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**	半导体量子科技 Semiconductor quantum technologies
2.	**授课院系 Originating Department**	物理系 Department of Physics
3.	**课程编号 Course Code**	PHYS009
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 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）**	丁飞，教授，量子科学与工程研究院 慧园 1 栋 508 Dingfei, Professor, Shenzhen Institute for Quantum Science and Engineering(SIQSE) Room 508, No.1 Wisdom Valley f.ding@fkp.uni-hannover.de 0755-88018234
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**
9	7 （分组讨论）			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)，固体物理(PHY321-15)
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**

This course will discuss semiconductor based quantum technologies. After the lecture, the students shall be familiar with the basic semiconductor engineering techniques and the spectroscopy techniques. More importantly, they will learn about the latest development of semiconductor based quantum light sources and their potential applications in quantum communication technologies.

16. **预达学习成果 Learning Outcomes**

The students will have an overview of the latest development in the field and understand the challenges in photonic based quantum communications. This helps them to choose advanced lectures, and further, to choose future research projects.

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.)

Part I: Introduction to semiconductor engineering techniques

- Characterization at the nanoscale (2 credit hours)
- Fabrication at the nanoscale (2 credit hours)
- Group discussion (2 credit hours)

Part II: Semiconductor nano- and quantum photonics

- Brief overview of photonics (2 credit hours)
- Optical microcavities with semiconductors (1 credit hour)
- Group discussion (2 credit hours)

Part III: Semiconductor based quantum light sources

- Introduction to photonic quantum communication (1 credit hour)
- Single and entangled photons: fundamental and applications (1 credit hour)
- Group discussion (3 credit hours)

第一章: 半导体工程技术简介

- 纳米尺度的表征技术（2 学时）
- 纳米尺度的器件制备（2 学时）
- 分组讨论（2 学时）

第二章：半导体纳米及量子光学

- 光子学基础简单回顾（2 学时）
- 半导体光学微腔（1 学时）
- 分组讨论（2 学时）

第三章：半导体量子光源

- 量子光通讯技术简介（1 学时）
- 单光子、纠缠光子源简介及其应用（1 学时）
- 分组讨论（3 学时）

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

1. Peter Michler “Single Semiconductor Quantum Dots”
2. Peter Michler “Quantum Dots for Quantum Information Technologies”
3. Nature Communications 9, 2994 (2018) Highly efficient extraction of entangled photons from quantum dots using a broadband optical antenna
4. Nature Communications 8, 15501 (2017) Solid-state ensemble of highly entangled photon sources at rubidium atomic transitions
5. Nature Materials 16, 982 (2017) Measurement of the spin temperature of optically cooled nuclei and GaAs hyperfine constants
6. Nature Communications 7, 10387 (2016) Wavelength-tunable entangled photons from silicon-integrated III-V quantum dots
7. Nature Communications 6, 10067 (2015) High yield and ultrafast sources of entangled-photons based on strain-tunable QDs

课程评估 ASSESSMENT

19.

评估形式 Type of Assessment	评估时间 Time	占考试总成绩百分比 % of final score	违纪处罚 Penalty	备注 Notes
出勤 Attendance		60%		
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**		40%		
其它（可根据需要改写以上评估方式） **Others (The above may be modified as necessary)**				

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