Astrophysical Sciences 203: The Universe

Spring 2008
Lectures: T & Th 3:00-4:20, McDonnell A02

This course comes in three parts – planets and life, stars and galaxies, and the universe – with a syllabus targeting the frontiers of modern astrophysics. Subjects include the intellectual history of astronomy, the solar system; the search for life in the universe; the birth, life, and death of stars; the structure of the Milky Way; the properties of galaxies; the expanding universe; Einstein's special and general theories of relativity; black holes; time travel; and big bang cosmology and the future fate of the universe.

This course has three faculty lecturers, Christopher Chyba, Michael Strauss, and J. Richard Gott. Each will give roughly eight lectures. Prof. Strauss is the administrative head of the course, and will be the easiest to reach throughout the semester. E-mail is always the easiest way to get ahold of us (put "AST 203" in the subject line, please!).

Professors:
Michael A. Strauss (x8-3808, 110 Peyton Hall, strauss@astro.princeton.edu)
Christopher F. Chyba (x8-3588, 122 Peyton Hall, cchyba@princeton.edu)
J. Richard Gott (x8-3813, 118 Peyton Hall, jrg@astro.princeton.edu)

Course Assistants:
Min-Su Shin (x8-8050, 9 Peyton Hall, msshin@astro.princeton.edu)
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Ragnhild Lunnan (29 Peyton Hall, rlunnan@princeton.edu)

Office hours are listed on the course web site.

There will be regularly scheduled informal precepts throughout the semester, which will allow discussion of the material presented in lecture, discussion of the homework assignments with the course and teaching assistants and an opportunity to work with other students on the homework. They will be held in the Peyton Hall auditorium.

In addition, we will hold observing sessions throughout the semester, to explore the night sky, the planets, double stars, and nebulae. They are usually scheduled for Tuesday nights, but may move to other nights depending on the weather. Watch

your e-mail!

Texts:

- The Cosmic Perspective, 4th Edition (2005) (*Recommended*) Jeffrey Bennett, Megan Donahue, Nicholas Schneider, and Mark Voit (Addison Wesley)
  There is not much difference between the 3rd and 4th editions; it will not hurt you much to have the 3rd edition, which you can probably buy used. The 5th edition may also be available (we haven't seen it yet). However, do *not* get the abbreviated version: 'Stars, Galaxies, and Cosmology'; this does not include some important chapters we will need.

- Time Travel in Einstein's Universe: The Physical Possibilities of Travel through Time (2001) (*Required*) J. Richard Gott (Houghton Mifflin)

Grading:

Homework: 35% (six assignments; mixture of essay and quantitative questions)
Mid-Term: 25% Combination of Essay and Quantitative Questions
Final Exam: 40% Combination of Essay and Quantitative Questions

Homework is due in class on the date indicated in the syllabus below. Late homework will not be accepted, as homework solutions will be made available at the time that the homework is due. You are welcome to work together on the homeworks, but each person's writeup should be their own, *using their own words.*

Each student will have a folder with their name on it, in one of a series of four boxes which will be placed in the hallway outside the lecture room (the Brush Gallery). Homework and exams will be handed in, and returned to you, via these folders.

The course Home Page is:
`http://www.astro.princeton.edu/~strauss/AST203/index.html`
Lecture notes, homework assignments (and solutions), and other relevant information will be posted on the page; check it out often. Notices will also be sent out by e-mail.

The following course outline is approximate, and may change as the course progresses. The syllabus can also be found on the course web site; it will be kept up-to-date. For each lecture, the corresponding chapters in our texts are indicated. You are responsible only for the material in the lectures and in the problem sets, not for all the material in the texts. There will be many occasions when the lectures cover material not discussed in the texts. Some supplementary reading material will be supplied.

Detailed outlines of each lecture will be made available on the course home page, as will a guide to what you should read in the textbooks. The dates and times of special events are listed in italics below. The schedule of observing sessions may change due to the vagaries of weather.

————Christopher Chyba: Science, Planets and Life————

Tuesday February 5	Introduction: Our Solar System and Life (Chapters 1, 7; Appendix C of CP)
Thursday February 7	Motions on the Sky and Ancient Astronomy (Chapters 2 and 3 of CP)
Tuesday February 12	The Copernican Revolution: Science and Skepticism (Chapter 3 of CP)
Tuesday February 12 *8 PM*	Observing session (for those whose last names start with A-F) Peyton Hall
Wednesday February 13 *7:30-9:30 PM*	Discussion/Problem Session Peyton Hall Auditorium
Thursday February 14	Kepler, Newton, and The Law of Universal Gravitation (Chapter 4 of CP) **Homework #1 due**.
Tuesday February 19	Philosophy of Science; Thermal Radiation (Chapter 5 of CP)
Tuesday February 19 *8 PM*	Observing session (for those whose last names start with G-M) Peyton Hall
Thursday February 21	Radioactive Dating: How Old is the Solar System? (Chapters 8 and 9 of CP)
Monday February 25 *7:30-9:30 PM*	Discussion/Problem Session Peyton Hall Auditorium
Tuesday February 26	Planetary Habitability and the Greenhouse Effect. (Chapter 10 of CP) **Homework #2 due.**
Tuesday February 26 *8 PM*	Observing session (for those whose last names start with N-Z) Peyton Hall
Thursday February 28	Life in the Solar System and Beyond (Chapter 24 of CP)
Friday February 29	Trip to Rose Center for Earth and Space at the American Museum of Natural History, New York City (details to follow)

Michael Strauss: Stars and Galaxies

Tuesday March 4	The Births and Lives of Stars (Chapters 14, 15, 16, 17 of CP)
Wednesday March 5 *7:30-9:30 PM*	Discussion/Problem Session Peyton Hall Auditorium
Thursday March 6	Star Death (Chapters 17 and 18 of CP) **Homework #3 due**
Tuesday March 11	The Interstellar Medium and the Structure of the Milky Way (Chapters 17, 19 of CP)
Thursday March 13	**Midterm exam** in class
SPRING BREAK	
Tuesday March 25	The Universe of Galaxies (Chapters 20, 21 of CP)
Thursday March 27	The Age and Expansion of the Universe (Chapters 20, 22 of CP)
Tuesday April 1	The Early Universe and the Big Bang (Chapters 22, 23 of CP)
Wednesday April 2 *7:30-9:30 PM*	Discussion/Problem Session Peyton Hall Auditorium
Thursday April 3	Quasars, Active Galaxies, and Supermassive Black Holes (Chapter 21 of CP) **Homework #4 due**

J. Richard Gott: Einstein and the Universe

Tuesday April 8	Einstein's Special Theory of Relativity, Part I (Chapter S2 of CP; Chapters 1 and 2 of TTEU)
Thursday April 10	Einstein's Special Theory of Relativity, Part II (Chapter S2 of CP; Chapters 1 and 2 of TTEU)
Thursday April 10 *9 PM*	Observing session Peyton Hall
Tuesday April 15	Einstein's General Theory of Relativity (Chapter S3 of CP; Chapters 1 and 2 of TTEU)
Wednesday April 16 *7:30-9:30 PM*	Discussion/Problem Session Peyton Hall Auditorium
Thursday April 17	Black Holes (Chapter 18 of CP; Chapter 3 of TTEU) **Homework #5 due**
Tuesday April 22	Cosmic Strings, Wormholes, and Time Travel (Chapter S3 of CP; Chapter 3 of TTEU)
Tuesday April 22 *9 PM*	Observing session Peyton Hall
Thursday April 24	The Big Bang and the Shape of the Universe (Chapters 22, 23 of CP; Chapter 4 of TTEU)
Tuesday April 29	Inflation, and Recent Developments in Cosmology (Chapters 22 and 23 of CP; Chapter 4 of TTEU)
Wednesday April 30 *7:30-9:30 PM*	Discussion/Problem Session Peyton Hall Auditorium
Thursday May 1	Our Future in the Universe (Chapter 5 of TTEU) **Homework #6 due**