PHI 531 Philosophy of Science: Symmetry, Structure, and Spacetime

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Course Description

There has recently been much interest in "structuralism", both in the philosophy of science and metaphysics. But what exactly is structuralism? The term has been used to stand for a number of striking theses, including:

1. We cannot *know* anything about the world above and beyond its structure: its "intrinsic nature" (if there is any such thing) remains beyond our grasp.
2. There *is* nothing to the world above and beyond its structure: every truth supervenes on and is fully "grounded in" structural truths.
3. Every truth is derivable or "scrutable" from structural truths.

We will discuss each of these theses and how they relate to one another, focusing on the role that *symmetry considerations* play in motivating these theses, and on the possibility of structuralism about *spacetime* in particular. The seminar is divided into three parts.

Topic 1: Symmetry as a guide to reality
There is a rich tradition in science and philosophy in which symmetry arguments are used to motivate "relationalist" views about the nature of spacetime. We will examine this use of symmetry reasoning in some detail, and then ask to what extent similar reasoning can be used to motivate theses like 1 and 2 above.

Topic 2: Structuralism and Scrutability
One might think that a necessary condition on the truth of a thesis like 2 is a thesis like 3: in order for something to be *grounded* in structural truths, it must be *derivable or "scrutable"* from structural truths. Carnap's *Aufbau* tried to show that something like 3 was true. We will look at that project, and then examine how it has been developed and defended more recently in Chalmers' *Constructing the World*.

Topic 3: Space(time) as an emergent phenomena
A striking thesis that is currently receiving a lot of discussion amongst philosophers of physics is that spacetime is an emergent phenomena, i.e. that it derives from some more fundamental, non-spatiotemporal domain. For example, some think that according to Classical Quantum Mechanics, the fundamental facts about the world involve the undulations of a wave-function in a *massively* high-dimensional Hilbert space, and the 3-dimensional space (or 4-dimensional spacetime) of the manifest image is a merely derivative phenomena. This striking thesis raises intriguing questions about the extent to which a physical theory can depart from the manifest image and still be worthy of our credence. As we will see, the thesis is really a kind of radical structuralism about space (or spacetime), so we will bring the discussion of Parts 1 and 2 to bear in trying to make sense of this debate.

Syllabus

All readings will be made available via the Blackboard site.
Readings marked * are optional.

Topic 1: Symmetry as a guide to reality

Feb 7th Absolutist vs relationalist theories of space

- Maudlin, *Philosophy of Physics: Space and Time* chapters 1, 2 and 3
- *The Leibniz-Clark Correspondence

Feb 14th Symmetry as a guide to reality

- Brading and Castellani, "Symmetries and Invariances in Classical Physics" (skip sections 6 and 7)
- Earman, *World Enough and Spacetime* chapter 3, pp. 41-48
- Baker, "Symmetry and the Metaphysics of Physics", pp. 1157-1162
- *Dasgupta, "Symmetry as an Epistemic Notion (Twice Over)"

Feb 21st Structuralisms

- Hawthorne, "Causal Structuralism"
- Ney, "Physicalism and Our Knowledge of Intrinsic Properties"
- *Lewis, "Ramseyan Humility"
- *Dasgupta, "Quality and Structure"

Feb 28th Modal problems for structuralism

- Pooley, "Handedness, Parity Violation, and the Reality of Space"
- Baker, "Some Consequences of Physics for the Comparative Metaphysics of Quantity"

Topic 2: Structuralism and Scrutability

March 7th Carnap's *Aufbau*

- Carnap, *Aufbau*, sections 10-16, sections 153-155
- Chalmers, *Constructing the World*, chapter 1
- *Demopolous and Friedman, "Bertrand Russell's *The Analysis of Matter*: It's Historical Context and Contemporary Interest"

March 14th Scrutability

- Chalmers, *Constructing the World*, selections from chapters 3, 4, and 7

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March 28th Structuralism, scrutability, and ground

- Chalmers, *Constructing the World*, selections from chapter 8 and the 16th excursus

Topic 2: Space(time) as an emergent phenomena

Readings marked "TW" are from *The Wavefunction*, edited by Ney and Albert.

April 4th Introduction to classical quantum mechanics
- Ney, "Introduction" (TW)

April 11th Wavefunction monism
- Albert, "Elementary Quantum Metaphysics"
- Ney, "The Status of our Ordinary Three Dimensions in a Quantum Universe"
- *Peter Lewis, "Life in Configuration Space"

April 18th **No Class**

April 25th Against wavefunction monism: primitive ontology
- Maudlin, "Completeness, Supervenience, and Ontology"
- Allori, "Primitive Ontology and the Structure of Fundamental Physical Theories" (TW)

May 2nd Constraints on grounding
- Hawthorne, "A Metaphysician Looks at the Everrett Interpretation"
- Ney, "Ontological Reduction and the Wave Function Ontology" (TW)