课程大纲
COURSE SYLLABUS

1.	**课程代码/名称** **Course Code/Title**	**冷原子物理 Cold Atom Physics**
2.	**课程性质** **Compulsory/Elective**	专业选修课 Degree Optional Course
3.	**课程学分/学时** **Course Credit/Hours**	3/48
4.	**授课语言** **Teaching Language**	英文 English
5.	**授课教师** **Instructor(s)**	郭鸣阳 Mingyang Guo
6.	**是否面向本科生开放** **Open to undergraduates or not**	是 Yes
7.	**先修要求** **Pre-requisites**	（如面向本科生开放，请注明区分内容。 If the course is open to undergraduates, please indicate the difference.） 原子物理 / Atomic Physics PHY210 量子力学 I 和 II / Quantum Mechanics I & II PHY 206 and PHY 305
8.	**教学目标** **Course Objectives**	
	（如面向本科生开放，请注明区分内容。 If the course is open to undergraduates, please indicate the difference.） 冷原子物理是现代原子分子光物理的一个非常重要且活跃的分支。它已经成为精密测量、探索新奇量子物质态和实现量子传感，量子模拟及量子计算的前沿研究领域。本课程的教学目标如下： 1. 利用基本的量子力学知识让学生深入理解原子的能级结构； 2. 介绍基本光与原子，原子与原子之间的相互作用，并引导学生利用这些知识解决实际实验问题； 3. 介绍冷原子物理中基本的物理原理和机制，以及如何在现实实验研究中实现和应用它们； 4. 介绍当前冷原子物理中的前沿研究和最新进展。 Cold atom physics is an important and exotic branch in modern Atomic, Molecular and Optical Physics. It has become a frontier research area to realize precision measurement, search novel quantum phases, and implement quantum sensing, simulation and computation. This course aims to guiding the students to reach the following objectives: 1. Utilizing fundamental knowledge of quantum mechanics to understand the energy structures of atoms. 2. Introducing basic interactions of light-atom and atom-atom, guiding the students to use the knowledge to solve real-world problems. 3. To Understand the basic physical principles of cold atom physics and how to implements them in real cutting-edge experiments. 4. Introducing to the most recent progress and exotic topics in cold atom physics.	
9.	**教学方法** **Teaching Methods**	
	（如面向本科生开放，请注明区分内容。 If the course is open to undergraduates, please indicate the difference.） 授课为主，兼用课堂讨论、专题调研和汇报等方式 Mainly by lecture talks, combined with class discussion, topic study and presentation	
10.	**教学内容** **Course Contents** （如面向本科生开放，请注明区分内容。 If the course is open to undergraduates, please indicate the difference.）	

Section 1	冷原子物理简介 Introduction to cold atom physics
Section 2	氢原子和类氢原子的能级结构：精细和超精细结构 Energy structures of H and H-like atoms: from electronic to FS, HFS
Section 3	外场下的类氢原子：塞曼和斯达克效应 H and H-like atoms in external fields: Zeeman and Stark effect
Section 4	原子与光的相互作用 I: 经典描述 Interaction between light and atom I: the classical discription
Section 5	原子与光的相互作用 I: 半经典方法 Interaction between light and atom II: the semi-classic approach
Section 6	原子激光光谱 Atomic laser spectroscopy
Section 7	激光冷却和陷俘 Laser cooling and trapping
Section 8	原子与原子的相互作用：超冷碰撞和蒸发冷却 Atom-Atom interactions: ultracold scattering and evaporative cooling
Section 9	玻色爱因斯坦凝聚和简并费米气体 Bose-Einstein condensation and degenerate Fermi gas
Section 10	（超）冷原子物理前沿 Frontiers in (ultra)cold atom physics

11. 课程考核
Course Assessment

（①考核形式 Form of examination；②.分数构成 grading policy；③如面向本科生开放，请注明区分内容。If the course is open to undergraduates, please indicate the difference.）

30% reports or presentation; 35% assignment; 35% middle-term examination and quiz

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

Atomic Physics, Christopher J. Foot (2005)
Laser Cooling and Trapping, Harold J. Metcalf and Peter van der Straten (1999)
Dan Steck's Quantum Optics notes (2007), free to download online
原子的激光冷却与陷俘，王义遒 (2007)
Bose-Einstein Condensation in Dilute Gases (2008), for promotion reading