

Course number		U-LAS70 10002 SE50					
Course title (and course title in English)	ILAS Seminar-E2 :The wonderful world of quantum physics (素晴らしい量子物理の世界)		Instructor's name, job title, and department of affiliation	Graduate School of Science Associate Professor,PETERS,Robert			
	ILAS Seminar-E2 :The wonderful world of quantum physics						
Group	Seminars in Liberal Arts and Sciences		Number of credits	2	Number of weekly time blocks	1	
Class style	seminar (Face-to-face course)		Year/semesters	2025・First semester		Quota (Freshman)	15 (15)
Target year	Mainly 1st year students	Eligible students	For all majors		Days and periods	Mon.5	
Classroom	Seminar room 23, ILAS Bldg.				Language of instruction	English	
Keyword	quantum mechanics / particles and wave / quantum phenomena / quantum computing						
[Overview and purpose of the course]							
We will start with an introduction of crucial experiments 100 years ago, which have changed the beliefs of physicists about small particles and atoms. From there, we will understand the differences between the macroscopic and microscopic worlds and the basic concepts of modern quantum theory. In the second part of the course, we will look at quantum phenomena and their applications, such as quantum teleportation, quantum computing, entanglement, magnetism, and superconductivity. In principle, this course is given in English. However, if there are parts that the students cannot understand in English, I can and will explain those in Japanese. まず、小さな粒子や原子に関する物理学者の概念を変えた、100年前の重要な実験の紹介から始める。そこから、巨視的な世界と微視的な世界の違いや、現代の量子論の基本概念の理解を目指す。講義の後半では、量子テレポーテーション、量子コンピューティング、量子エンタングルメント、磁性、超伝導などの量子現象とその応用について見ていく。 講義は原則として英語で行う。ただし、英語で理解できない部分があれば、日本語で説明することも可能。							
[Course objectives]							
- Catching a glimpse of the bizarre behavior of the quantum world. - Seeing the differences between the macroscopic and microscopic worlds - Becoming familiar with the basic concepts of quantum physics - Revealing the mysteries behind quantum computing, quantum teleportation, and quantum phenomena such as magnetism, superconductivity, and entanglement.							
- 量子の世界の奇妙な振る舞いを垣間見る。 - 巨視的世界と微視的世界の違いを見る							
Continue to ILAS Seminar-E2 :The wonderful world of quantum physics (素晴らしい量子物理の世界) (2)↓↓↓							

- 量子物理学の基本概念に慣れる
- 量子コンピューティング、量子テレポーテーション、磁性、超伝導、エンタングルメントなどの量子現象に隠された謎を解き明かす。

[Course schedule and contents]

The course will be adapted to the level of the students. Therefore, the number of weeks may change.

- Introduction to experiments on atoms and quantum particles which have changed the beliefs of physicists 100 years ago (4-6 weeks)
 - light as wave and particle
 - electrons as waves
 - double-slit experiment for electrons
 - the development of modern quantum mechanics
 - Heisenberg uncertainty-principle
 - why quantum mechanics is weird
- Applications of quantum phenomena (3-4 weeks)
 - quantum tunneling
 - quantum teleportation
 - quantum computing
- Quantum phenomena in atoms, molecules, and larger bodies (5-7 weeks)
 - atoms
 - why more is different (many-body physics)
 - molecules
 - superconductivity
 - magnetism

Total : 14 classes, 1 Feedback class.

* 15 lectures per semester(two credits) including a class for feedback

受講者のレベルに合わせて授業を進めるので、状況により変更する場合がある。

- 100年前の物理学者の常識を覆した原子や電子に関する実験の紹介 (4~6週間)
- 波動と粒子としての光
- 波動としての電子
- 電子の二重スリット実験
- 現代の量子力学の発展
- ハイゼンベルクの不確定性原理
- 量子力学が奇妙な理由
- 量子現象の応用 (3-4週間)
- 量子トンネリング
- 量子テレポーテーション
- 量子コンピューティング

- 原子、分子、より大きな体における量子現象 (5-7週間)

- 原子
- なぜ異なるのか (多体物理学)
- 分子
- 超伝導
- 磁性

全14クラス、フィードバッククラス1クラス。

[Course requirements]

None

[Evaluation methods and policy]

Attendance and participation (50%), assignment (50%)

出席と参加の状況 (50%)、課題(50%)

[Textbooks]

Not used

[References, etc.]

(References, etc.)

Introduced during class

[Study outside of class (preparation and review)]

The students should read texts about quantum phenomena. The texts that I will hand out will help to understand the contents of the class and provide the background for discussions during the lecture.

量子現象に関するテキストを読んでおくこと。配布するテキストは、授業の内容を理解する助けとなり、講義中の議論の背景となる。

[Other information (office hours, etc.)]

Office hours: After the course

オフィスアワーは 講義終了後