

# PHYSICS/ PHILOSOPHY 419 & 420 SPACE, TIME, & MATTER

Spring 2018

Tuesdays & Thursdays, 12.30p–1.50p, in 276 Loomis

**Website** for course info: [courses.physics.illinois.edu/phys419](http://courses.physics.illinois.edu/phys419)

Turn in assignments & track grades via **Compass**: [compass2g.illinois.edu](http://compass2g.illinois.edu)

## **Things to do by Thursday!**

1. Read grading rubric for written assignments (on Compass).
2. Read the list of assignment-writing suggestions (Compass).
3. Look at the exemplary homework assignment (Compass).
4. Start reading one of the course texts (see website).
5. Start Homework Assignment #1 (see website): it is due **Friday** (the **19th**)!

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**Course assistants:**

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Charles is only able to respond electronically, not in person; however, he is usually able to respond to email quickly. Use him as a resource for your paper-writing at any time – though please do not initially send whole drafts (which can lead to a very passive writing process); instead, first send questions or paper bits (thesis, outline, etc.).

**Lectures:** I will not lecture for 80 minutes straight. There will be in-class discussions, either initiated by your questions and comments, or by mine, or both.

**Homework:** 6 short essays, 500-750 words, will be graded both for content and style and returned quickly. Each will be graded out of a total of 20 points. Your lowest homework grade will be dropped when determining final grades. Late submissions are accepted, with a deduction of 5% per day, beginning right after the deadline, until no credit remains.

**Quizzes:** There will be two short, in-class quizzes in the middle of the term (15 February & 27 March). These are designed simply to make sure that you are keeping up with the course topics and reading.

**Term paper** (for 419 students only): You will write a critical essay of about 2500–4000 words on a topic that reflects your interests and is closely relevant to the scientific and philosophical themes of the course. The term paper has a series of required deadlines. See the website ([courses.physics.illinois.edu/phys419/sp2018/termpaper.htm](http://courses.physics.illinois.edu/phys419/sp2018/termpaper.htm)) for details.

**Exam:** The final exam will be 1.30p–4.30p, Tuesday, 8 May, will consist of about four short essays, and will be open-book & open-notes.

**Plagiarism:** SafeAssign (via Compass) checks for plagiarism. You must understand and follow the guidelines. Any violation will result in significant penalties. For academic papers, **you must always quote when using others' words, and must always cite when quoting, paraphrasing, or using others' ideas.**

Regarding submissions, **it is your responsibility to turn your assignment in on time, and to verify that it uploaded correctly.** If you have difficulties, you must contact Charles ([bcharles@illinois.edu](mailto:bcharles@illinois.edu)) *right away*. It will not be deemed an acceptable excuse to contact us at some later time for credit because of a glitch that you claim occurred on Compass or SafeAssign (whereas if you contact Charles at the time that a difficulty is occurring, we can work out a solution). One thing you can do to help in this regard is to not submit at the last minute.

**Writing help:** You are encouraged to contact & work with the assistants! This is a writing-intensive course, and 419 counts as Advanced Composition credit for UI. When working with an instructor over email, please *do not send a whole draft initially* (rather, begin with specific questions or comments).

**English as a foreign language:**

If English is not one of your native languages, academic writing in English may present additional challenges for you. As this is a writing-intensive course, we recommend that you seek out some additional assistance as soon as possible if you have not already. Here is a link with some resources, including on obtaining help at the U of I (link is also on Compass): [www.cws.illinois.edu/workshop/writers/esl/](http://www.cws.illinois.edu/workshop/writers/esl/)

**Grading:**

**419:** Homework 40%, term paper 35%, quizzes 5%, final exam 20%. Class participation will be used as a form of extra credit to determine borderline final grades.

**420:** Homework 62%, quizzes 8%, final exam 30%. Class participation will be used as a form of extra credit to determine borderline final grades.

**The course:** Starts off with a bang! The first number of homework assignments **have rapid turnover**, so get started early, don't fall behind, and you will benefit. Start reading and writing right away, submit on time, pay attention to your grader's comments, and use your professor and assistants as resources!

### Books

**Note about the reading:** No single text covers the entire course. You are given freedom to pursue the books that are of most relevance/ interest to you, but you should definitely be reading *at least* one of the principal books below. Peruse them first, but if you are at a loss about where to start, contact Charles ([bcharles@illinois.edu](mailto:bcharles@illinois.edu)) with your major, interests, and background, and he will be happy to provide some general guidance.

All these books, as well as others relevant to the course and useful for the term papers, are on reserve in the Engineering Library; see the course website for a more exhaustive reserve list. The first three are the principal, general texts for the course:

**J. T. Cushing (1998), *Philosophical Concepts in Physics*:** Somewhat similar in coverage to Sklar, but more historically-oriented. Cushing has a definite thesis to advocate – in particular the part on quantum mechanics – but this does not detract from the usefulness of the text.

**F. Rohrlich (1987), *From Paradox to Reality: Our Basic Concepts of the Physical World*:** While perhaps historically and philosophically naïve, this book complements Sklar by presenting an attitude toward the fundamentals that is probably typical of that of many thoughtful working physicists.

**L. Sklar (1992), *Philosophy of Physics*:** This covers a large portion of the material, but it is densely-argued, and you must be prepared, if necessary, to read a particular passage several times.

Recommended:

*The Character of Physical Law* by R. P. Feynman (a set of brief, entertaining lectures that give a feel for how the basic principles look to a thoughtful working physicist).

*The Copernican Revolution* by T. S. Kuhn (gives a feel for how one major change in outlook occurred).

*The Mystery of the Quantum World* by Euan Squires (a fair-minded account of some interpretation issues).

*Relativity, the Special and General Theory* by A. Einstein (a very accessible introduction to relativity).

*A Brief History of Time* by S. W. Hawking (a lively tour of many of the high points of modern physics).

### What is Physics/ Philosophy 419 & 420 about?

“My present endeavor is rather to present in non-technical language the conceptual revolutions that the scientific community had to undergo in order to be able to accept ‘modern physics’.”

– Rohrlich, *From Paradox to Reality*, p. viii

“philosophy’s role is to serve, not as some ground for the sciences or as some extension of them, but as their critical observer... The relationships of the [scientific] concepts to one another, although implicit in their use in science, may fail to be explicitly clear to us. It would then be the job of philosophy of science to clarify these conceptual relationships.”

– Sklar, *Philosophy of Physics*, p. 2

### Specific topics

- The transition from the Aristotelian-Ptolemaic picture of the Universe to Copernicanism.
- The birth of modern mechanics and the philosophical issues raised by it.
- The theory of electromagnetism and its awkward coexistence with classical mechanics.
- The special theory of relativity and its alleged paradoxes.
- General relativity and its philosophical implications.
- Quantum mechanics: Can we make sense of it, and what parts of your worldview must go?
- Irreversibility and the “arrow of time”.
- Current problems in cosmology and elementary physics.