Physics & Astronomy 108 – Astronomy Laboratory - S
Spring Semester 2019 – 1 Credit Hour
Online Learning

Instructor

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University email is preferable to a phone call, and will provide you with a written response you can save. Video conferences in my "virtual office" are available too, through the Zoom conferencing system if you have a microphone and webcam, or an Android cellphone or Iphone. Please send an email first to set up an appointment and for connection instructions.

Objectives

This course offers a "hands-on" opportunity to learn by exploration and discovery how physicists and astronomers have arrived at their current understanding of the universe. There will be experiments you will do on your own at home, guided exercises with web-based resources, and use of images and data from the university's telescopes in Kentucky, Arizona, and Australia. Our overall objective is for you to learn how thoughtful reasoning about experiments and observations is the foundation of physics and astronomy. It meets the University's Cardinal Core Requirements for a Natural Science laboratory. There is a separate optional Physics 107 Elementary Astronomy course which should be taken concurrently or before taking this lab. It is also offered online.

As with other Cardinal Core Natural Science classes, the objective of this course is to incorporate astronomy into your critical thinking skills, and to understand how the methods of science work. We will do that by exploring how physics and astronomy help us unravel the underlying mysteries of the Universe, and to

1. Help you understand (and cope with) astronomy encountered in everyday life: seasons, solar energy, and the GPS in your cell phone.

2. Provide a basis for understanding the latest developments about astronomy you will hear in the news.

3. Recognize that while physics does not fully explain the universe, it does predict the effects of intangible invisible things, even though nobody knows what they really are ... yet. (That is, not to fret when something seems incomprehensible, since science itself still does not explain everything, and has to rely on predictable behaviors of invisible things such as gravity and the properties of the fundamental particles which nobody completely understands.)

4. Present you with mysteries not yet solved, or with contradictory or untested theories, so that you may solve them in the future and win a Nobel Prize or have fun trying. (There is plenty of astronomy, not to mention physics, that we do not yet know.)

5. Teach physics and astronomy that you may apply to make life better for yourself and others now, and in the future.

6. Open your mind to new discovery by knowing that the universe should be understandable.

Cardinal Core Outcomes and Assessments

Natural Sciences are concerned with understanding the laws of nature and the physical world. Students who satisfy the Cardinal Core requirement for Natural Sciences will be able to do all of the following:

1. Demonstrate an understanding of the nature and methods of science inquiry.

2. Apply scientific principles: to interpret evidence, to make predictions, and/or to explain cross-cutting concepts in one or more of the sciences.

3. Explain how scientific principles relate to issues of personal and/or societal importance.

4. Communicate effectively an understanding of scientific concepts and experimental outcomes in speech or writing, using sound scientific terminology and citation appropriate to the discipline.

In this course these outcomes will be assessed through weekly activities that require written responses to questions, and analysis of observations and measurements. A monitored online forum for class discussion of topics posed both by students and by the instructor will encourage students to develop their knowledge, deeper understanding of the science, and the skills to communicate effectively with others.

Outcome 1

Demonstrate an understanding of the nature and methods of science inquiry.

The course covers many interactive examples of how we have come to understand the entire universe and its evolution. From the simplest visual observations of the sky, to working with real scientific data representative of that leading to paradigm shifting discoveries, you will come to understand the contributions of individual scientists and their contemporaries, and the current process of scientific enterprise. Thoughtful questions posed to others in the class are encouraged to engage one another in analysis of the weekly activities of the lab, and to develop communication skills. Each week you complete your work by submitting answers to questions we have asked, and explaining what you understand about the methods and results of that week's study.

Outcome 2

Apply scientific principles: to interpret evidence, to make predictions, and/or to explain cross-cutting concepts in one or more of the sciences.

While astronomy is based on observation and measurement, the analysis of the observations depends on physics. The emphasis in this course is not as much on fact or measurement of a specific quantity, as it is on understanding what those facts tell us about the universe, how we come to those conclusions, and what the uncertainties are in that process. The requisite simple but essential physics is incorporated into the activities as needed, and the simplifications that leads to allow predictions based on knowledge of the current state and the science responsible for that. Many of the experiments are designed to develop an understanding of how we came to the knowledge we have, and to use that process as a tool. An example would be determining the mass of Jupiter from the motions of its satellites while using those observed motions to predict where the satellites would be in the future. Another would be using measurements of supernova to find the behavior of exploding dying stars, and in turn applying that knowledge to infer the distance to other galaxies in which such supernovae are found. Each week the activity involves gathering data, interpreting it, and explaining it with the foundation science that is incorporated into that work.

Outcome 3

Explain how scientific principles relate to issues of personal and/or societal importance.

The role of science in modern society is a topic that recurs throughout this class, especially from the relevance of the Sun, Earth and seasonal cycles to our life, and the environment of our planet in the solar system. Our calendar and precision time keeping has been a core component of astronomy since prehistoric times, and in the first activities of this laboratory class you will learn how the daily and annual changes you can see in the sky enable predictions of climate useful for agriculture. You will see how telescopes determine where we are in the universe, the age of the Sun, and ultimately the fate of the Earth. In exploring Mars through robotic spacecraft, you will find how the society's investment in large scale science returns deeper understanding of the origins of life here and potentially elsewhere. Your understanding of these concepts is assessed by questions you answer weekly. While some reflect a measurement or analysis result, many require a written thoughtful response explaining the principles and methods. Additionally, your comments on the class forum will engage others in discussing the relevance of the things your are learning to your life and to society.

Outcome 4

Communicate effectively an understanding of scientific concepts and experimental outcomes in speech or writing, using sound scientific terminology and citation appropriate to the discipline.

There are required written responses every week to the scheduled work. You are expected to convey your understanding of the concepts underpinning the work, and how the experimental or observational results are interpreted and analyzed. Of course this includes also explaining problems you encountered, and resolving difficulties in the same way that science is done today on the most cutting edge topics. The written responses are assessed and become part of the course grade. There is a mentored discussion forum for the class that

invites participation by everyone, so that skills to communicate scientific concepts develop during the course when students explain those concepts to one another, and pose questions to their peers.

A part of this class is to use data from our telescopes and from observatories in space to explore an idea or object that interests you. You will be asked to explain what caught your interest, what you expect to learn, and then to use that data to arrive at an explanation that places it in the context of what you knew before.

In addition to real-world experiences and measurements that are dependent on astronomy, we will guide you through the use of astronomical instruments to understand how we acquire scientific knowledge, even taking a close up look at Proxima Centauri, the Sun's nearest neighbor with a planet that is potentially habitable.

Requirements

The class website will guide you through experiments or observations on different weekly topics over the semester, and will pose specific questions to answer. While you may work on these on- or off-line, your responses will be entered online interactively and will be graded. We reserve the right not to accept work that is late, but please let us know when you need extra time.

While you study, you are expected to use the discussion forum on the website with other students in the same way that you would work with one another for any class. This is a very important part of the class and we monitor the forum to see where you are having difficulty. We encourage collaboration and peer instruction because our goal is to have you participate in the activities to gain an understanding of the science, and learn by whatever means you find most helpful, but of course you must do your own work. We will try to resolve questions you may have for the class as a whole through the discussion forum whenever we can, and to respond to email individually as needed.

Use the discussion forum, take your time to understand, ask questions when you need help, and remember the objective is to learn how to observe, reason, and use your growing knowledge and skill to solve problems. Individual and group assistance through email, our Zoom video conferencing system, or telephone is available on request.

Websites

The University's Blackboard system is the University's gateway to Distance Education programs:

http://blackboard.louisville.edu/

Use your University *User ID* and *Password* to log into Blackboard for announcements. For this Astronomy Laboratory, however, all of the content and responses to work will be managed on our program website at

http://prancer.physics.louisville.edu/moodle

This site is available only to registered students, and it requires a personal password that is different from your university computer password. Instructions on how to use this system will be posted on Blackboard and sent to registered students by email on or before the first day of classes. Please contact Professor Kielkopf if you have not received this by the second day of classes, or if you have difficulty logging into the website. The University's Help Desk can only respond to questions about Blackboard.

Textbook

The content will be provided online through the class website. There is no textbook for this class. In many cases, simply by using a Google search and looking for an appropriate entry in the Wikipedia you can find an answer to basic physics and astronomy questions, and links to far more detail than most textbooks provide. If you follow this suggestion, be selective in accepting answers from Internet resources. Wikipedia has proven to be very reliable, as are the sites supported by NASA, ESA, or ESO, and the selected links we offer.

Information on useful software and other materials will be provided online. No matter what kind of computer you use, there will be tools available for you. While we are working to provide all content through advanced web-based technology, this is still under development and access to a desktop or laptop rather than a tablet or cellphone may be necessary for some of the required work. If you have problems with class content or software, please use our website and post your question to the Discussion Forum. Often other students have seen the same issue and will know the answer, or if not, we can work together to a solution.

Evaluation and Grading

Plan to complete one experiment each week, and to respond to the weekly lab "quiz" on the class website. You may do the work at any time during the week, and you may return to the quiz to modify your answers as often as you want. A new experiment or activity will be made available each week through the end of the semester. Although the initial scoring of most questions is done automatically, where possible, if we see an issue about what you have submitted, we may ask for you to respond again before we assign a final score for credit. Remember, our purpose is to help you learn and understand by observation and reason, not to hear an echo of a precisely "correct" textbook answer. There are 14 activities this semester and your completion of each one contributes equally to the course grade.

We may add an additional 5% for students who make consistent thoughtful contributions to the forum discussions on the class website. Another 5% extra credit is available for those who would like data from our telescopes acquired specifically for them in a small guided project in addition to regular class work. However the sure way to have a good outcome in the class is to participate weekly in the activities and submit work on time.

We will average all of your work and assign letter grades approximately A (90 to 100); B (80 to 89); C (70 to 79); and D (60 to 69).

Caveats

We reserve the right to make changes in the syllabus when necessary to meet learning objectives, when new astronomical discoveries occur, or when there is a technical or software

issue that requires a change in content or methodology. Any changes will be announced by email and posted in the current online syllabus and schedule.

Title IX/Clery Act Notification

Sexual misconduct (including sexual harassment, sexual assault, and any other non-consensual behavior of a sexual nature) and sex discrimination violate University policies. Students experiencing such behavior may obtain confidential support fromthe PEACC Program (502.852.2663), Counseling Center (502.852.6585), and Campus Health Services (502.852.6479). To report sexual misconduct or sex discrimination, contact the Dean of Students (502-852-5787) or University of Louisville Police (502.852.6111).

Disclosure to University faculty or instructors of sexual misconduct, domestic violence, dating violence, or sex discrimination occurring on campus, in a University-sponsored program, or involving a campus visitor or University student or employee (whether current or former) is not confidential under Title IX. Faculty and instructors must forward such reports, including names and circumstances, to the University's Title IX officer.

For more information, see the Sexual Misconduct Resource Guide.

Syllabus version of Januayr 1, 2019

Getting Started

- From the notice on Blackboard or our emails to you, locate your username and your password to our class website
- Connect to http://prancer.physics.louisville.edu/moodle
- Select your class and log in with your username and password (case sensitive)
- First time login you will be asked to change your password
- Update your profile if you want others to know more about you (optional)
- If you have a problem with this, send an email to `kielkopf@louisville.edu`

What to do Weekly

- Each Monday begins a new activity for that week
- Read the instructions and content on line, work through it at your own pace
- Ask and answer questions on the discussion forum
- Before end of day the following Sunday, complete the "Answer questions about ..." section for that week

January 7 - 13 Watch the sky.

January 14 - 20 Identify constellations.

January 21 - 27 The Earth rotates.

January 28 - February 3 Our dynamic Sun.

February 4 - 10 Explore Mars.

February 11 - 17 Light and telescopes.

Feburary 18 - 24 Experiment wih astronomical images.

February 25 - March 3 Use an astronomer's "CCD" camera.

March 4 - 10 Explore the sky with astronomical telescopes.

March 11 - 17 Spring Break week.

March 18 - 24 Earth's Moon.

March 25 - 31 Where are we in the Milky Way?

April 1 - 7 Virgo's galaxies.

April 8 - 14 Under the southern sky in Namibia.

April 15 - 21 Proxima Centauri: Our nearest neighbor with planets.