

Course number	U-LAS70 10002 SE50				
Course title (and course title in English)	ILAS Seminar-E2 :How to Study Atoms and Molecules with the Help of Light (光を使って原子や分子を調べる) ILAS Seminar-E2 :How to Study Atoms and Molecules with the Help of Light		Instructor's name, job title, and department of affiliation	Graduate School of Science Associate Professor,THUERMER, Stephan	
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 ・ Second semester		Quota (Freshman) 15 (15)
Target year	Mainly 1st year students	Eligible students	For all majors		Days and periods Tue.5
Classroom	23, Yoshida-South Campus Bldg. No. 1			Language of instruction	English
Keyword	Photon science / Colors / Laser / Molecule properties / Spectroscopy				

[Overview and purpose of the course]

Light lets you see and get to know the world around you. But we can only see a very small part of all the ‘ light ’ and it is impossible to see atoms and even big molecules with your eyes. In this seminar we will learn how different forms of light are used in physics and chemistry to ‘ see ’ the atoms, molecules, distant stars and the world around us. We will learn the fundamentals of light, get to understand light phenomena in your daily life and see how light can be used as a measurement tool in natural sciences. Students with any major are welcome.

可視光は私達の視覚に不可欠ですが、光あるいは電磁波は様々な波長やエネルギーを持ちます。電磁波は、原子や分子の構造や性質を調べる上で、最も強力な手段であり、分光学と呼ばれる手法は物理、化学、生物、工学のあらゆる分野で必要です。このセミナーでは、光の基礎的な性質から原子や分子を調べる方法までの基礎を、英語で学んでいきます。

[Course objectives]

Students will gain the following from this seminar:

- Interest and fun to learn more about phenomena in nature and study topics on their own.
- Knowledge about light as a measurement tool in chemistry, (astro-)physics and biology.
- The ability to understand difficult theoretical and ‘ invisible ’ phenomena in an intuitive way.
- The ability to express their ideas, discuss and present topics of natural sciences in English.

光の性質、光の吸収や散乱を利用した原子や分子の研究方法を学びながら、英語で科学を学習したり議論するスキルを身につける。

[Course schedule and contents)]

This seminar is held in a causal and interactive way! Students can influence the selection of topics based on their interest!

The course will work though fundamentals of light, the interaction of light with materials, and methods of spectroscopy, which include the following topics. The plan below is not strict and rather serves as a guideline.

1. Introduction - What is light and how to use it? (4 weeks)

We will learn about ' light ', its fundamentals and properties such as ' color ' and how we can make use of light as a measurement tool.

2. Apples are red and water is blue? (3 weeks)

We get to know light ' s behavior when interacting with different materials. We learn about the ' spectrum ' and the basics of spectroscopy. This knowledge answers questions like ' why do things have color? ' or ' what can we learn about distant stars? '

3. Laser beams and rainbows (4 weeks)

We see how light is generated in light bulbs, lasers and other light sources. This light then can be selected, modified and redirected with the help of various spectroscopic tools. The same knowledge helps us to understand light phenomena in daily life such as rainbows, anti-reflective glasses or mirrors.

4. Dancing molecules (3 weeks)

We learn how light interacts with atoms and molecules (and induces molecular vibration and rotation in the process), and what this tells us about the shape and properties of molecules. This knowledge is a first look into chemical analysis and studying fundamental physics questions.

5. Feedback and presentation (1 week)

Depending on the available time and interest of the students, we may also discuss the use of light in technical applications and astronomy as well as spectroscopic methods in physics and chemistry or the operation principles of advanced spectroscopic devices.

[Course requirements]

None

[Evaluation methods and policy]

Preparing homework (30%)

Small exercises during the seminar (30%)

Giving a short presentation at the end of the seminar (40%)

[Textbooks]

Not used

No textbook is used. Lecture notes will be provided during class.

[References, etc.]

(References, etc.)

Ian A. Walmsley 『Light: A Very Short Introduction』 (Oxford University Press) ISBN:9780199682690 (A good read about light, which is the basis of most spectroscopies)

Simon Duckett, Bruce Gilbert, Martin Cockett 『Foundations of Molecular Structure Determination』 (Oxford University Press) ISBN:9780199689446 (This compact book gives a good overview over all relevant spectroscopic methods to study molecules)

J. Michael Hollas 『Modern Spectroscopy』 (Wiley) ISBN:9780470844168 (A more in-depth book about spectroscopy in general)

[Study outside of class (preparation and review)]

Students are expected to review the lecture handouts after each class and look up unknown English terms themselves. Homework assignments need to be prepared before the next lecture. It is also encouraged to refer to additional sources of information (books, websites) for the specific topics. If something is unclear or difficult, the instructor can be asked at any time.

[Other information (office hours, etc.)]

The lectures will be held in English, but some supporting material and explanations are also given in Japanese. Students are welcome to ask questions in English or Japanese during and after the class. Office hours are flexible. Appointments can be made directly or via email.

[Essential courses]