

“當代原子與分子物理導論”

(Introduction to recent trends in atomic and molecular physics)

Lectures in English on every Tuesday (9:10-12:00) at Room 311 of IAMS

Date	lecturer	Date	lecturer
2/23 Tuesday 9:10~12:00	Prof. Kaito Takahashi	4/26 Tuesday 9:10~12:00	Prof. Ming-Shien Chang
3/1 Tuesday 9:10~12:00	Prof. Kaito Takahashi	5/3 Tuesday 9:10~12:00	Prof. Ming-Shien Chang
3/8 Tuesday 9:10~12:00	Prof. Kaito Takahashi	5/10 Tuesday 9:10~12:00	Prof. Ying-Cheng Chen
3/15 Tuesday 9:10~12:00	Prof. Michitoshi Hayashi	5/17 Tuesday 9:10~12:00	Prof. Ying-Cheng Chen
3/22 Tuesday 9:10~12:00	Prof. Michitoshi Hayashi	5/24 Tuesday 9:10~12:00	Prof. Ying-Cheng Chen
3/29 Tuesday 9:10~12:00	Prof. Jer-Lai Kuo	5/31 Tuesday 9:10~12:00	Prof. Yu-Ju Lin
4/12 Tuesday 9:10~12:00	Prof. Jer-Lai Kuo	6/7 Tuesday 9:10~12:00	Prof. Yu-Ju Lin
4/19 Tuesday 9:10~12:00	Prof. Ming-Shien Chang	6/14 Tuesday 9:10~12:00	Prof. Yu-Ju Lin

Kaito Takahashi

Week 1 (2/23)

1.5 hours on “Recent success in using quantum simulations to understand interesting physics and chemistry”

- Using quantum chemistry methods to predict metal surface reactions
- Ab initio molecular dynamics simulation on liquid/solid phase of water
- Quantum chemistry calculation of proteins
- Reaction dynamics using quantum chemistry based trajectories to understand curious reaction features for $\text{CD}_3\text{H}+\text{F}$

1.5 hour on “Born-Oppenheimer approximation and its failures (using equations)”

Week 2 (3/1)

2 hours of “Linear Combination of Atomic Orbitals (using equations and figures)”

- Diatomic molecules (H_2^+ , H_2)
- Polyatomic molecules using LCAO

1 hours of “Vibration of diatomic molecules”

- Harmonic oscillator, morse oscillator

Week 3 (3/8)

1.5 hours on “Vibration in polyatomic molecules, normal modes”

1.5 hours on “Potential Energy Surface and reaction”

Michitoshi Hayashi

Week 1 (3/15)

Wave-particle duality of large molecules

-- Review on the foundation and concept of quantum theory and its application to molecules

Week 2 (3/22)

Van der Waals force and weak interactions

-- Quantum fluctuation, Coulomb interaction, Exchange energy, etc.

Jer-Lai Kuo

Week 1 (3/29)

Understanding structure of water via molecular spectroscopies (I)

-- This lecture will introduce different spectroscopic methods to probe different structures of water in gas, liquid to crystalline phases.

Week 2 (4/12)

Understanding structure of water via molecular spectroscopies (II)

-- We will introduce a few simple examples on how computational methods can be useful to understand experimental data to extract structural information.

Ming-Shine Chang

3 weeks (4/19, 4/26, 5/3)

1. Introduction to atom-photon interaction

- Two-level atom without spontaneous decay
- Coherent control on a two-level atom: Rabi's and Ramsey's methods
- Two-level atom with spontaneous decay
- Optical Bloch equation

2. Atom trapping and cooling

- Optical force on atoms
 - Laser cooling
 - Magneto-optical trap
 - Magnetic trap
 - Optical dipole trap
 - Evaporative cooling
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Ying-Cheng Chen

3 weeks (5/10, 5/17, 5/24)

1. Atom-photon interaction in a three-level system (4hrs)
 - Electromagnetically induced transparency (EIT)
 - Slow light, Storage of light and stationary light
 - Nonlinear optics based on the EIT
 - Single photon and bi-photon generation based on EIT
 2. Coherent manipulation of atoms with lasers
 - Raman transition
 - Controlling the internal and external states
 - Application to quantum information sciences
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Yu-Ju Lin

3 weeks (5/31, 6/7, 6/14)

- atoms dressed by photons
 - Bose-Einstein condensates
 - selected topics of cold atoms in optical lattices
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