

Physics 101: The Evolving Universe

Fall 2007

Location: Masters Hall 208
Time: MWF 1:10-2:00pm
Office Hours: M 2:00-4:00pm
W 10:00-11:00am
or by appointment

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Required Text:

Physics: Concepts & Connections by Art Hobson (4th edition)
A pocket calculator with scientific notation.

Recommended: A graphing calculator.

Suggested Reading (Optional):

The Elegant Universe and *The Fabric of the Cosmos* by Brian Greene
Cosmos by Carl Sagan

Course Overview

The Evolving Universe is an introduction to the story of the cosmos and our role in it. This story evolves on its own and in the continual development of our scientific understanding of the universe. No background in physics is necessary.

Central to our study are the main characters of the physical universe (the fundamental forces of nature, the fundamental particles, and the unifying concept of energy) and their language (scientific units and notation, the constants of nature, and certain key mathematical results). We will discuss both the origin and final fate of the cosmos, including the recent developments of string theory and the discovery of the accelerating universe.

Our story has four chapters: (1) *The Clockwork Universe*, (2) *The Universe of Light*, (3) *The Relativistic Universe*, and (4) *The Quantum Universe*. For each chapter, we will connect the elements of this story to its human discoverers: Galileo, Kepler, Newton, Maxwell, Einstein, and many others. Their methods of inquiry, incorporating both theory and experiment, serve as both the foundation and the model of modern science and technology. Their influence truly extends to our entire culture, and our response may impact the future of human civilization. The possibility of other civilizations will also be discussed.

At the end of this course you will be able to identify the various scales and structures present in the universe, how they interact, and how we come to know these things through scientific argument.

Regarding the use of Mathematics: You will not be required to memorize equations or solve typical physics problems in this course. However, you will be required to identify physical units (force, energy, etc.) and to evaluate and interpret graphical representations of some equations. As stressed by Hobson: “Literate people must also be *numerate*” (i.e. capable of quantitative thought and expression).

Grading

There are four components to the grading: quizzes, homework, exams, and a paper. The quizzes will occur every other week throughout the semester, based on your reading of the text. After a short discussion given on Monday, these are to be completed before Wednesday’s class on Angel (on rare occasions, these may become in-class quizzes). These will be multiple choice and based on the concept checks and review questions in Hobson. On alternating weeks there will be homework exercises which will include the use of equations, numerical estimation, and writing. Specific problems will be assigned on Wednesday (and listed on Angel), to be turned in at the beginning of class the following Wednesday. There will be two in-class exams and a final, based on both the book (quizzes and homework) and material introduced in class. Finally, a paper will be assigned near the Thanksgiving break (see below). The grading breakdown will be the following:

Graded Work	Grading Weight
Quizzes	10 %
Homework	10 %
Exam 1	15 %
Exam 2	20 %
Paper	20 %
Final Exam	25 %

Class participation is highly encouraged, and can improve your grade by up to 10%. Discussions of recent events or Physics Department Colloquia are particularly welcome.

Late policy: Should you be unable to submit an assignment due to a reasonable conflict, let me know at least a week in advance; if due to a serious emergency, documentation may be requested. Otherwise, late quizzes will not be accepted; late homework will be accepted but will be subject to a late penalty of up to 50% (~20% each day, until solutions are posted, typically on the following Monday).

Student Collaboration is allowed for homework and the short paper (but must be acknowledged; see below). Quizzes must be done independently.

Videos and Paper

Periodically, the class will view videos (sometimes in the Hatter Planetarium) supplementing the text: *Cosmic Voyage* narrated by Morgan Freeman, *Cosmos* by Carl Sagan, and *The Elegant Universe* by Brian Greene. These are meant to bring life to our story of the universe, and should be considered a central part of the course. These (and a few others) will remain on reserve in the library.

The short paper will also be based on video selections, but here you will have a choice: the science-fiction film *Contact* (starring Jodie Foster, based on the book by Carl Sagan), the documentary *An Inconvenient Truth* (starring Al Gore), or the historical drama *Apollo 13* (starring Tom Hanks). Other film choices can be proposed to the class (and perhaps approved) before the Thanksgiving break. An initial submission and revised submission will be allowed. More details will be presented in the beginning of November.

Course Outline and Schedule

Week	Dates	Chapter / Video	Assignments Due
1	Aug. 27-29-31	CU: <i>Cosmic Voyage</i>	Hobson Ch. 1+2;
2	Sept. 3-5-7	CU: <i>Cosmos</i> Ep.III	Hobson Ch. 1+2; HW 1
3	Sept. 10-12-14	CU: none	Hobson Ch. 3+4; Q1
4	Sept. 17-19-21	CU: <i>Cosmos</i> Ep.IX	Hobson Ch. 5; HW 2
5	Sept. 24-26-28	CU: none	Hobson Ch. 6+7; Q2
6	Oct. 1-3-5	UL: none	Hobson Ch. 8; HW3
7	Oct. *-10-12	UL: none	Hobson Ch. 8; Exam 1
8	Oct. 15-17-19	UL: none	Hobson Ch. 9; Q3
9	Oct. 22-24-26	RU: <i>Cosmos</i> Ep.VIII	Hobson Ch. 10; HW4
10	Oct. 30-31-Nov. 2	RU: none	Hobson Ch. 10; Q4
11	Nov. 5-7-9	RU: <i>Elegant Universe 1</i>	Hobson Ch. 11; HW5
12	Nov. 12-14-16	RU: none	Hobson Ch. 11+12; Exam 2
13	Nov. 19-**-*	<i>Cosmos</i> Ep. XII	Hobson Ch. 12; none
14	Nov. 26-28-30	QU: none	Hobson Ch. 13+14; Q5+P
15	Dec. 3-5-7	QU: <i>Elegant Universe 3</i>	Hobson Ch. 14+18; HW6+RP
Final	Dec. 15		Final Exam

Key: CU: The Clockwork Universe; UL: The Universe of Light
 RU: The Relativistic Universe; QU: The Quantum Universe
 HW: Homework Exercise; Q: Quiz; P: Short Paper; RP: Revised Short Paper

Honor Code

Every work that is done by you and your fellow students is subject to the honor code. Note that the honor code is not just about cheating: all activities in class are to be undertaken with honesty and integrity. However, this should not be pursued at the expense of learning. Your peers are a great resource, and you are greatly encouraged to discuss this class and all written assignments (except the exams and quizzes) with your fellow students. However, all submitted work must be your own. Should you incorporate any ideas in written assignments arising from discussion with others, please acknowledge this at the end of the text (this is quite common in scientific writing), and properly reference any other materials you have utilized. If in doubt, contact me for assistance.

Final Disclaimers

All contents of this syllabus are subject to revision by the instructor. While physics is not usually a politically charged topic, passionate discussion may occasionally occur. Please do not take any perceived offense personally, and please see me if you have any concerns.