PHY 100

Exploring Physics and Astronomy

Meetings: MWF 11:45AM-12:50PM
Room: ISEC 120

Course Objectives

1

GAIN UNDERSTANDING

You will gain knowledge and understanding of physics and astronomy.

2

IMPROVE SKILLS

You will build on your laboratory, data analysis, and problem solving skills.

3

PRACTICE THINKING

You will practice critical thinking and self-evaluation.

4

BUILD COHORT

You will meet other students and faculty in physics and astronomy

Course Structure

This course is a “team taught” course by 5 faculty members from the Department of Physics and Astronomy. Each faculty member will lead a two week module related to their field of expertise.

Week 1-2

Prof. Scott LaBrake - ***labrakes@union.edu***

Accelerator-Based Materials Analysis: We will use a particle accelerator to generate and accelerate a beam of protons which will then bombard a sample of material of unknown composition. From the interaction of the protons with the elements in the sample, x-rays, characteristic of the elements in the sample, will be produced. By collecting a spectrum of these x-rays, we will identify the elements that make up the sample of material.

Week 3-4

Prof. Chad Orzel - ***orzelc@union.edu***

Quantum Mechanics: Quantum mechanics describes the behavior of microscopic particles-- atoms, molecules, electrons, and light-- and is famously weird. It predicts numerous phenomena that run counter to our everyday intuition: objects passing through obstacles they shouldn't be able to cross, objects in multiple states at the same time, "spooky" correlations between widely separated particles. In this module, we'll discuss the physics behind some recent high-profile experiments that demonstrate these strange results in the real world.

Week 5-6

Prof. James McKee - ***mckeej@union.edu***

Pulsars: The serendipitous discovery of pulsars by Jocelyn Bell-Burnell revolutionized our understanding of stellar life cycles, but also provided us with an extremely useful tool for measuring the cosmos. From testing theories of nuclear physics to detecting the echoes of the early universe, pulsars allow us to make some of the most precise measurements in all of astrophysics. We will explore the discovery of the first pulsars, their formation and properties, and we will use observational data to make astrophysical measurements of our own.

Week 7-8

Prof. Francis Wilkin - wilkinf@union.edu

Gravitational Waves: Over 100 years ago Albert Einstein predicted the existence of Gravitational Waves through his theory of General Relativity. But only recently scientists succeeded in measuring these waves using two very large laser interferometers (LIGO). In June of 2023, four groups using pulsar-timing arrays announced that ripples had been detected with wavelengths as long as a light year. These observations of the merger of two black holes, which have been verified many times by now, have opened a whole new way of "looking" at our universe.

Week 9-10

Prof. Pravini Fernando- ***fernandm@union.edu***

Exploring the Nanoscale: Billionths of a meter may sound unimaginably small, yet this is the scale that defines DNA, modern transistors, and countless other structures that shape our world. The nanoscale generally refers to dimensions of roughly 1 to 100 nanometers, where the arrangement of atoms or molecules can determine key material properties such as appearance, strength, and electrical conductivity. In this module, we will define the nanoscale and discuss why it is important. We will also examine the experimental methods that allow scientists to study matter at these dimensions, with particular emphasis on atomic force microscopy (AFM).

Course Work

The course will be taught in a format that emphasizes active learning. In a given class meeting, there may be any combination of presentation, discussion, demonstration, lab work, computer modeling, and/or problem solving. Generally, you will work in groups of 2-3. It is very important that you attend all classes to make sure you are on top of the required material for each module.

Learning Assessment

Each individual faculty member will provide a variety of homework, assessments, quizzes etc. within their two week block. The final breakdown of grades for the entire course will be divided equally between modules as follows:

Activity	Grade Weight
Accelerator materials analysis	20%
Quantum Mechanics	20%
Pulsars	20%
Gravitational Waves	20%
Exploring the Nanoscale	20%

If you need accommodations for quizzes or assessments, please speak with the faculty members as soon as possible. It is expected that you will make every effort to avoid conflicts with the scheduled assessments. If you have an unavoidable conflict, you must confer with the faculty members in advance. Only in unusual situations and with advanced notice will a make-up test be scheduled.

"It is not knowledge, but the act of learning, not possession but the act of getting there, which grants the greatest enjoyment."

Carl Friedrich Gauss

Diversity and Inclusion

In this course, we will do our best to ensure that students from all backgrounds and perspectives will be served equitably. The diversity that students bring to this class will be viewed as a resource, strength and benefit. It is our intent to present materials and activities that are respectful and inclusive of the many identities of students in terms of gender, sexual orientation, disability, age, socioeconomic status, ethnicity, race, culture, perspective, and other background characteristics. Your suggestions about how to improve the value of diversity and inclusiveness in this course are encouraged and appreciated.

Health and Safety Statement

We recognize that certain aspects of this course may change at any time to comply with Union College and NY State health guidelines and policies. Our intent is to provide important hands on and interactive learning experiences as much as possible, while still prioritizing the health and safety of everyone participating. We will be meeting in person, and the expectation is that all students are present to participate in every class session. If you are ill, for the safety and health of other students and faculty, we request that you stay home and let the faculty member running the module at the time know your situation. We will make every effort to provide you with materials and help you not fall too far behind in the course.

Academic Honesty

Union College recognizes the need to create an environment of mutual trust as part of its educational mission. Responsible participation in an academic community requires respect for and acknowledgment of the thoughts and work of others, whether expressed in the present or in some distant time and place. Matriculation at the College is taken to signify implicit agreement with the Academic Honor Code, available at honorcode.union.edu. It is each student's responsibility to ensure that submitted work is his or her own and does not involve any form of academic misconduct. Students are expected to ask their course instructors for clarification regarding, but not limited to, collaboration, citations, and plagiarism. Ignorance is not an excuse for breaching academic integrity. Students are also required to affix the signed Honor Code Affirmation, or the following shortened version, on each item of coursework submitted for grading: ***"I affirm that I have carried out my academic endeavors with full academic honesty."***

RESOURCES FOR STUDENTS

Academic Achievement Office: A variety of programs are available to assist students in becoming stronger, more independent learners. The office is committed to helping students get the information and resources they need to be successful at Union**. https://www.union.edu/academic-achievement**

Counseling services: If you or someone you know is experiencing mental health challenges at Union College, please contact the Counseling Center located in the Wicker Wellness Center or call 518-388-6161 between the hours of 8:30 A.M. to 5;00 P.M. Counseling services are free and confidential. In a crisis situation, or after hours, contact Campus Safety at 518-388-6911.
The National Suicide Prevention hotline also offers a 24-hour hotline at 800-273-8255.