interactions between glycolipid metabolism-related GPCRs and small molecule metabolites. This limitation restricts our full understanding of the regulatory mechanisms underlying intestinal diseases. Although research on the interactions between metabolites and GPCRs has made certain progress, it has mainly focused on the interaction between individual GPCRs and ligands, primarily relying on traditional molecular biology and pharmacological approaches. There is a lack of multidimensional and multilevel integrative studies. With the rapid development of biotechnology, the application of high-throughput screening technologies and structural biology techniques has provided technical support for identifying interactions between gut microbial metabolites and GPCRs. In this project, GPCR receptors associated with intestinal diseases will be screened using high-throughput screening platforms such as the PRESTO-Tango GPCR Assay to investigate the interactions of receptors and gut microbial-derived metabolites. Finally, the role of the interaction between gut microbial metabolites and GPCRs in intestinal diseases will be validated in a mouse model.
Contact points	Informal inquiries may be addressed to Dr Loh Teng-Hern Tan (Loh-Teng-Hern.Tan@nottingham.edu.cn) and Prof. Jia DUAN (duanjia@simm.ac.cn).
PhD topic	**To explore the pathogenesis of cardiovascular diseases and find new therapeutic targets based on modern medical biotechnology. This will encompass, drug screening, developing novel drug delivery systems, and evaluating biological mechanisms for the treatment of cardiovascular diseases**
SIMM Supervisor	Prof. Hanbin Lin
UNNC Supervisor(s)	Prof. Yong Ren
Short introduction & description of PhD project	Cardiovascular disease is a prevalent and progressively worsening condition, with its incidence and death rates consistently rising and affecting individuals at younger ages. Currently, cardiovascular disease has surpassed cancer as a leading cause of mortality globally. This underscores the importance of exploring the

	pathological mechanism and developing new therapeutic targets to aid the diagnosis, prognosis, and treatment of cardiovascular diseases. As such, our study will aim to investigate pathological mechanisms of cardiovascular disease and develop new therapeutic targets and drug delivery systems via technologies including microfluidics. This will encompass the utilization of multi-omics and molecular biotechnology to examine and validate novel targets and biological mechanisms of cardiovascular diseases. In vivo and in vitro models will be established to study the biological mechanisms of cardiovascular disease through cardiac function, including histopathological changes, and myocardial enzymes. Furthermore, novel therapeutic targets will used to evaluate the attenuation of cardiovascular disease in vitro and in vivo. In addition, our study will investigate novel drug delivery systems to improve drug bioavailability and achieve targeted treatment of cardiovascular diseases. This major involves pharmacodynamics, pharmacology, histopathology, materials science, nanomedicine pharmaceutics, and other disciplines. Candidates should be self-motivated and have a strong background in pharmacology, pathology, or materials science. This Ph.D. program is multi-disciplinary, which covers broad fields of pharmacology, pharmacodynamics, pharmaceutics, and histopathology and materials science. The potential candidate should be self-motivated and have strong background in material sciences, pharmacological sciences or pathological sciences.
Contact points	Informal inquiries may be addressed to Prof. Hanbin Lin (linhanbin@simm.ac.cn), and Prof. Yong Ren (Yong.ren@nottingham.edu.cn).
PhD topic	**Using our gene editing tools, we target potential therapeutic targets for cardiovascular diseases. Additionally, we are integrating advanced technologies such as microfluidics to create new drug delivery systems. Our goal is to develop more effective gene therapy strategies that provide significant benefits to patients.**
SIMM Supervisor	Prof. Hui Yang
UNNC Supervisor	Prof. Yong Ren
Short introduction & description of PhD project	Cardiovascular disease (CVD) is a prevalent and increasingly severe health issue, characterized by a continuous rise in both incidence and mortality rates. Alarmingly, it is now affecting younger populations more than ever before. Currently, CVD has surpassed cancer as the leading cause of death worldwide. This alarming trend underscores the critical need to explore the pathological mechanisms underlying these diseases and to develop novel therapeutic targets that can aid in the diagnosis, prognosis, and treatment of cardiovascular conditions. Our research aims to leverage self-developed gene editing tools to target potential pathways involved in CVD. We intend to utilize microfluidic technologies to create new drug delivery systems that enhance the efficacy of treatments. By establishing both in vivo and in vitro models through gene editing techniques, we will investigate the biological mechanisms of cardiovascular disease, focusing on cardiac functions that include histopathological changes and myocardial enzymes. Additionally, we will conduct comprehensive evaluations of animals following gene editing therapies to assess their effects.

	Furthermore, we will develop innovative drug delivery systems designed to improve the bioavailability of medications and facilitate targeted therapies for cardiovascular disease. This multifaceted approach encompasses various disciplines, including pharmacodynamics, pharmacology, histopathology, materials science, and nanomedicine. Candidates for this doctoral program should demonstrate ambition and possess a strong background in pharmacology, pathology, or materials science. This interdisciplinary program spans a broad range of fields, including pharmacology, pharmacodynamics, pharmaceutical sciences, histopathology, and materials science, making it essential for applicants to have a solid foundation in these areas.
Contact points	Informal inquiries may be addressed to Prof. Hui Yang (yanghui@simm.ac.cn), and Prof Yong Ren (Yong.ren@nottingham.edu.cn).
PhD topic	**Microfluidic System-based High-throughput Transcriptome Sequencing In Drug Screening**
SIMM Supervisor	Dongxin Zhao
UNNC Supervisor(s)	Yong Ren
Short introduction & description of PhD	High-throughput screens combined with transcriptome profiling represent a transformative approach for drug discovery by enabling the generation of rich, multidimensional phenotypic data. This methodology supports the evaluation of drug mechanisms, the identification of potential therapeutic targets, and the prediction of adverse side effects. Traditionally, high-throughput screens have relied on plate-based platforms. While effective, these platforms are limited in throughput and scalability. In this project, we aim to enhance the throughput of drug screening by integrating microfluidic systems with single-cell sequencing. This integration will allow us to investigate transcriptomic responses to specific compounds in thousands of individual cells. To achieve this, we will encapsulate cells and compounds within microscopic droplets, alongside beads conjugated with oligonucleotides carrying unique DNA barcode sequences. These barcodes will serve as identifiers for each compound, enabling precise tracking of chemical perturbations and their effects on cellular transcriptomes. This innovative strategy will allow for high-resolution mapping of compound-induced transcriptional changes at the single-cell level. The overarching goal of this project is to develop a next-generation high-throughput chemical screening platform for studying cellular responses to specific drug treatments. This project brings together an interdisciplinary team with expertise spanning mechanical engineering, pharmacology, and cell biology. Ph.D. students joining our team will work in a dynamic, collaborative environment, leveraging cutting-edge microfluidic technologies to make significant contributions to drug discovery and the development of innovative therapeutic solutions.
Contact points	Informal inquiries may be addressed to Prof Yong Ren (Yong.ren@nottingham.edu.cn) and Dr Dongxin Zhao (zhaodongxin@simm.ac.cn).
Contact points	Informal inquiries may be addressed to Prof. Hanbin Lin (linhanbin@simm.ac.cn), and Dr. Yong Ren (Yong.ren@nottingham.edu.cn).

Other potential supervisors

UNNC	
Profile	**Email**
Di Hu	di.hu@nottingham.edu.cn
SIMM, CAS	
Profile	**Email**
CHENG Ming	chengming@simm.ac.cn
ZHOU Yingsi	yingsizhou@simm.ac.cn
TONG Huawei	tonghuawei@simm.ac.cn
SHEN Jingshan	shenjingshan@simm.ac.cn
LI Jingya	jyli@simm.ac.cn
DING Kan	dingkan@simm.ac.cn
JIANG Xiangrui	jiangxiangrui@simm.ac.cn
XU Yechun	ycxu@simm.ac.cn
XUAN Lijiang	ljxuan@simm.ac.cn
HUANG Yongzhuo	yzhuang@simm.ac.cn
WANG Yujun	yjwang@simm.ac.cn
ZHOU Yupeng	zhouyupeng@simm.ac.cn
XU Zhijian	zjxu@simm.ac.cn
XU Baofu	bfxu@simm.ac.cn