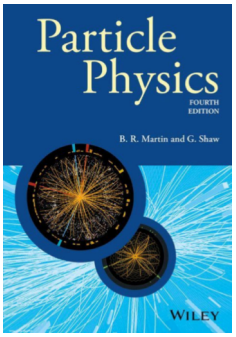
PHYSICS 4390 — INTRODUCTION TO PARTICLE PHYSICS
3 CREDITS
FALL 2017

*"Who ordered **that**?"* — Isador Rabi, on the discovery of the muon

INSTRUCTOR: Prof. Darin Acosta
EMAIL: acostad@ufl.edu
PHONE: 352-846-3144
OFFICE HOURS: M,F 4-5pm, in NPB 2035
LECTURES: MWF, period8 (3:00-3:50pm) in NPB 1200

COURSE WEBSITES: http://www.phys.ufl.edu/courses/phz4390/fall17/
and http://elearning.ufl.edu/



REQUIRED RESOURCES: The required text is Particle Physics, fourth edition, by Martin & Shaw, published by Wiley. The older third edition is also acceptable.

ADDITIONAL RESOURCES: Detailed lecture notes will be made available through the Canvas E-learning system. The web site and reviews of the Particle Data Group (PDG) are an excellent resource, found at pdg.lbl.gov . Other useful textbooks, albeit somewhat more advanced, are Introduction to Elementary Particles by Griffiths, Quarks & Leptons by Halzen & Martin, A Tour of the Subatomic Zoo by Cindy Schwarz, and High P_T Physics at Hadron Colliders by Green.

COURSE DESCRIPTION: PHZ4390
This one semester course at the undergraduate level is designed to give an introduction to the field of particle physics, including the history, concepts, experimental techniques, and general overview of the fundamental theories that comprise the Standard Model of particle physics.

PREREQUISITE KNOWLEDGE AND SKILLS: Introductory physics with calculus (PHY2048/9 or equivalent) and modern physics (PHY3101 or PHY3063), with Quantum Mechanics 1 (PHY4604) as a co-requisite.

PURPOSE OF COURSE: The purpose of this course is to provide you, the student, with a foundation in the concepts, fundamental principles, and methods used in modern particle physics. Examples include kinematics in special relativity, symmetry principles in particle physics, the quark-parton model of hadrons, and the principles of operation for modern detectors. The course is designed for people who have already had a basic introduction to modern physics. It will not entail a systematic approach to all topics, such as the gauge theories

that comprise the Standard Model, as such advanced topics are better suited to accompany a graduate curriculum in physics. Rather this course will survey some of the important conclusions from these topics.

COURSE GOALS AND/OR OBJECTIVES: By the end of this course, students will have a solid foundation in the important concepts, principles, terminology, and methodologies used in particle physics. Specifically, students will be able to:

- **Analyze** particular physical situations such as particle reactions, and thus identify the fundamental principles pertinent to those situations,
- **Apply** fundamental principles like those in special relativity to formulate mathematical equations describing the relation between physical quantities in these particular situations,
- **Solve** mathematical equations to find the values of physical quantities,
- **Communicate** unambiguously both the principles that apply to a situation and the results of specific calculations resulting from the steps above,

INSTRUCTIONAL METHODS: This course meets face-to-face three times a week for lectures and discussion. Lecture notes and other pertinent content will be made available primarily through the Canvas e-Learning system, which can be accessed through http://elearning.ufl.edu/ Students are expected to read the assigned sections in the textbook and the corresponding instructor notes ahead of the scheduled lecture on the topic. To help you stay on track, in-class reading quizzes will be given periodically, and quantitative homework problems are assigned each week to assess your understanding of the concepts and principles presented and your ability to calculate the solution to posed physics exercises.

COURSE POLICIES:

ATTENDANCE POLICY: You are expected to attend lectures regularly. You are also expected to interact with the instructor and with your fellow students through in-class discussions and activities.

ASSIGNMENT POLICY: Homework due dates, exam dates, and presentation deadlines are set on the course schedule and the Canvas course calendar, which may be accessed via the Canvas "Syllabus" link.

HOMEWORK AND READING QUIZ POLICY: Homework sets will be made available through Canvas with the deadline set on the schedule (nominally 3:00pm in class on the day assigned). The assignment should be completed on paper and turned in by the posted deadline (could be emailed instead). Homework may be collaborative, but each student must turn in their own assignment with sufficient detail on the solutions to judge that the student understood the solution. Reading quizzes in class are not collaborative.

EXAM POLICY: Two mid-term exams will be given in class. Exams are not collaborative and are completed alone.

MAKE-UP POLICY: Requirements for class attendance and make-up exams, assignments, and other work are consistent with university policies that can be found at https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx. For a foreseeable absence, it is your responsibility to identify yourself as requiring an accommodation at least one week prior to the absence.

UF POLICIES:

UNIVERSITY POLICY ON ACCOMMODATING STUDENTS WITH DISABILITIES: Students requesting accommodation for disabilities must first register with the Dean of Students Office (http://www.dso.ufl.edu/drc/). The Dean of Students Office will provide documentation to the student who must then provide this documentation to the instructor when requesting accommodation. You must submit this documentation prior to submitting assignments or taking the quizzes or exams. Accommodations are not retroactive, therefore, students should contact the office as soon as possible in the term for which they are seeking accommodations.

UNIVERSITY POLICY ON ACADEMIC MISCONDUCT: Academic honesty and integrity are fundamental values of the University community. Students should be sure that they understand the UF Student Honor Code at https://www.dso.ufl.edu/sccr/process/student-conduct-honor-code/.

GETTING HELP:

OFFICE HOURS: Students needing help outside of class should definitely make use of assistance from the instructor during scheduled office hours. In case of schedule conflicts, or matters requiring more time or confidentiality, please contact the instructor to schedule an appointment.

EMAIL: For short questions not requiring extensive discussion or derivation, use of e-mail is also acceptable either directly to the instructor's UFL email address or through the Canvas E-learning system.

ONLINE DISCUSSION: Questions to the course community also can be posted to the Canvas Discussions forum.

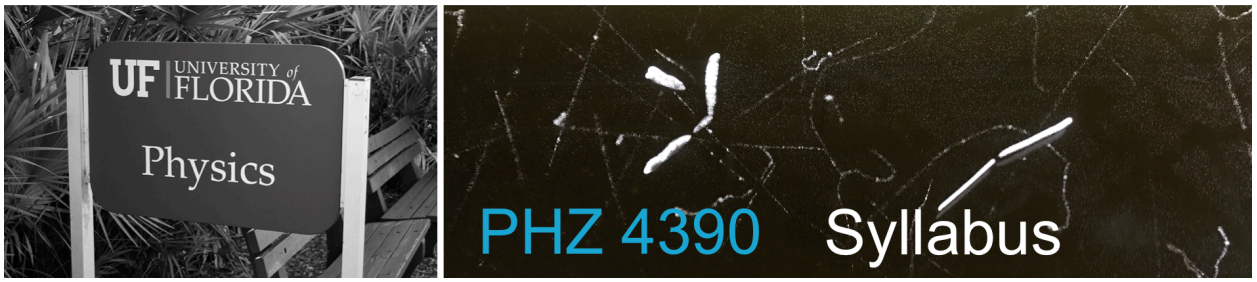
GRADING POLICIES:

Grades in the course are awarded based on an overall course score made up as follows, and explained further below:

Assignment	Max Points
Exam 1	20
Exam 2	20
Paper reading project and presentation	25
Homework	25
In-class participation and quizzes	10
Total Course Points	100

EXAMS: Two in-class exams will be given during the term, each worth 20 points. The exams are open-book and open lecture notes by the professor. There will not be a final exam. The content of the exams will be on the material covered, including also the homework assignments.

PAPER READING: You are asked to select a recent article in experimental particle physics published in (or at least submitted to) a scientific journal, and summarize the physics, methods, results, and findings in a in a 10 minute class presentation and a short written synopsis (1000 words, about 2 pages single spaced). The presentation and the written synopsis are each worth 10 points, plus 5 points for paper difficulty, response to questions, and achieving deadlines. The professor will provide guidance on journals and experiments. You must have your selected article submitted to the professor for approval by the posted deadline (Oct.18). It should be unique in that no other student has chosen it. Grading will be according to the difficulty of the selected article, the clarity of your presentation and text (i.e. good presentation and writing



skills), your accuracy and understanding of the content and how it relates to topics discussed in class, and your response to questions posed by your peers and by the professor. The presentations will be scheduled for the last 2 weeks of class. The written paper, which is meant to be a synopsis in your own words, is due after the presentation (Saturday, first day of finals week). It should include responses to any questions that you were not able to answer during the presentation.

HOMEWORK: Homework assignments will be given approximately weekly and due by 3:00pm on the assigned due date. Late homework is reduced 50% each week thereafter. The homework score will be computed from your fraction of the maximum possible multiplied by 30 points.

QUIZZES AND PARTICIPATION: In-class quizzes based on the assigned textbook and lecture note readings will be given periodically, as well as in-class activities. Students are also expected to participate in discussions during class. For example, you will be expected to ask questions during the final presentations as well.

The total minimal scores (based on a 100 point scale) ensuring particular letter grades are shown below:

A	A-	B+	B	B-	C+	C	C-	D+	D	D-	E
80	75	70	65	60	55	50	45	40	35	30	<30

COURSE SCHEDULE:

Wk #	Week Starting	Exams & *Holidays*	Topics
0	8/21/17		Course Overview and Introduction
1	8/28/17		Relativity
2	9/4/17	*Labor Day (M)*	Quantum Mechanics
3	9/11/17		Intro to the Standard Model

4	9/18/17		Symmetries and Quark Parton Model
5	9/25/17	**Exam 1**	Heavy Quarks
6	10/2/17	*Homecoming (F)*	Scattering
7	10/9/17		Accelerators, Interactions of Particles
8	10/16/17	**Paper Selection**	Detectors
9	10/23/17		Hadron Structure
10	10/30/17	**Exam 2**	QCD
11	11/6/17	*Veterans Day (F)*	Electroweak & Higgs
12	11/13/17		Beyond the Standard Model
13	11/20/17	*Thanksgiving (W,F)*	Beyond the Standard Model
14	11/27/17	**Presentations**	
15	12/4/17	**Presentations**, *End of class*	
16	12/11/17	**Reports**	

Disclaimer: This syllabus represents my current plans and objectives. As we go through the semester, those plans may need to change to enhance the class learning opportunity. Such changes, communicated clearly, are not unusual and should be expected.