

AGPhil 7: Symmetries and Principles

Time: Wednesday 16:15–18:30

Location: AGPhil-H14

Invited Talk AGPhil 7.1 Wed 16:15 AGPhil-H14
On an inferential role of spacetime in particle physics —
 •TUSHAR MENON — Faculty of Philosophy, University of Cambridge,
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Here is a plausible claim from particle physics: the states in a gauge multiplet correspond to (possibly distinct) configurations of the same type of particle. Take, for example, the spin-up and spin-down states (with respect to some axis) of an electron in an SU(2) multiplet. But surely, one might worry, not all such formal unifications count. Consider an electron-neutrino doublet, which is also an SU(2) multiplet. It seems less straightforward (or correct!) to consider these two be two states of the same type of particle. But why?

Consider what we might call the Redhead-Weingard thesis: two or more states in a multiplet of the gauge group of a quantum field theory are ontologically unified if they transform into each other under the action of a spacetime transformation. The Redhead-Weingard thesis seems to generate the intuitively correct verdict in a number of cases, including the two SU(2) cases presented above. In ordinary relativistic QFTs, it works because the question of what structure counts as spatiotemporal is settled pretheoretically. But this fact conceals a contingent fact that is tacitly assumed across much theorising about spacetime: that spacetime plays the same inferential role regardless of the theoretical framework within which it is employed. The primary goal of this talk is to demonstrate this contingency by discussing how these roles come apart in supersymmetric quantum field theories.

AGPhil 7.2 Wed 17:00 AGPhil-H14
Cassirer and Weyl on the Constitutive Structure of Physical Theory — •NOAH STEMEROFF — University of Bonn

Though representative of divergent philosophical and intellectual traditions, both Ernst Cassirer and Hermann Weyl held that a given mathematical framework must always serve as a necessary presupposition of scientific thought (within a broadly Kantian position). Neither thought that this framework was fixed, a priori, as it was for Kant. However, in allowing for the revision of the constitutive framework of scientific thought, both were forced to face the spectre of a pervasive relativism. In response, each suggested that the relativist abolition of the standard of objectivity does not entail the abolition of the difference in value and performance of various scientific theories. On this view, scientific theories do not stand apart in their relation to the world, to be judged solely on their own merits, but rather as part of a progressive series. In this context, Cassirer and Weyl both highlighted the fundamental role that group theory played as a constitutive feature of our understanding of objectivity through the progress of science. In this paper, I will examine the differing views of Cassirer and Weyl concerning the constitutive role of group theory in physical enquiry, and what lessons we can draw from this history concerning modern debates on the methodology of physics.

AGPhil 7.3 Wed 17:30 AGPhil-H14
Naturalness and the Heuristic Role of Scientific Principles
 — •ENNO FISCHER — Bergische Universität Wuppertal, Interdisziplinäres Zentrum für Wissenschafts- und Technikforschung

The naturalness principle roughly demands that a theory should not involve independent parameters that are finely tuned. This principle was employed heavily over the last 40 years by theoretical physicists as a guideline for developing theories of beyond the Standard Model physics (BSM). However, since experiments at the Large Hadron Collider (LHC) have not found conclusive signs for new physics, the significance of naturalness arguments has been questioned and it has been suggested that high-energy physics has reached the "dawn of the post-naturalness era."

I argue that an explanation of the current shift in attitude towards naturalness can be given if we acknowledge that the naturalness principle has experienced epistemic support through the theories it has inspired. I argue that the potential coherence between major BSM proposals and the naturalness principle led to an increasing degree of credibility of the principle. The absence of new physics at the LHC has undermined the potential coherence and has led to the principle's current loss of significance. On the basis of this account I assess the heuristic role of naturalness as a guiding principle in high-energy physics and draw some tentative conclusions about the role of principles in the context of scientific progress.

AGPhil 7.4 Wed 18:00 AGPhil-H14
A neo-Kantian approach to the epistemology of the LHC flavour anomalies — •ALEX SEUTHE — Technische Universität Dortmund

Large scale experiments at the LHC, like the LHCb experiment, seek to answer questions about the fundamental structure of matter and the nature of the cosmos. Since the discovery of the Higgs boson and correspondingly of all predicted particles of the Standard Model, the field is faced with an open horizon for gaining knowledge. In flavour physics, various anomalies in $b \rightarrow s\ell^+\ell^-$ decays have been attracting attention in recent years. Although the single measurements are not yet statistically significant for a discovery, the overall picture might hint at possible extensions or modifications of the Standard Model. So far, only little epistemological reflection on the scientific process related to these anomalies has been presented. In my talk, I suggest a first attempt utilizing Ernst Cassirer's concept of science as a series process towards the limit of reality. Here, the experimental anomalies and theoretical explanatory models, including specific models or model-independent effective theories, stand in an alternating series of cognitions, oriented towards the ideal of reality as a regulative principle.