

Introduction to Particle Physics and Structure of Our Universe

FYO seminar Syllabus
University of Georgia, Fall 2022

Disclaimer: Goals of the FYO seminar program

Goal 1: Introduce first-year students to the importance of learning and academics so that we engage them in the academic culture of the University.

Goal 2: Give first-year students an opportunity for meaningful dialogue with a faculty member to encourage positive, sustained student-faculty interactions.

Goal 3: Introduce first-year students to the instruction, research, public service, and international missions of the University and how they relate to teaching and learning in and outside the classroom so that we increase student understanding of and participation in the full mission of the University.

Course description

This particular seminar series will introduce the first-year 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. Also, currently open issues in Particle Physics beyond the Standard Model will be discussed.

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 as we know it today from particle physics point of view. No prerequisite exists, but it helps if the student has already taken some science class at high school and is acquainted with basic concepts such as units, dimensions, and scientific notations.

Basic Information

Instructor: Kanzo Nakayama Email: nakayama@uga.edu
Office: 219 Physics Building

Class: Tuesdays, Period 6 (3:55-5:10 pm), Room 327 Physics Building
Office hours: Tuesdays, 5:15-6:15 pm or by appointment

Assignments and Grading Policy

You will be asked to write short reports on some of the topics covered in class as the course progresses. A detailed instruction as well as some additional supporting materials for preparing these reports will be given in class. Class attendance will be checked. You are expected to attend class and participate in the discussions. Your overall grade will be determined as follows:

50% reports turned in
50% class attendance and participation

Letter grades will be assigned from your overall numerical grade according to the following:

	$A \equiv [90, 100]$	$A- \equiv [87, 90)$
$B+ \equiv [80, 87)$	$B \equiv [75, 80)$	$B- \equiv [70, 75)$
$C+ \equiv [65, 70)$	$C \equiv [60, 65)$	$C- \equiv [55, 60)$
$D \equiv [50, 55)$	$F \equiv [0, 50)$	

Standard rounding will be used for the final numerical grade. For example, 89.499 will be 89 and $A-$, but 89.5 will be 90 and A . There are no exception to these letter grade assignments.

Students are required to attend at least three campus events as part of this course. One of the events may be a mandatory attendance to a Physics Departmental Colloquium if there is a relevant talk in the semester. Goals of the FYO program include making you aware of the considerable opportunities available on campus and encouraging you to become engaged in the intellectual and cultural life of the University. There are many events to choose from (<https://fyo.uga.edu/BrowseEvents.aspx>), including musical performances, films, and visiting speakers. You may participate in five hours of service to the community through VolunteerUGA as one event. At the end of the semester, you will be asked in the course evaluation which events you attended and asked for your input about the events.

Academic Honesty

As a University of Georgia student, you have agreed to abide by the University's academic honesty policy, "A Culture of Honesty," and the Student Honor Code. All academic work must meet the standards described in "A Culture of Honesty" found at: www.uga.edu/honesty. Lack of knowledge of the academic honesty policy is not a reasonable explanation for a violation. Questions related to course assignments and the academic honesty policy should be directed to the instructor.

Student Responsibilities

You're responsible for all topics discussed in class and all class announcements. Absence does not excuse you from this responsibility.

Topics & Schedule:

FYO Class Schedule Fall 2022

The schedule below is tentative and subject to changes which will be announced in class. Each student is *fully responsible* for keeping track of such changes by attending class.

Class	Date	Topic	
1	T Aug. 23	Scales: from subatomic to cosmos	Energy, Length, Temperature & Time.
2	T Aug. 30	Fundamental Forces of Nature	Gravity, Electromagnetic, Weak & Strong forces.
3	T Sep. 06	Nuclear & Elementary Particle Physics	an overview.
4	T Sep. 13	Nuclear & Elementary Particle Physics	continuation.
5	T Sep. 20	Standard Model	Theory of Electromagnetic Weak & Strong forces.
6	T Sep. 27	Quantum Electrodynamics	Theory of Electromagnetic Force.
7	T Oct. 04	Quantum Chromodynamics	Theory of Strong Force.
8	T Oct. 11	Weak Interaction	Neutrino Physics: responsible for the existence of life on Earth.
9	T Oct. 18	Gravity	Dark Matter & Dark Energy.
10	T Oct. 25	Unified Universe	Cosmology & Particle Physics.
11	T Nov. 01	Unified Universe	continuation.
12	T Nov. 08	Beyond Standard Model	Super Symmetry (SUSY).
13	T Nov. 15	Structure of the Universe	Patterns, Structures & Symmetries.
14	T Nov. 22 Nov. 23 - 25	TBA	Thanksgiving
15	T Nov. 29	TBA	
16	T Dec. 06	TBA	