课程详述

COURSE SPECIFICATION

以下课程信息可能根据实际授课需要或在课程检讨之后产生变动。如对课程有任何疑问，请联系授课教师。

The course information as follows may be subject to change, either during the session because of unforeseen circumstances, or following review of the course at the end of the session. Queries about the course should be directed to the course instructor.

1.	**课程名称 Course Title**	量子信息科学前沿 Frontier of Quantum Information Science
2.	**授课院系 Originating Department**	物理系 Department of Physics
3.	**课程编号 Course Code**	PHYS008
4.	**课程学分 Credit Value**	1
5.	**课程类别 Course Type**	专业选修课 Major Elective Courses
6.	**授课学期 Semester**	夏季学期 Summer
7.	**授课语言 Teaching Language**	中英双语 English & Chinese
8.	**授课教师、所属学系、联系方式（如属团队授课，请列明其他授课教师）Instructor(s), Affiliation& Contact（For team teaching, please list all instructors）**	翁文康，副教授，物理系 慧园 1 栋 506 Man-Hong Yung, Associate Professor, Department of Physics Rm.506, No.1 Wisdom Valley. yung@sustc.edu.cn 0755-88018276 陈远珍，助理教授，物理系 第二科研楼 120 Yuanzhen Chen, Assistant professor, Department of Physics Rm.120, Faculty Research Building 2 chenyz@sustech.edu.cn 0755-88018226 辛涛，助理研究员，量子科学与工程研究院 创园一栋 502 Tao Xin, Assistant Researcher, Institute for Quantum Science and Engineering Rm.502 ,No.1, Innovation Park xint@sustech.edu.cn 15510012787 张君华，助理研究员，量子科学与工程研究院 创园一栋 506 Junhua Zhang, Assistant Researcher, Institute for Quantum Science and Engineering Rm.506 ,No.1, Innovation Park zhangjh6@sustech.edu.cn

		18500612191 李俊，副研究员，量子科学与工程研究院 创园一栋 502 Jun Li，Associate Researcher，Institute for Quantum Science and Engineering Rm.502, No.1, Innovation park lij3@sustech.edu.cn 15911136927 邓修豪，副研究员，量子科学与工程研究院 台州楼 502-17 Xiuhao Deng，Associate Researcher，Institute for Quantum Science and Engineering Rm.502-17, Taizhou Hall dengxh@sustech.edu.cn 13122057602 吴志刚，副研究员，量子科学与工程研究院 创园一栋 502 Zhigang Wu，Associate Researcher，Institute for Quantum Science and Engineering Rm.502, No.1, Innovation park wuzg@sustech.edu.cn 18310117781 范靖云，研究员，量子科学与工程研究院 创园一栋 504 Jingyun Fan, Researcher, Institute for Quantum Science and Engineering Rm.504, No.1, Innovation park fanjy@sustech.edu.cn 18918302002
9.	实验员/助教、所属学系、联系方式 Tutor/TA(s), Contact	待公布 To be announced
10.	选课人数限额(可不填) Maximum Enrolment（Optional）	

11. 授课方式 Delivery Method / 学时数 Credit Hours

讲授 Lectures	习题/辅导/讨论 Tutorials	实验/实习 Lab/Practical	其它(请具体注明) Other（Please specify）	总学时 Total
16	0	0	0	16

12.	先修课程、其它学习要求 Pre-requisites or Other Academic Requirements	量子力学 I （PHY206-15）/ Introduction to Quantum Mechanics （PHY206-15）
13.	后续课程、其它学习规划 Courses for which this course is a pre-requisite	
14.	其它要求修读本课程的学系 Cross-listing Dept.	

教学大纲及教学日历 SYLLABUS

15. 教学目标 Course Objectives

此课程重点将学生带向量子信息研究的最前沿，本课程主要目的是介绍量子信息领域的主要思想和基本方法，同时讲授该

领域最新的研究成果，使学生打下扎实的基础，为进一步在量子信息及其相关方面的研究做准备。

The focus of this course is to guide students to the forefront of quantum information. The main purpose of this course is to introduce the main ideas and basic methods in the field of quantum information, and to teach the latest research results in this field, so that students can lay a solid foundation for further quantum. Prepare for research on information and related aspects.

16. 预达学习成果 Learning Outcomes

通过学习本课程，可以是学生掌握量子信息的基本知识，了解该领域研究的基本方法和量子信息理论最基本的结果，利用最新成果的介绍为学习者提供好的研究题目。

After studying this course, students can master the basic knowledge of quantum information, understand the basic methods of research in this field and the most basic results of quantum information theory, and use the introduction of the latest results to provide learners with good research topics.

17. 课程内容及教学日历 （如授课语言以英文为主，则课程内容介绍可以用英文；如团队教学或模块教学，教学日历须注明主讲人）
Course Contents (in Parts/Chapters/Sections/Weeks. Please notify name of instructor for course section(s), if this is a team teaching or module course.)

1， 主讲人：翁文康

介绍量子信息科学前沿基本概念 Introducing the basic concepts of quantum information science

2， 主讲人：陈远珍

主题：超导量子计算实验介绍 Introduction to superconducting quantum computing experiment

主要内容：超导量子计算实验的简要发展历史，超导量子线路中的量子现象，超导量子比特的类型和原理，典型超导量子比特的模型，制备，测量等信息

A brief history of superconducting quantum computing experiments, quantum phenomena in superconducting quantum circuits, types and principles of superconducting qubits, models of typical superconducting qubits, preparation, measurement, etc.

3， 主讲人：张君华

主题：囚禁离子量子计算平台的基本原理和实验技术 Basic Principles and Experimental Techniques of the Imprisoned Ion Quantum Computing Platform

主要内容：包括囚禁离子的方法、激光冷却技术、囚禁离子量子比特的表示与基本操作、多离子纠缠的方案、囚禁离子量子计算平台的优势与挑战。

The main contents of this course include the method of trapping ions, laser cool technology, representation and basic operation of trapping ion qubits, scheme against multi-ion entanglement, and advantages and challenges of quantum ion computing platform.

4， 主讲人：李俊

主题：量子调控 Quantum regulation

主要内容：从经典控制到量子控制，量子控制在量子信息中的广泛应用，量子控制的建模、方法与数值技术，量子控制的挑战。介绍实例的时候，结合核磁共振实验体系

From classical control to quantum control, quantum control is widely used in quantum information, quantum control modeling, methods and numerical techniques, and quantum control challenges. When introducing examples, combined with nuclear magnetic resonance experimental system.

5， 主讲人：辛涛

主题：核磁共振量子计算平台的基本原理及其量子计算云平台 The basic principle of NMR quantum computing platform and its quantum computing cloud platform

主要内容：NMR 实现量子计算的基本原理、包括初始化技术、比特操控技术、门操作实现技术以及态读出技术；基于 NMR 系统的可开放控制地层的量子云平台开发；以及 NMR 在量子计算领域所取得的进展。

NMR implements the basic principles of quantum computing, including initialization techniques, bit manipulation techniques, gate operation implementation techniques, and state readout techniques; quantum cloud platform development based on NMR systems for open control of formations; and advances in NMR in the field of quantum computing.

6， 主讲人：邓修豪

主题：超导量子计算理论 Theory of Superconducting quantum computing

主要内容：量子比特实现，包括超导量子比特等固态量子比特及跨系统互联、量子网络、光机械、量子纠错码

Quantum bit implementation, including solid-state qubits such as superconducting qubits and cross-system interconnects, quantum networks, optomechanics, and quantum error correction codes

7， 主讲人：吴志刚

主题：中性原子量子计算简介 Introduction to Neutral Atomic Quantum Calculation

主要内容：原子的囚禁与冷却，单比特门和双比特门的实现，里德伯原子量子门，中性原子量子计算近期发展

Atomic imprisonment and cooling, single-bit gate and double-bit gate implementation, Rydberg atomic quantum gate, neutral atom quantum computing recent development

8， 主讲人：范靖云

主题：量子精密测量 Quantum precision measurement

主要内容：误差—扰动型测不准关系

Error-disturbance type uncertainty relationship

18. 教材及其它参考资料 Textbook and Supplementary Readings

自编教材

课程评估 ASSESSMENT

19. 评估形式	评估时间	占考试总成绩百分比	违纪处罚	备注

Type of Assessment	Time	% of final score	Penalty	Notes
出勤 Attendance		100%		
课堂表现 Class Performance				
小测验 Quiz				
课程项目 Projects				
平时作业 Assignments				
期中考试 Mid-Term Test				
期末考试 Final Exam				
期末报告 Final Presentation				
其它（可根据需要改写以上评估方式） Others (The above may be modified as necessary)		本课程为考查性质。成绩为通过和不通过两种。		

20. 记分方式 **GRADING SYSTEM**

☐ A. 十三级等级制 **Letter Grading**
☑ B. 二级记分制（通过/不通过） **Pass/Fail Grading**

课程审批 REVIEW AND APPROVAL

21. **本课程设置已经过以下责任人/委员会审议通过**
This Course has been approved by the following person or committee of authority

物理系教学指导委员会
Education Instruction Committee of Physics department