

PHYS 4900/6900: Course Syllabus

Instructor: K. Nakayama, Room 219

Class Hours: TR 2:00-3:15pm.

Office Hours: TR 4:30-5:30pm.

Course Materials: There is no particular textbook to be followed in this course. Instead, course materials, in the form of power point or pdf files and some reading texts, will be provided.

Class Attendance: Class attendance is mandatory.

Assignments: Reports on few selected topics to be turned in.

Grade: $\text{Grade} = \frac{1}{2} \times (\text{class attendance} + \text{participation}) + \frac{1}{2} \times (\text{report grade average})$

Incompletes: Rules concerning withdrawals and incompletes: We will follow the rules of the UGA Bulletin concerning withdrawals and incompletes.

Grading Scheme: Use of the plus/minus system is a requirement – it is the only grading system approved for the University of Georgia.

	$A \equiv [85, 100]$	$A- \equiv [82.5, 85)$
$B+ \equiv [80, 82.5)$	$B \equiv [70, 80)$	$B- \equiv [67.5, 70)$
$C+ \equiv [65, 67.5)$	$C \equiv [55, 65)$	$C- \equiv [52.5, 55)$
$D \equiv [40, 52.5)$	$F \equiv [0, 40)$	

Academic Honesty: All academic work must meet the standards contained in "A Culture of Honesty." Students are responsible for informing themselves about those standards before performing any academic work. More detailed information about academic honesty can be found at the website given above. As a UGA student, you are responsible for knowing and understanding this policy. If you have any questions about the propriety of actions relating to this course, you are obligated to ask me for clarification. See also the UGA website: <http://www.uga.edu/honesty/>.

Course Description: This course will introduce the students to Particle Physics starting from the discovery of atomic nuclei in 1911 by Ernest Rutherford and the subsequent discoveries of subatomic particles, such as the proton and neutron, all the way down to quarks and gluons, culminating in the current theory of particle physics known as the Standard Model. This theory is a theory of Electromagnetic, Weak and Strong interactions, three of the four fundamental forces in nature (the fourth interaction is the gravitational force). The basic physics ideas along with the key experiments that have led to the formulation of the Standard Model will be discussed, including the recent discovery of the Higgs Boson, a fundamental particle whose existence is required by underlying symmetries to complete the establishment of the Standard Model. Particular emphasis will be devoted to the current understanding of our universe from the Particle Physics point of view. Issues on dark matter and dark energy will be addressed. For this, there will also be a discussion on Cosmology, in particular, on the standard Big Bang Theory. Currently open issues in Particle Physics beyond the Standard Model will be discussed, especially, the supersymmetry.

All the discussions will be at a qualitative level so that, at the end of the course, the students will have a basic qualitative idea of the current understanding of Particle Physics and the structure of our universe from particle physics point of view.

Topics

Below is a tentative list of topics to be covered in this course. Note that it is subject to changes. These (and other) changes will be announced in class. Each student is *fully responsible* to keep track on such changes by attending class.

- **Scales:**
From subatomic to cosmos: Energy, Length, Temperature & Time.
- **Fundamental Forces of Nature:**
Gravity, Electromagnetic, Weak & Strong forces
- **Nuclear & Elementary Particles:**
From the discover of atomic nuclei to quarks: an overview.
- **Standard Model:**
Theory of Electromagnetic, Weak & Strong forces.
- **Quantum Electrodynamics:**
Theory of Electromagnetic Force.
- **Quantum Chromodynamics:**
Theory of Strong Force.
- **Electroweak Interaction:**
Neutrino Physics.
- **Beyond Standard Model:**
Super Symmetry (SUSY).
- **Gravity:**
Dark Matter, Dark Energy & Gravitational Waves.
- **Cosmology:**
Standard Big Bang Theory.
- **Unified Universe:**
Cosmology & Particle Physics.
- **Structure of our Universe:**
Patterns, Structures & Symmetries.