Introduction to Astronomy

Physics 090, Spring 2020

A grand tour of painstaking observations, remarkable inspiration, and an occasional wrong turn, beginning with the light refracting in a drop of water and finishing with the red-shifted photons that have been traveling to us for 13 billion years since the Big Bang.

Revised: February 9th, 2020

Any minor updates to the syllabus will be available at:

physics.stmarys-ca.edu/courses/Phys090/20S

INSTRUCTIONAL TEAM

- Prof. Brian Hill, lecture and 1st lab section
- Prof. Hill's office phone, office location and office hours are available at physics.stmarys-ca.edu/faculty/brianhill.
- Prof. Aaron Lee, 2nd lab section
- Prof. Hans de Moor, 3rd lab section

OVERVIEW

Astronomy is a wonderful subject just for the pleasure of perusal, and the variety of exotic phenomena in the sky makes it a life-long interest for many people. However, the goal of the discipline of astronomy is to understand the great variety of observations in terms of the rather few principles of physics.

Understanding astronomical observations from physics turns out to be a two-way street. Some of the principles of physics — for example, Newton's Law of Universal Gravitation — or that neutrinos change type as they travel — were deduced from astronomical observations in combination with laboratory physics experiments. The relationship is so close that the field is now often called "astrophysics" and it can be considered a specialty of physics, like condensed matter physics or particle physics.

The associated laboratory course (Physics 91) will have roughly about five Wednesday indoor labs where physics experiments (light, optics, spectroscopy, the Doppler shifts and gravitation) are performed, and about five Wednesday outdoor labs where you will learn to operate and make observations with the College's telescopes. Refer to the Astronomy Laboratory Syllabus for more details.

Necessarily, the class will use mathematics — specifically, algebra and geometry. This is integral to the modern scientific method. Every physics theory that we are confident of, we are confident of precisely because it has been tested quantitatively as well as qualitatively. As we use them, we will review high school math and science subjects such as scientific notation, algebra and trig functions, the periodic table, and others.

The interplay between astronomical observations, physical principles and quantitative predictions is an excellent example of what the Core Curriculum refers to as "Mathematical and Scientific Understanding" — one of the Core's four pathways to knowledge. This course is designed for you to acquire a new-found or deepened understanding of that pathway while simultaneously having the pleasure of studying the most spectacular phenomena that nature has to offer.

MATERIALS

Textbook and Handouts

- We will be using the OpenStax textbook. Chapter and page numbers will refer to this edition: Astronomy, Revision AS-2016-003(08/18)-RS.
- At some point in the future, perhaps you will want to get whatever subsequent updates have occurred directly from the publisher. Those can be downloaded for free from https://openstax.org/details/books/astronomy.
- In addition, I will frequently provide supplementary handouts.
- In past years, I have used The Cosmos: Astronomy in the New Millenium, now in its 5th edition, by Jay M. Pasachoff and Alex Filippenko. It is a modern, and beautifully constructed and illustrated book. If you want to go deeper than we can go in our course, I would be pleased to help you work through sections of this book.
- For studying for the midterms, it will be very helpful to keep a well-organized set of the handouts. For studying for the final, you should also retain your midterms, because I will re-use many problems from the midterms on the final.

Homework System

To go along with the free textbook, there is an on-line homework system (the publishers have to make some money somehow!). Registration in the system is $32.50. This is far less than the traditional textbook cost. Expect an email from me explaining how to sign up for Expert TA. All homework will be assigned through this system.

SCHEDULE

For the Spring Semester we are allotted 14 weeks, not counting the additional week reserved for the Final Exam Schedule. Subtracting one week for Easter break, there remain 13 weeks available to cover the five units:

- Unit 1: Light, Matter, Energy, Geometrical Optics, Telescopes.
    - Note: The Geometrical Optics and Telescopes part of this unit will be covered in the Physics 91 labs over the course of the semester. In class, we will focus on Light, Matter and Energy — not optics and telescopes.
- Unit 2: The Motions of the Earth, the Moon and the Planets — The scale of the Solar System
- Unit 3: Kepler, Newton — The Composition and Properties of The Sun and the Planets.
- Unit 4: Parallax method, Astronomical Distance Scales (Light-Year and Parsec), Hertzsprung-Russell Diagram, Leavitt-Pickering Period-Luminosity Relationship, Magellanic Clouds
- Unit 5: Novae and Supernovae, Other Galaxies, The Big Bang, Dark Matter.

Five units in 13 weeks means that our pace will be a little faster than 3 weeks per unit. There will be an exam after each of the first four units, and a final exam that is cumulative and cover the fifth unit.

The exam dates are:

- Unit 1 - 8am, Friday, February 28
- Unit 2 - 8am, Wednesday, March 18
- Unit 3 - 8am, Friday, April 17
- Unit 4 - 8am, Monday, May 4
- Unit 5 and Cumulative Final - 8am, Monday, May 18

DETAILED DAILY SCHEDULE

Detailed, daily schedules for each unit will be *retrospectively* maintained.

- Detailed Schedule

EXAMS AND GRADING

35% for assignments, 10% on each unit exam (totaling 40%), 25% final.

Most or all exam problems will be multiple choice. Carefully compare your work with the detailed solutions whenever solutions are discussed in class or handed out.

Late assignments are accepted for reduced credit but not later than the beginning of the next class! If you have to miss a class, rely on your classmates, their notes, and any handouts.

STEM CENTER TUTORING

Saint Mary's has a center for students taking STEM classes in Assumption Hall, Room 200. The STEM Center provides several services, including free tutoring in math, chemistry, physics, and biology. Please be very respectful of the Assumption Hall residents. Physics and math tutors will usually be able to help with introductory astronomy problems.

ACADEMIC HONOR CODE

The Saint Mary's Academic Honor Code (AHC) is applicable to this (and all) Saint Mary's courses. You are responsible for familiarizing yourself with it: AHC Website.

STUDENT DISABILITY SERVICES

Accommodations that take into account the context of the course and its essential elements for individuals with qualifying disabilities are extended through the office of Student Disability Services (SDS). Information regarding the services available may be found on the SDS Office Website.

Return to Physics & Astronomy Home