PHYS4900/6900 (F20)
Introduction to Particle Physics and Structure of our Universe

Instructor: K. Nakayama, Room 219

Class Hours: TR 9:35-10:50am (will be completely in online mode, using zoom).

Office Hours: TR 10:55-11:55am or by appointment (using zoom).

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 (online) is mandatory.

Assignments: Reports on selected topics to be turned in.

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

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.

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A \equiv [90, 100] \quad A- \equiv [87, 90] \\
B+ \equiv [80, 87] \quad B \equiv [75, 80] \quad B- \equiv [70, 75] \\
C+ \equiv [65, 70] \quad C \equiv [60, 65] \quad C- \equiv [55, 60] \\
D \equiv [50, 55] \quad 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. All withdrawal will be processed in accordance with University policy as stated in the undergraduate bulletin. For withdrawals before the midpoint, a grade of "W" will be assigned for all cases.

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 lead 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, Supersymmetry and Grand Unification Theory.

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 Electrodymanics:
  Theory of Electromagnetic Force.

• Quantum Chromodymanics:
  Theory of Strong Force.

• Electroweak Interaction:
  Neutrino Physics.

• Beyond Standard Model:
  Super Symmetry (SUSY).
  Grand Unification Theory (GUT).

• Gravity:
  Dark Matter, Dark Energy & Gravitational Waves.

• Cosmology:
  Standard Big Bang Theory.

• Unified Universe:
  Cosmology & Particle Physics.
• Structure of our Universe:
  Patterns, Structures & Symmetries.

Coronavirus Information for Students

Face Coverings:
Effective July 15, 2020, the University of Georgia - along with all University System of Georgia (USG) institutions - requires all faculty, staff, students and visitors to wear an appropriate face covering while inside campus facilities/buildings where six feet social distancing may not always be possible. Face covering use is in addition to and is not a substitute for social distancing. Anyone not using a face covering when required will be asked to wear one or must leave the area. Reasonable accommodations may be made for those who are unable to wear a face covering for documented health reasons. Students seeking an accommodation related to face coverings should contact Disability Services at https://drc.uga.edu/.

DawgCheck:
Please perform a quick symptom check each weekday on DawgCheck - on the UGA app or website - whether you feel sick or not. It will help health providers monitor the health situation on campus: https://dawgcheck.uga.edu/

What do I do if I have symptoms?
Students showing symptoms should self-isolate and schedule an appointment with the University Health Center by calling 706-542-1162 (Monday-Friday, 8 a.m.-5 p.m.). Please DO NOT walk-in. For emergencies and after-hours care, see https://www.uhs.uga.edu/info/emergencies.

What do I do if I am notified that I have been exposed?
Students who learn they have been directly exposed to COVID-19 but are not showing symptoms should self-quarantine for 14 days consistent with Department of Public Health (DPH) and Centers for Disease Control and Prevention (CDC) guidelines. Please correspond with your instructor via email, with a cc: to Student Care & Outreach at sco@uga.edu, to coordinate continuing your coursework while self-quarantined. If you develop symptoms, you should contact the University Health Center to make an appointment to be tested. You should continue to monitor your symptoms daily on DawgCheck.

How do I get a test?
Students who are demonstrating symptoms of COVID-19 should call the University Health Center. UHC is offering testing by appointment for students; appointments may be booked by calling 706-542-1162.
UGA will also be recruiting asymptomatic students to participate in surveillance tests. Students living in residence halls, Greek housing and off-campus apartment complexes are encouraged to participate.

What do I do if I test positive?
Any student with a positive COVID-19 test is required to report the test in DawgCheck and should self-isolate immediately. Students should not attend classes in-person until the isolation period is completed. Once you report the positive test through DawgCheck, UGA Student Care and Outreach will follow up with you.