PHILOSOPHY OF PHYSICS

FIFY10, FITF20, FITF30, FITF3L -- FALL 2020

Class meetings

Thursday, 13h00 – 15h30, except for 17/12/2020 (12h30 – 15h00) and 11/01/2021 (Monday)
Online

Instructor

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Course description

The course provides an introduction to the philosophy of physics. Physics purports to describe the fundamental nature of the world, but its descriptions often do not square with our intuitive grasp on that world. Thus, we are faced with a twofold challenge: "what is the fundamental nature of the world, and how does that fundamental structure relate to our intuitive grasp on the world around us?" We will approach this challenge from the perspective of our various best physical theories. This course will not provide a full survey of the debates in philosophy of physics, but it will familiarize students with some of the central debates and the general methodology of philosophy of physics. Topics addressed will include the nature of space and time, the nature of measurement in quantum mechanics, and reduction and emergence.

The course is aimed at philosophy students with an interest in physics, and at physics students who are interested in philosophical questions raised by physics. Participants should be prepared to handle a certain amount of math formalism. The lectures avoid technicalities whenever possible and are accessible to anyone with knowledge of physics at the science high school level.

Course goals

At the end of this course, students will have developed the following skills:

- History and philosophy of physics
    - Explain key concepts from physics
    - Discuss some of the central debates in philosophy of physics
    - Identify questions of philosophical interest raised by a physical theory
- Philosophical skills
    - Explain a debate in philosophy of physics in accessible terms
    - Write a brief argumentative essay on a topic in philosophy of physics

Requirements

Attendance and participation

Due to the unusual circumstances, the attendance requirement for this class has been waived.

Take-home final

You will complete a take-home final, due January 17th, 2021. The take-home final will be posted a week before the due-date.

Tentative course schedule (subject to revision)

All required readings will be available online. Additional (non-required) readings will be recommended as they become relevant.

Week	**Date**	**Topic**	**Readings**
UNIT I: Introduction			
45	05/11	Introduction The relation between physics and philosophy	Weinberg - "Ch. 7: Against Philosophy" (Excerpt) Rovelli - "Physics needs Philosophy. Philosophy needs Physics."
UNIT II: Space and Time			
46	12/11	Classical mechanics and special relativity	du Châtelet - "Of Space" (available here) Norton - "Special Relativity: The Principles"; "Special Relativity: Adding Velocities" NOTE: Stockholm now has access to Very Short Introduction---Use Okasha! [Optional: use this reading guide for du Châtelet's work]
47	19/11	Special relativity and general relativity	Norton - "Is special relativity paradoxical?"; "General Relativity"; "Ontology of Space and Time: The Relativity of Accelerated Motion"; "Ontology of Space and Time: The Hole Argument"
UNIT III: Quantum Mechanics			
48	26/11	Introduction to quantum mechanics	Ney - "Introduction" (section 1-3) Ismael - "Quantum Mechanics"
49	03/12	The measurement problem	Ney - "Introduction" (section 4-5)
UNIT IV: Thermodynamics & Statistical Mechanics			
51	17/12	Thermodynamics, statistical mechanics and the arrow of time	North - "Time in Thermodynamics" (except section 3)
UNIT V: Student Choice			

1	07/01	Possible topics: * Experiments in HEP * Finetuning * Black hole physics * Symmetries *...	TBD
2	11/01	Possible topics (see above)	TBD

Full reading list:

Week 1:

- Weinberg, Steven (1992). "Against Philosophy" In: *Dreams of a Final Theory*. New York: Phantom Books. Pp. 116-190. *Excerpts*
- Rovelli, Carlo (2018). "Physics Needs Philosophy. Philosophy Needs Physics" *Foundations of Physics* 48: 481–491 https://doi.org/10.1007/s10701-018-0167-y

Week 2:

- du Châtelet, Emilie (1740) "On Space" In: *Foundations of Physics*. Trans.: Katherine Brading et al., 2018 (The Notre Dame Du Châtelet Group). A full list of translations is available here. For this week, read Chapter 5, "Of Space" (available here).
- John Norton has created an entire course titled *Einstein for Everyone*, which uses Einstein's work as a starting point to introduce a wide range of topics in history and philosophy of physics. We'll use the course text (available here) for this and next week's discussion. For the first week, please focus on:
    - "Special Relativity: The Principles"
    - "Special Relativity: Adding Velocities"
- *Optional:* Stockholm University Library currently has trial access to Oxford University Press' *Very Short Introduction*-series. In Samir Okashas's *A Very Short Introduction to Philosophy of Science*, there is an excellent introduction to the debate about absolute or relative space between Leibniz and Clarke (pp. 95-103)

Week 3:

- The readings for this week are drawn from Norton's *Einstein for Everyone* course. For this session particularly focus on the following pages (open links in new tabs):
    - "Is special relativity paradoxical?"
    - "General Relativity"
    - "Ontology of Space and Time: The Relativity of Accelerated Motion"
    - "Ontology of Space and Time: The Hole Argument"

Week 4:

- Ney, Alyssa (2013) "Introduction". In: *The Wave Function: Essays on the Metaphysics of Quantum Mechanics*. Ed: Alyssa Ney and David Z Albert. Oxford: Oxford University Press.
  For this week, focus on sections 1-3 (pp. 1-25)
- Ismael, Jenann, "Quantum Mechanics", *The Stanford Encyclopedia of Philosophy* (Fall 2020 Edition), Edward N. Zalta (ed.), https://plato.stanford.edu/archives/fall2020/entries/qm/

Week 5:

- Ney, Alyssa (2013) "Introduction". In: *The Wave Function: Essays on the Metaphysics of Quantum Mechanics*. Ed: Alyssa Ney and David Z Albert. Oxford: Oxford University Press.
  For this week, focus on sections 4-5 (pp. 25-47)

Week 6:

- North, Jill (2011). "Time in Thermodynamics". In: *The Oxford Handbook of Philosophy of Time*. Ed: Craig Callender. Oxford: Oxford University Press. Everything except section 3

Week 7+8:

- TBD based on student votes.