AGPhil 6: Models, Theories, Explanation

Zeit: Dienstag 16:30–18:15 Raum: SR 113

Hauptvortrag AGPhil 6.1 Di 16:30 SR 113

Models in theory building: the case of early string theory — •Elena Castellani — Department of Philosophy, Florence, Italy

The history of the origins and first steps of string theory, from Veneziano's formulation of his famous scattering amplitude in 1968 to the 'first string revolution' in 1984, provides rich material for discussing traditional issues in the philosophy of science. This paper focusses on the initial phase of this history, that is the making of early string theory out of the 'dual theory of strong interactions' motivated by the aim of finding a viable theory of hadrons in the framework of the so-called S-matrix theory of the Sixties: from the first two models proposed (the Dual Resonance Model and the Shapiro-Virasoro Model) to all the subsequent endeavours to extend and complete the theory, including its string interpretation.

As is the aim of this paper to show, by representing an exemplary illustration of the building of a scientific theory out of tentative and partial models this is a particularly fruitful case study for the current philosophical discussion on how to characterize a scientific model, a scientific theory, and the relation between models and theories.

References:

J. T. Cushing (1990), Theory Construction and Selection in Modern Physics: The S-Matrix, Cambridge: Cambridge University Press.

A. Cappelli, E. Castellani, F. Colomo, and P. Di Vecchia (eds.) (2012), The Birth of String Theory, Cambridge: Cambridge University Press.

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Explanatory Hypotheses Formation and the Anomalous β Spectrum — •Tjerk Gauderis — Centre for Logic and Philosophy of Science, Ghent University, Belgium

Between 1928 and 1934, a persevering anomaly mystified the physics community: while alpha decay behaved perfectly according to the new quantum mechanics, the energy of electrons emitted in beta decay displayed a broad continuous spectrum. This puzzle invoked a lively debate among the most established physicists at the time. But the curious thing was that they all suggested hypotheses of very different formal types: Rutherford and Chadwick thought of varying internal energies, Bohr suggested to restrict the energy conservation principle, Heisenberg tinkered with a new quantization of space, and Pauli suggested the existence of a new elementary particle - all these hypotheses being radical and highly controversial.

In physics, an anomalous experimental result can trigger the formation of formally very different hypotheses. A scientist confronted with such a result has no strict guidelines to help her decide whether she should explain this result by withdrawing or adapting a constraint (e.g. a law) of the current theory, or by presupposing the existence of a hitherto unobserved entity (e.g. a particle) that makes the anomaly fit within that theory. In this talk I aim to gain some insights how scientists make this choice, by examining in the above case study how the choice of the various mentioned physicists depended on their previous experiences and their specific perception of the problem.

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The Explanatory Capability of Physical Theories — •Radin Dardashti — Munich Center for Mathematical Philosophy, Munich, Germany

At any given time there are certain aspects of our well-confirmed physical theories that we cannot explain. For instance, the dimensionality of space and time or the specific group structure of the standard model of particle physics. These are taken to be brute facts and they have to be specified before the theory unfolds its explanatory powers. Attempts to explain these aspects have been limited to anthropic reasoning which has been argued against elsewhere. The aim of this paper is to consider the possibility to use results from mathematical physics to give non-anthropic explanations of certain brute facts. We will start by specifying a minimalistic approach towards accounts of scientific explanation. This will be followed by a specification of the notion of brute facts before presenting the proposed approach towards a better understanding of these brute facts. The approach will be exemplified for the specific case of the dimensionality of space and time within the theory of General Relativity.