

Philosophy 754: Foundations of Relativity Theory

Chris Smeenk

TC 310, M 11:30 - 2:30

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· Office Hours: M 3-4, F 1-2:30, or by appointment

Evaluation: Participation, weekly short responses, presentation, and either (1) a research paper due at the end of the term, or (2) four shorter papers due roughly every 3-4 weeks. For option (1), a brief description of the paper topic and / or outline, along with a bibliography, is due March 24th, and I am happy to consult with students. For option (2), students will be responsible for choosing topics for 5-page papers based on the readings and seminar discussion. Students choosing either option will give a 30 minute presentation, on a topic of their choice (in consultation with me). Short responses: brief comments (about 300-500 words) on papers to be discussed in the seminar, due weekly at 5:00 p.m. on Sunday before class (full credit for six responses).

I will aim to insure that the seminar is accessible to students who are not familiar with the relevant mathematics and physics, although I will presume basic undergraduate mathematics. If there is an interest in doing so, I would be willing to hold optional sessions devoted to more technically detailed discussions.

Course Website & Readings: Assigned readings, supplementary readings, updated schedules, and short responses will be posted on the website. Although I haven't placed orders at the bookstore, you should consider purchasing: Earman, *World Enough and Spacetime*; Geroch, *General Relativity from A to B*; and Einstein et al., *The Principle of Relativity*.

Topics

- Introduction: Space, Time and Motion in Classical Mechanics
 - Earman, *World Enough and Spacetime*, Chapters 2-3.
 - Belot, "Geometry and Motion," *BJPS* 51 (2000): 561-595.
- Special Relativity and Minkowski Spacetime (1-2 weeks)
 - Einstein, "On the Electrodynamics of Moving Bodies," (Kinematical Part), in *The Principle of Relativity*.
 - Geroch, *General Relativity from A to B* (selections).
 - di Salle, *Understanding Space-Time*, Chapter 4 (4.1-4.3).
- General Relativity and Relativistic Spacetimes (3-4 weeks)
 - Einstein's path to general relativity: Einstein, "The Foundation of the General Theory of Relativity," in *The Principle of Relativity* (selections); selections from historical literature, e.g. Renn et al., *Einstein's Zurich Notebook*
 - Geroch, *General Relativity from A to B* (selections).
 - di Salle, *Understanding Space-Time*, Chapter 4 (4.4-4.7).
 - Malament, "Classical General Relativity," in *Handbook for the Philosophy of Physics*, edited by Earman and Butterfield, and lecture notes (available at Malament's website).
- Hole Argument and Background Independence (2-3 weeks)

- Earman and Norton, “What price spacetime substantivalism? The hole story,” *BJPS* **38** (1987): 515-525.
- Earman, *World Enough and Spacetime*, Chapter 9.
- Butterfield, “The Hole Truth,” *BJPS* **40** (1989): 1-28.
- Hofer, “The Metaphysics of Spacetime Substantivalism,” *Journal of Philosophy* **93**: 5-27.
- Earman, “Two Challenges to the Requirement of Substantive General Covariance,” *Synthese* **148** (2006).
- Belot, “Background Independence” (preprint, selections).
- Time and Change in General Relativity
 - Relativistic McTaggart: Thoroughly Modern or Thoroughly Muddled? (Earman - Maudlin exchange in *Philosopher's Imprint*)
 - Earman and Belot, “Pre-Socratic Quantum Gravity,” in *Physics Meets Philosophy at the Planck Scale* (selections).
- Reconsidering Relationalism
 - Belot, “Rehabilitating Relationalism,” *International Studies in Philosophy of Science* **13**: 35-52.
 - Pooley and Brown, “Relationalism Rehabilitated I: Classical Mechanics” *BJPS* **53**: 183-204.
 - Huggett, “Regularity Account of Relational Spacetime” *Mind* **115**: 41-73.
 - Rynasiewicz, “Absolute Versus Relational Space-Time: An Outmoded Debate?,” *Journal of Philosophy* **93** (1996): 279-306.
 - Hofer, “Absolute Versus Relational Spacetime: For Better Or Worse, the Debate Goes on,” *BJPS* **49** (1998): 451-467.
- “Constructive” / neoLorentzian Approach to Special Relativity
 - Harvey Brown, *Physical Relativity: Space-time Structure from a Dynamical Perspective* (selections).
- Conventionality of Simultaneity and Geometry
 - Reichenbach, *Philosophy of Space and Time* (selections).
 - Torretti, *Relativity and Geometry* (selections).
 - Malament, “Causal Theories of Time and the Conventionality of Simultaneity,” *Noûs* **11** (1977): 293-300, and discussion in “Classical General Relativity.”
 - Janis, “Conventionality of Simultaneity,” *Stanford Encyclopedia*, and “Simultaneity, Relativity, and Conventionality,” forthcoming in *SHPMP*.
- Black Holes and Singularities
 - Earman, *Bangs, Crunches, Whimpers, and Shrieks* (selections).
- Other Possible Topics
 - Time’s Arrow
 - Time travel and causal structure
 - Relativistic cosmology
 - Observation and prediction in general relativity