UNIVERSITY OF CAMBRIDGE
Faculty of Philosophy

PART IB PHILOSOPHY OF SCIENCE – PHILOSOPHY OF PHYSICS

These lectures offer a non-technical introduction to the philosophy of modern physics. We will look at issues in three main areas: (i) spacetime and relativity; (ii) puzzles of quantum theory; and (iii) time and thermodynamics. We will be interested in the philosophical issues that arise in these areas, and in the role of arguments of a philosophical kind within physics, in all these cases.

Recommended introductory reading

Kosso, P., *Appearance and Reality: An Introduction to the Philosophy of Physics* (Oxford University Press, 1998) [Good short introduction, covering most of the material in sections (i) and (ii).]

Albert, D., *Quantum Mechanics and Experience* (Harvard University Press, 1993) [Good non-technical introduction to quantum mechanics and its puzzles.]

Albert, D., *Time and Chance* (Harvard University Press, 2003), Chs. 1–4. [Good non-technical introduction to issues about thermodynamics and irreversibility.]

Penrose, R. *The Emperor's New Mind* (OUP, 1989), Chs. 5, 6 & (especially) 7. [Highly readable introduction to the main philosophically significant parts of modern physics, relevant to all three sections.]

Price, H. *Time's Arrow and Archimedes' Point* (OUP, 1996), esp. Chs. 1–2, 8–9. [Relevant to sections (ii) and (iii).] Available at Oxford Scholarship Online: 10.1093/acprof:oso/9780195117981.001.0001

Sklar, L., *Philosophy of Physics* (Westview, 1992) [Excellent introductory text – a fraction more technical than Kosso, but still very accessible.]

Further useful background reading

Cushing, J., *Philosophical Concepts in Physics* (CUP, 1998) [Good and thorough.]

Sklar, L., *Space, Time and Spacetime* (University of California Press, 1974) [Classic and readable book on the spacetime and relativity materiall, in much more detail than we will deal with it.]

Whitaker, A., Einstein, *Bohr and the Quantum Dilemma: From Quantum Theory to Quantum Information,* 2nd edn. (CUP, 2006). Online here: dx.doi.org/10.1017/CBO9780511805714

Lecture outline

1. Three unresolved problems in classical physics at the end of the 19th century: (i) the relation between Maxwell's laws and classical mechanics; (ii) the UV catastrophe; and (iii) the origin of the second law of thermodynamics. In later lectures we will be looking at how physics was revolutionised as (i) and (ii) were dealt with (paying particular attention to the associated philosophical issues); and reviewing the current status of issue (iii), with particular attention to some common patterns of fallacious reasoning.
2. Special Relativity. Einstein's new vision: its basic features in contrast to Newtonian physics, viz Lorentz invariance and the relational character of mass, length and time. Philosophical influences on Einstein (Mach, Hume).
3. General Relativity. The general theory, and the unification of space, time and matter. Further aspects of Einstein philosophical thought. The status of geometry.
4. Time-asymmetry and thermodynamics.
5. Historical origins of QM, and basic features in contrast to classical mechanics. Early issues of interpretation: the Copenhagen interpretation, and its links with philosophical instrumentalism. The issue of completeness.
6. Arguments against *completeness* interpretations (Schrödinger's cat, the measurement problem, and the original EPR argument).
7. Arguments against *incompleteness* interpretations (the two slit experiment, Bell's theorem, nonlocality and its (apparent) conflict with special relativity).
8. Three possible ways forward, in the puzzle of the nature of the quantum world: (i) the de Broglie-Bohm hidden variable theory; (ii) the Everett interpretation ("many worlds"); (iii) retrocausal hidden variable views.

Lecture handouts will be available online, a day or two after each lecture: prce.hu/w/teaching.html