

**History 181B: Modern Physics**  
**MWF 2-3, 3 Le Conte, Spring 2008**  
**4 units, CCN 39612, Exam Group 6**  
**on bSpace: History 181B LEC 001 Sp08**

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## A. COURSE DESCRIPTION

### 1. *What*

This course covers the establishment of the ideas and institutions of modern physics, tracking the evolution of the discipline over the last two centuries. The period has witnessed dramatic developments, both intellectual and structural. While the course's guiding thread is the history of physical concepts, these are woven into their social, cultural, and political context.

We begin with the nineteenth-century organization of the discipline and the debates over the classical world picture: mechanics, thermodynamics and statistical mechanics, electromagnetism and optics, concepts of matter and fields. We then follow the dramatic changes that reworked the classical picture, from the discovery of radioactivity, x-rays, and the electron, through Einstein's theories of relativity, on to the creation of quantum mechanics and accompanying philosophical disputes. We consider the elucidation of atomic structure, the exploration of the nucleus, and the establishment of the field-theoretic description of natural phenomena.

Alongside these conceptual upheavals we will watch the transformation of the discipline from a small-scale, academic, largely European enterprise to a world-wide profession on an American model, carried out in reliance upon massive state funding, and endowed with the power, through its creations (solid-state devices, the atomic bomb), to shape national and international destinies.

### 2. *How*

The course draws approaches and materials from both history and science. We deal in some depth with scientific concepts, but in a way that remains accessible to non-scientists willing to put in some effort. Throughout, however, we emphasize historical development. The ideas of science are not timeless, and they did not drop from the sky. A main course goal is to practice thinking historically; assignments and examinations call on those skills.

### 3. *Who*

The course is aimed equally at two groups of students.

- **Science and engineering majors** will gain an understanding of the structure and functioning of a field they have studied. They should come away from the course with a sense for how physics works and hangs together, not just how to do problem sets.
- **Non-science/engineering students** will get a historical introduction to this scientific discipline. A decent high-school course in physics or chemistry is adequate preparation. Students concerned about their background should feel free to talk to me or the GSI. This course fulfills the L&S breadth requirement in physical sciences.

Major is not a good predictor of success in the class. In past years, students who got As and A-s have come from history, astrophysics, philosophy, MCB, music, math, IB, engineering physics, business administration, English, physics, Near Eastern studies, PACS, and EECS.

### 4. *For help*

**Come to office hours.** The GSI and I are here to answer your questions.

**Sign up for optional sections** (no extra units). The sections are coordinated with the reading response option (see below). The two sections meet:

- **Sect 101, Wednesday 9-10, 255 Dwinelle** – mainly for extra help on the science.
- **Sect 102, Friday 1-2, 279 Dwinelle** – mainly for extra help on history and writing.

Unless there is overcrowding, you are welcome to drop in even if you are not signed up.

**Do the worksheets.** Optional ungraded worksheets on bSpace can consolidate your grasp of the science. Answers are on the site, and the GSI and I will take questions. The fact that we have worksheets on the science but not on the history doesn't mean the history is unimportant. It just means history isn't well studied through worksheets.

**Do extra credit assignments.** Instructions are on bSpace.

**Use all the bSpace resources.** Get detailed instructions for assignments. Review reading questions, lecture outlines, and (enrolled students only) powerpoints. Download podcasts (2-day delay). Look at sample exams.

**Come to class!** Ask questions. The class cumulates; follow it in real time. Don't think that ppts plus podcasts substitute for attending. My powerpoints go along with my lectures, but they **are not** bulleted lists of things to know for the exam. And don't assume you already know the history of physics from television specials, popular reading, or your science class. You don't.

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## B. ASSIGNMENTS, EXAMS, AND GRADING

### 1. Required of everyone: reading

This is a history course, and there is (gasp) something to read for almost every class. Do it before coming to class, as the lectures will presume your familiarity. For guidance, refer to the page of reading strategies (on bSpace) and reading questions for each assignment (in the reader and on bSpace).

Most of the readings are primary sources written by scientists. The **reader** is available from Copy Central, 2560 Bancroft Way, and on reserve in the Physics Library. Several assignments can be completed **only** on the web.

**Two required books** (both fiction) are available in the bookstores and on reserve in the Physics Library:

- Russell McCormmach, *Night Thoughts of a Classical Physicist* (Cambridge, MA: Harvard University Press, 1991), ISBN 0674624610.
- Michael Frayn, *Copenhagen* (New York: Anchor Books, 2000), ISBN 0385720793.

There is no textbook for this course; one that would work hasn't been written. However, the Physics Library has relevant supplementary books on reserve. Browse the list on bSpace or ask me for guidance.

### 2. Required of everyone: writing assignments

Instructions for the four required writing assignments are on bSpace. The assignments must be submitted on paper in class (not electronically). Due dates:

- *Night Thoughts* assignment (4-5 pp.). Due **Monday, February 11**.
- *Physical Review* assignment (3 pp.). Due **Wednesday, February 27**.
- *Copenhagen* assignment (4-5 pp.). Due **Friday, April 18**.
- *Bulletin of the Atomic Scientists* assignment (3 pp.). Due **Friday, May 2**.

**Late papers** will be penalized by the following scheme: each day of lateness (or fraction thereof, starting at the end of class) reduces the grade by  $\frac{2}{3}$  of a letter (e.g., A to B+). Take late papers to the History Department office (3229 Dwinelle Hall, open 9-12 and 1-4), **put on a time-and-date stamp**, and leave in the GSI's mailbox.

Instead of the four writing assignments, you may make special arrangements with me to write a 12-15-page **research paper**. If you are considering this option, you **must** come talk with me by **Wednesday, February 6**. I will be happy to help brainstorm, and I will work with you through the semester. Details are on bSpace.

### 3. Section and reading response option

If you choose, you can **sign up for a section and write reading responses**. Because this gives you more direct engagement with the course material, you get to **skip the midterm and take a shorter final exam**. You have to choose this option in time to submit your reading responses for the first unit. After that point, you can't switch into the option – though you can switch out by **Monday, March 10**, by dropping the section and taking the midterm.

**Section:** Enrollment is managed by the GSI, not BearFacts. The two sections are (see above)

- **Sect 101, Wednesday 9-10, 255 Dwinelle** – mainly for extra help on the science.
- **Sect 102, Friday 1-2, 279 Dwinelle** – mainly for extra help on history and writing.

But you can sign up for either section, whatever your background. If you want to do reading responses and can't attend either section, let the GSI know and we'll see what we can do.

**Reading responses:** For this option, you must also write at least three responses per syllabus unit. You must submit each response by e-mail **before** the class for which that reading is assigned. If you do more than three responses in a unit, you get extra credit. See bSpace for guidance and details.

### 4. Exams

- The **midterm** (closed-book) will be given in class on **Monday, March 10**. It covers the first two units of the syllabus. **Students who choose the section and reading response option do not have to take the midterm.**
- The **final exam** (closed-book) is scheduled for **Friday, May 16**, from 5:00-8:00 p.m. It covers the entire semester. **Students who choose the section and reading response option take a shorter final exam.**

### 5. Grading

Final grades will be assigned as follows:

<i>Night Thoughts</i> assignment	1 part
<i>Physical Review</i> assignment	1 part
<i>Copenhagen</i> assignment	1 part
<i>Bulletin of the Atomic Scientists</i> assignment	1 part

AND

Reading responses and reduced final	6 parts (4 parts plus 2 parts)
OR	
Midterm and final exam	6 parts (2 parts plus 4 parts)

Any work not completed will count as an F. In individual cases (e.g., marked improvement over the course of the semester) I may choose to deviate from this scheme.

### 7. Extra credit

See bSpace. Extra credit does not simply add points to your overall class score. Any *two* extra credit assignments count as much as *one* short writing assignment and are added in as one extra “part” in the grading scheme.

## C. COURSE SCHEDULE (Major assignments noted)

<b>Unit 1: Classical World Pictures</b>				
W	1/23	1	<i>Introduction and overview</i>	
F	1/25	2	<i>Natural philosophy and mechanical explanation</i>	
M	1/28	3	<i>New mechanical principles</i>	
W	1/30	4	<i>Thermodynamics</i>	
F	2/1	5	<i>Electricity and magnetism</i>	
M	2/4	6	<i>Electromagnetism</i>	
W	2/6	7	<i>Making sense of Maxwell</i>	Res ppr option – check in
F	2/8	8	<i>Classical world pictures (1)</i>	
M	2/11	9	<i>Classical world pictures (2)</i>	Night Thoughts assignment
W	2/13	10	<i>Kinetic theory and statistical mechanics</i>	
F	2/15	11	<i>Empires of science</i>	

  

<b>Unit 2: Challenges</b>				
M	2/18		HOLIDAY	
W	2/20	12	<i>New radiations, new phenomena (1)</i>	
F	2/22	13	<i>New radiations, new phenomena (2)</i>	
M	2/25	14	<i>Radiation problems</i>	
W	2/27	15	<i>The quantum</i>	Physical Review assignment
F	2/29	16	<i>Einstein and relativity (1)</i>	
M	3/3	17	<i>Einstein and relativity (2)</i>	Res ppr option – topic due
W	3/5	18	<i>Einstein and relativity (3)</i>	
F	3/7	19	<i>General relativity and beyond</i>	
M	3/10			MIDTERM

  

<b>Unit 3: The Quantum Mechanical Era</b>				
W	3/12	20	<i>Atomic physics</i>	
F	3/14	21	<i>The old quantum theory of atomic structure</i>	
M	3/17	22	<i>Making quantum mechanics (1)</i>	1st Nobel option (extra cr)
W	3/19	23	<i>Making quantum mechanics (2)</i>	

F	3/21	24	<i>Making sense of quantum mechanics</i>	
M	3/24		SPRING VACATION	
W	3/26		SPRING VACATION	
F	3/28		SPRING VACATION	
M	3/31	25	<i>Making use of quantum mechanics</i>	
W	4/2	26	<i>The solid state</i>	
F	4/4	27	<i>Quantum fields</i>	
M	4/7	28	<i>Quantum particles</i>	Res ppr option – outline due
W	4/9	29	<i>The rise of American physics</i>	
F	4/11	30	<i>Advancing physics at home</i>	2nd Nobel option (extra cr)
M	4/14	31	<i>Nuclear physics</i>	
W	4/16	32	<i>The threats of the 30s</i>	
F	4/18	33	<i>Physics under National Socialism</i>	Copenhagen assignment

<b>Unit 4: World War II and Beyond</b>				
M	4/21	34	<i>The physicists' war</i>	
W	4/23	35	<i>Fission as a weapon</i>	
F	4/25	36	<i>Physics, politics, and the state</i>	
M	4/28	37	<i>Rethinking quantum field theory</i>	
W	4/30	38	<i>Renormalization</i>	
F	5/2	39	<i>The Standard Model</i>	Bulletin assignment
M	5/5	40	<i>And beyond</i>	
W	5/7	41	<i>Astrophysics and cosmology</i>	
F	5/9	42	<i>Simplicity and complexity</i>	3rd Nobel option (extra cr)
M	5/12	43	<i>Possible worlds and alternate histories</i>	Res ppr option – ppr due
F	5/16		Exam, 5-8 p.m.	FINAL