Atomic physics

Objects of this course:

This course aims to give students a broad perspective of the current understandings of :

- The structure of atoms, to the nucleus
- The interaction with one another
- The interaction with electric and magnetic fields.

Key Points:

- Building physics pictures
- Clear description of physics concepts

Teaching outlines

The following sections are included:

- **Introduction (2 hour)**

  Motivations , why and how?

- **Chapter 1.Theory of Relativity (6 hours)**

1.1 Special relativity

1.2 General relativity

❖ Chapter 2. Basic aspects of Atom (Rutherford) (6 hours)

2.1 The background
2.2 Emergence of the Rutherford model
2.3 Rutherford Scattering formula
2.4 Experimenta verification of the Rutherford Formula
2.5 Summary of the Significances and difficulties of the Nuclear model

❖ Chapter 3. Bohr model of the Hydrogen atom (6 hours)

3.1 Background
3.2 Bohr model
3.3 Experimental evidence I: Spectra
3.4 Experimental evidence II: Frank-Herz Experiment
3.5 Extension of the Bohr Model
3.6 Summary

❖ Chapter 4. Fine structure (Spin) (6 hours)

4.1. Magmetic moment produced by the electron orbital motion in an atom
4.2. The stern-Gerlach experiment
4.3. The hypothesis of electron spin
4.4. Doublet lines of Alkali Metals
4.5. The Zeeman Effects (I)
4.5. The Zeeman Effects (II)
4.6. Summary of the Hydrogen energy spectrum
Summary, Exercise and problems

❖ Chapter 5. Many-electron atoms (Pauli-Blocking) (6 hours)

5.1. The spectra and energy levels of Helium
5.2. The coupling of the two electrons
5.4. The periodic Table of elements
5.5 Summary ,excerice and problems

❖ Chapter 6. X-Ray (6 hours)

6.1. The discovery of X-rays and their wave nature
6.2. Mechanisms for producing X-rays
6.3. Compton Scattering

6.4. Absorption of X-rays
6.5 Summary, problems

The curriculum form

- Lectures (by prof. Defu Fou)
- Seminars (students presentations)
- Summary & Exercise (prof. &TA)

Includes lectures and exams, and involves presentation and discussion

Evaluation of the course

Attendeance & participation (10%)

Homework (20%)

Mid-term (25%)

Final test (45%)

Textbooks & References

(1) Modern atomic and Nuclear physics , by F.J Yang J.H Hamilton , 2010 World scientific Publishing Co. **(textbook)**

(2) The Physics of Atoms and Quanta, sixth edition, by H. Haken and H. C. Wolf, 2003, published by Springer-Verlag and World scientific publ.

(3) Theoretical Atomic Physics, by H Friedrich , 2006 by Springer

(4) Atomic physics, by FP Miller, AF Vandome, J Mcbrewster, Alphascript Publishing, 2009

(5) Riepe D. Atomic Physics and Human Knowledge, by Niels Bohr[M]// Atomic Physics and Human Knowledge. Изд-во Иностранной литературы, 1961:596-597.

(6) Using Diode-Lasers for Atomic Physics, CE Wieman, L Hollberg - 《Review of Scientific Instruments》, 1991

(7)Atomic physics with super-high intensity lasers , M Protopapas, CH Keitel, PL Knight - 《Reports on Progress in Physics》 - 1997
(8)Atomic Physics and Human Knowledge by Niels Bohr, D Riepe - Atomic Physics and Human Knowledge. - 1961
(9)Discussion with Einstein on epistemological problems in atomic physics N Bohr - 《Schilpp P.a.albertnstein Philosopherscientist》 - 1949
(10) A learning pathway in high‐school level quantum atomic physics Juergen Petri, Hans Niedderer - 《International Journal of Science Education>> 2012