

# Modern Physics



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教授簡介	<p><b>Experience:</b>          Oct. 2009 ~ Sep. 2015, Department Director/Chief Technical Research Fellow, Materials &amp; Energy Technology Laboratories, Sharp Labs of Tokyo, Japan.          Oct. 2002 ~ Sep. 2009, Senior Research Scientist Fellow, Hitachi Displays, Ltd., Japan          Oct. 2006 ~ Sep. 2009, Adjunct Professor, Department of Physics, Sogang University, Korea          Sep. 2005 ~ Dec. 2009, Visiting Research Fellow, FOM Institute for Atomic and Molecular Physics, Amsterdam, Netherlands          Oct. 2004 ~ Mar. 2008, Senior Research Scientist Fellow, Japan Science &amp; Technology Agency, SORST: Solution Oriented Research for Science and Technology, Liquid Crystal Nano-system Project, Tsukuba, Japan          Feb. 2002 ~ Sep. 2004, Research Scientist Fellow, Japan Science &amp; Technology Agency, ERATO: Exploratory Research for Advanced Technology, Yokoyama Nano-structured Liquid Crystal Project, Tsukuba, Japan          Mar. 1996 ~ Sep. 2002, Senior Research Scientist Fellow, Display Group of Hitachi Ltd., Japan          Nov. 1998 ~ Oct. 2000 and June 2001~July 2001, Visiting Research Fellow, Department of Physics, University of California, Berkeley, USA          April 1989 ~ Feb. 1996, Research Scientist Fellow, Hitachi Research Laboratory, Hitachi Ltd., Japan</p> <p><b>Education:</b>          March 1998, PhD, Department of Chemistry, Tokyo Institute of Technology, Japan          April 1987~March 1989, MS, Department of Chemistry, Tokyo Institute of Technology, Japan          April 1983~March 1987, BS, Department of Chemistry, Tohoku University, Japan</p>
研究領域和重點	<p><b>Organic Optoelectronic Materials: Liquid crystal display (LCD) related materials and devices, Organic light emitting diode (OLED) related materials and devices</b></p> <p><b>Soft-matter Optical Spectroscopy: Surface nonlinear optical spectroscopy, Sum-frequency generation spectroscopy as a probe for molecular orientations</b></p>

# Organic Optoelectronics Materials & Soft-matter Optical Spectroscopy

1. Organic Optoelectronic Materials: Liquid crystal display (LCD) related materials and devices, Organic light emitting diode (OLED) related materials and devices

2. Soft-matter Optical Spectroscopy: Surface nonlinear optical spectroscopy, Sum-frequency generation spectroscopy as a probe for molecular orientations

## FYI: Soft-matter

**Soft matter** is a subfield of condensed matter comprising a variety of physical systems that are deformed or structurally altered by thermal or mechanical stress of the magnitude of thermal fluctuations. They include liquids, colloids, polymers, foams, gels, granular materials, liquid crystals, and a number of biological materials. These materials share an important common feature in that predominant physical behaviors occur at an energy scale comparable with room temperature thermal energy. At these temperatures, quantum aspects are generally unimportant. Pierre-Gilles de Gennes, who has been called the "founding father of soft matter," received the Nobel Prize in physics in 1991 for discovering that methods developed for studying order phenomena in simple systems can be generalized to the more complex cases found in soft matter, in particular, to the behaviors of liquid crystals and polymers.

[https://en.wikipedia.org/wiki/Soft\\_matter](https://en.wikipedia.org/wiki/Soft_matter)

# Organic Optoelectronics Materials & Soft-matter Optical Spectroscopy Lab.

Contribution to industry

Molecular orientations  
*surfaces/interfaces, bulk, etc.*

Spectroscopy  
*laser equipment, SFG, SHG, etc.*

Display technologies  
*physics, materials, defects, etc.*

1. Enjoy starting up a laboratory from scratch together.
2. Enjoy doing research and learning something new.
3. Enjoy speaking English (official language in the lab).

Novel organic devices

Soft-matter materials  
design, characterization, etc.

Materials science  
*QM, MD, mobility, etc.*

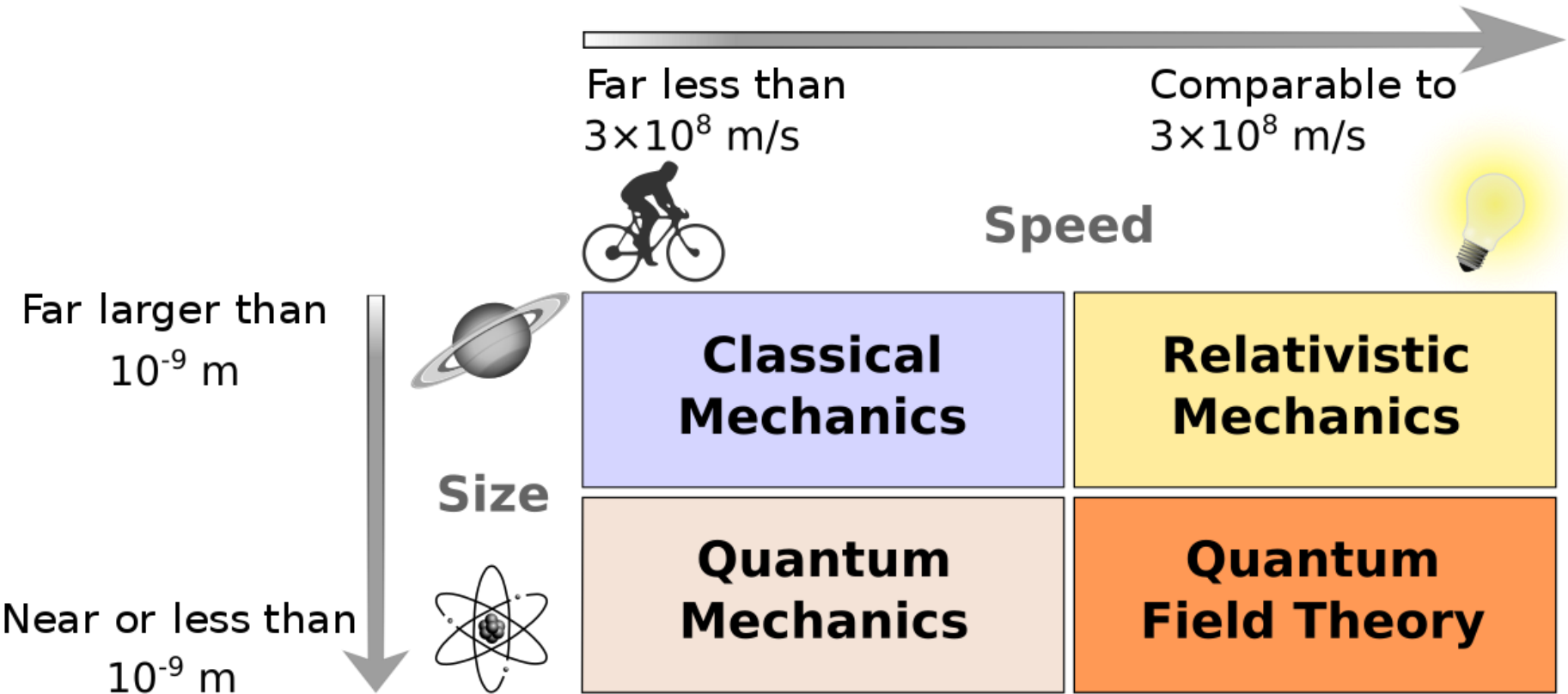
Year 2016

Starting up from scratch

# What is "Modern Physics"?

- ✓ Contemporary physics vs. Modern physics
- ✓ Our lives are beneficial to "Modern physics"
- ✓ You have not yet studied "Modern physics".
- ✓ "Modern physics": Physics in the 20<sup>th</sup> century.
- ✓ Education of physics starts from the physics in the 19<sup>th</sup> century.
- ✓ "Modern physics" provides introductory contents to understand materials and devices by QM.

# What is "Modern Physics"?



# What is "Modern Physics"?

✓ Classical physics (Prior ~ 1900)

Two "Giants": **Newton** and **Maxwell**

**Newtonian (Classical) mechanics** and **EM**

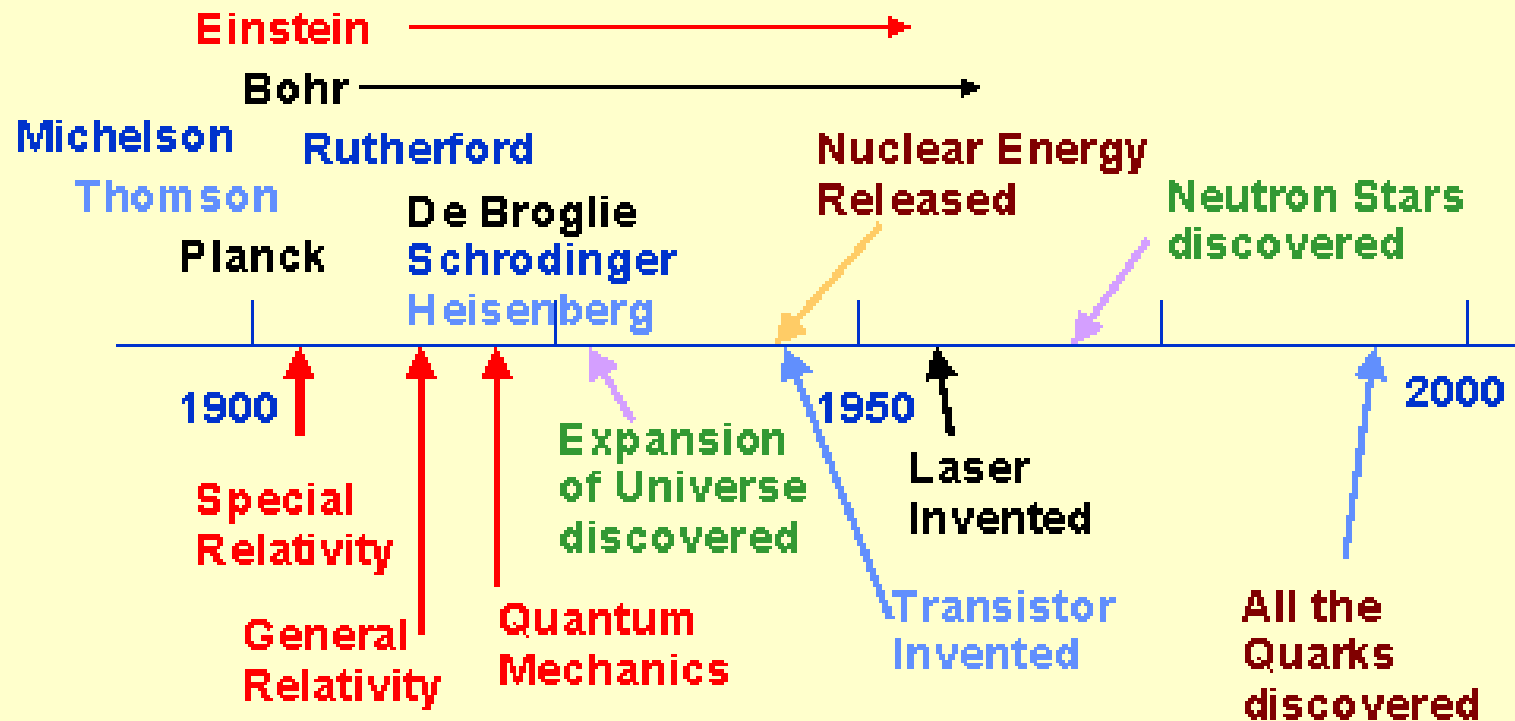
✓ Around 1900: Three crises in Physics

- **Michelson & Morley's experiment (Speed of light)**
- **Photoelectric effect (Quantization of energy)**
- **Blackbody radiation (UV catastrophe)**

✓ Modern physics (after ~ 1900): **This course covers.**  
7

Relativity & Introductory to quantum mechanics (QM)

# Timeline - Modern Physics



- “Modern Physics” began with a two great revolutions starting around 1900, and ending ????
- See Timeline description of lives of various scientists on WWW pages.



## Two pillars of this course

### 1. Relativity

What happens when things go really fast?

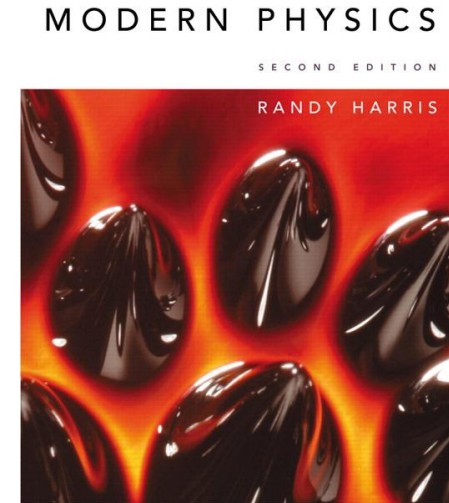
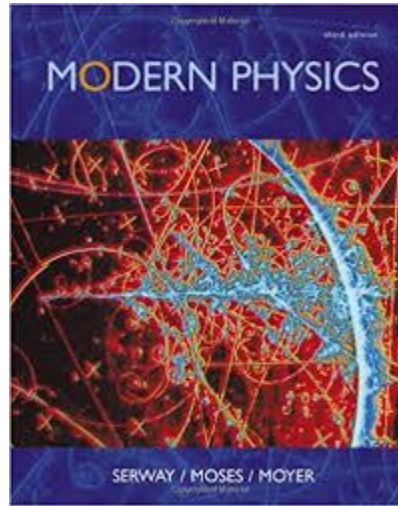
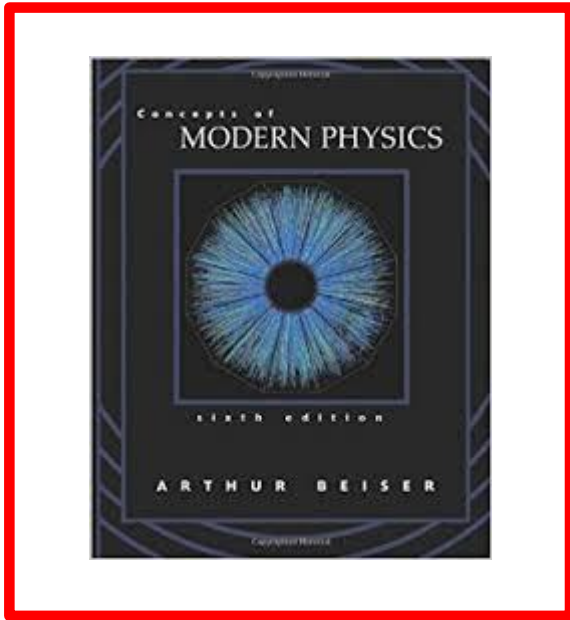
- Special relativity
- General relativity (Not included)

### 2. Introductory to quantum mechanics

Describes the properties of really small things.

- Properties of light and EM radiation
- How light interacts with matter
- Properties of materials
- Basics of all modern technologies.

# Textbook



"Concepts of Modern Physics",  
sixth edition, by Arthur Beiser

Course materials (Lecture notes and viewgraphs) will  
be uploaded to iLMS appropriately (Not every week).  
, basically when each chapter finishes.

## Tentative schedule and evaluation

- ✓ Attendance, Homework, Quiz,  
Midterm (paper), final (paper)
- ✓ Reading assignment (Every week)
- ✓ Problem sets (Several times)

Tentative schedule:

April 5: No class

April 16 or 23: Midterm

June 11: Final ?

# Teaching assistants



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