

Physics 206  
Special Topics in Physics:

# Physics of the Early Universe

Spring 97-98 MWF 1:20  
1412 Sterling Hall

One of the most rapidly developing areas of physics is cosmology and the study of the early Universe. Luckily, the basics of this subject can be understood with no more than a solid knowledge of first-year physics and calculus. This course is designed to make current theories and observations in cosmology accessible to physics and other science concentrators.

**Prerequisites:** Math 221 or equivalent.

One semester of intro physics (Equivalent of Physics 103 or 201 or 207)  
Open to freshmen.

**Textbooks:** Principles of Cosmology and Gravitation, M. V. Berry 1989  
Introduction to Cosmology, 2<sup>nd</sup> Edition, Matts Roos, 1997  
The First Three Minutes, Steven Weinberg, 1993

I've put many more good books are on reserve in the Physics Library.

**Web Site:** <http://wisp5.physics.wisc.edu/~timbie/p206/syllabu.htm>

Here you'll find links to many things, including email addresses for your classmates and relevant websites.

**Staff:**

**Instructor:** Professor Peter Timbie, 6209 Chamberlin, 262-5916  
timbie@wisp.physics.wisc.edu

**Grader:** Mr. Chris O'Dell, 6246 Chamberlin, 262-5916  
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**Secretary:** Ms. Donna Garcia, 6219 Chamberlin, 262-5916  
donna@SAL.WISC.EDU

**Office Hours:**

Mondays and Fridays 2:10-3:00 (right after class)

I am happy to set up an appointment if office hours are not convenient for you.

Feel free to contact me by email at any time.

PHYSICS 206

fall '95

Texts:

French-Special Relativity

Taylor and Wheeler - spacetime Physics

Einstein - Special Relativity

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WEEK MATERIAL COVERED

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4 Sep	Historical introduction
11 Sep	Newton, Maxwell: The Ether
18 Sep	Eintein Postulates Synchronicity
25 Sep	The train paradox, Lorentz Transformation
2 Oct	Minkowski space time, Doppler Effect
9 Oct	The twins
13 Oct	Review - First Exam Taylor and Wheeler pgs 11-47 French Chps 3-5
16 Oct	Photons
23 Oct	Energy and momentum
30 Oct	Particle Physics
6 Nov	Four vectors
10 Nov	Review Second Exam French Ch 2 Ch 6-7 Taylor and Wheeler pgs 101-174
13 Nov	The principle of equivalence
20 Nov	Gravitational red shift
27 Nov	Curved Sace-Time
4 Dec	Experimental verifications
11 Dec	Review -Term Paper Final

## Topics:

- Contents of the Universe
  - cosmic distance ladder
  - redshifts and the Hubble expansion
  - Olber's paradox
- Some ideas from relativity
  - Special Relativity
  - geodesics
  - Mach's principle
  - Einstein's Equivalence Principle
  - curvature and gravitation
  - General Relativity
- Cosmic Kinematics: navigating in curved spacetime
  - Robertson-Walker metric
  - open, closed, critical universes
  - redshifts and horizons
- Cosmic Dynamics
  - Friedmann Equations
  - model universes; Inflation
- History of the Universe
- Relics from the Big Bang:
  - Microwave Background Radiation
  - Cosmic Neutrino Background
  - Nucleosynthesis; the formation of the light elements
- Open Questions
  - Horizon Problem
  - Flatness Problem
  - Inflation
  - Dark Matter

## Expectations:

The lectures will follow the textbooks fairly closely. I expect you to read the assigned sections carefully before class and be ready to ask and answer questions about them. I may have an occasional in-class quiz!

### *Weekly Homework.*

Due each Friday in class. Problem solving is at the heart of the course. You'll work in small teams to solve homework problems. Each team will write a problem solution and will present it to the class. Some of the homework will ask for short essays.

*Midterm Exam* In class on Friday, March 6

*Short Paper* (8-10 pages). You'll present this to the class in a 15 minute report.

### *Final Exam*

Each of these parts will count for 25% of the course grade.