Welcome to PHYS 421, Contemporary Atomic Physics!

We will first cover the basics of atomic physics and quantum theory needed to understand the contemporary atomic: laser cooling and trapping of atoms, ions and molecules; ultracold quantum gases (BEC and degenerate Fermi gases), optical lattices, ion trap and quantum simulations/quantum computing.

- Class meets TTh 10:30 - 11:50 am in room PAA A110.
- Homework is assigned weekly on Thursday, due the following Thursday.
- Textbook: "Atomic Physics" (Oxford Master Series in Atomic, Optical and Laser Physics) 1st Edition by Christopher J. Foot.
- Final project (paper on contemporary atomic physics). Due: Friday, June 2 2023. NO LATE SUBMISSIONS WILL BE ACCEPTED.
- Grading: 60% HW + 40% Final Project = 100%.

Lecture topics, slides and homework assignments:

Week 1: Brief review of atomic physics. Hydrogen atom. Foot, chapter 1 and chapter 2.1 - 2.2.

Homework 1:
problems 1.8, 1.9 from Foot.

Week 2: Hydrogen atom. Foot chapter 2.

Homework 2:
1. Prove spherical symmetry of the complete p-shell and d-shell. Use properties of spherical harmonics to do so.
2. Problem 2.4 from Foot

Week 3: Alkali. Foot chapter 4.

Homework 3:
Problems 2.13, 4.3 and 4.8 from Foot

Week 4: Helium. Foot chapter 3

Homework 4:
Problems 3.1 and 3.3 from Foot.

Week 5: Alkali earth atoms. Hyperfine structure. Semiclassical light/atom interaction. Foot chapters 5, 6, 7.

Homework 5:
Problems 5.3, 6.4 and 7.3 from Foot.

Week 6: Semiclassical light/atom interaction.

Homework 6:
Problems 7.5, 7.9 and 8.3 from Foot.

Week 7: Laser cooling and trapping.

Homework 7:
Problems 9.2, 9.12 from Foot.

Week 8: More cooling and trapping.

Week 9: BEC. Ion trapping.

Week 10: Quantum optics topics.