Physics 621 – Nuclear Physics I
Fall 2022

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Lecture hours:
12:40-1:30PM Mo, Wed, Fri
Nielsen 306
Office hours: appointment

Course description: This course teaches nuclear physics for graduate students. You will learn about nuclear physics – as broadly as reflected by the research efforts in the Department.

Prerequisites: Physics 556 (Survey of Modern Nuclear Physics) or equivalent; graduate quantum mechanics (essential), advanced quantum mechanics / field theory (useful), thermodynamics (useful), and special relativity (useful); numerical problem solving (any programming language will work: Mathematica, Maple, Python, …).

Literature: We will draw from a large body of references, because no single text covers it all. Literature is available via Canvas. **Students are expected to arrive prepared at class, e.g. to have read the relevant material**. The Class time will be devoted to understanding concepts, and to active learning by working out examples and thinking about relevant problems. The students' active participation in class is expected.

Academic honesty: All work submitted by a student is expected to represent their own work. Students are expected to perform all work in conformance with the University policies regarding Academic Honesty.

Disability statement: The University of Tennessee, Knoxville, is committed to providing an inclusive learning environment for all students. If you anticipate or experience a barrier in this course due to a chronic health condition, a learning, hearing, neurological, mental health, vision, physical, or other kind of disability, or a temporary injury, you are encouraged to contact Student Disability Services (SDS) at 865-974-6087 or sds@utk.edu. An SDS Coordinator will meet with you to develop a plan to ensure you have equitable access to this course. If you are already registered with SDS, please contact your instructor to discuss implementing accommodations included in your course access letter.

Grading policy: The semester grade will be a weighted average of in-class activities, homework scores, student project, and class attendance.

Class activities will comprise 45% of the final semester grade. Active in-class learning (sometimes each student working alone, sometimes working in groups of two to three students) is a most important part of this course. Activity sheets are available on Canvas and need to be handed in to the instructor after class for grading.

Homework will comprise 25% of the final semester grade. Homework consists of problems that each student is expected to solve within one week after the homework assignment. Due dates for problem sets are firm. In lieu of extensions, the homework set with the lowest score will be dropped from the average. Students are encouraged to discuss homework problems, but teamwork is not allowed.

The student project will comprise 25% of the final semester grade. Each student must select one recent article on nuclear physics research published in high-impact journals such as Physical Review Letters, Nature, Nature Physics, or Science, and present the selected work in a 12-minutes talk plus 3 minutes of questions. The selected publication cannot be co-authored by the student and has to be approved by the instructor. The presentations are scheduled for the last two weeks. All students need to hand in their presentation before 12/05.

Class attendance is required, and classes will start on time. You can earn up to 5% of the final semester grade by arriving on time. You also need to read the relevant material before class, so that you are familiar with basic definitions. Class time will be used to focus on concepts and understanding. Active participation in this class is required for an active learning experience. Students are expected to interact with each other academically in a respectful and attentive atmosphere.

Tennessee Voice valuation of this course is required. Students are expected to e-mail or turn in the "Certificate of Completion" to the instructor to show that they have completed the evaluation of this course.

<u>Schedule:</u> The schedule below is tentative. Any changes will be announced in class. Depending on progress and preparation of the students, topics originally envisioned for Physics 622 might also enter.

Week	Date	Material
1	Aug 24-26	Course Overview, Introduction to Nuclear Physics
2	Aug 29-Sep 2	Naïve dimensional analysis; introduction to QCD: symmetries, confinement, running coupling constant
3	Sep 7-9	Spontaneous and chiral symmetry breaking
4	Sep 12-16	Quark gluon plasma, perfect liquid
5	Sep 19-23	Nucleon structure, form factors
6	Sep 26-30	Deep inelastic scattering
7	Oct 3-5	Scattering theory, variable phase approximation
7	Oct 10-14	Lippmann-Schwinger equation
8	Oct 17-21	Nuclear forces / effective field theory
9	Oct 24-28	Renormalization
10	Oct 31-Nov 4	Nucleon-nucleon EFT continued
11	Nov 7-11	Nuclear equation of state, Neutron stars, neutron skins
12	Nov 14-18	Pairing in neutron gases
13	Nov 21	Nuclear astrophysics
14	Nov 28-Dec 2	Nuclear astrophysics
15	Dec 5-7	Student presentation
15	Wed, Dec-14	1:00 p.m. – 3:15 p.m. Student presentation