AGPhil 4: Philosophy of Physics 4

Zeit: Dienstag 16:45–19:00 Raum: VMP6 HS G

Hauptvortrag AGPhil 4.1 Di 16:45 VMP6 HS G
Progress and Gravity: Overcoming Divisions among General Relativity, Particle Physics and the History and Philosophy of Science — •J. Brian Pitts — University of Cambridge, UK

Space-time physics can be illuminated by stronger interaction among GR, particle physics, and the history and philosophy of science. Sometimes old answers make more sense; sometimes new answers or even new questions arise.

Bayesianism shows the value of simplicity, the need for rival theories, and the role of evidence.

Noether's first theorem ties each rigid symmetry of the action to local conservation. GR has an infinity of translations but supposedly 0 local conservation laws. Can one take Noether's theorem more seriously?

A 1950s particle physics spin-2 derivation split the total stress-energy into a term 0 on-shell and a curl to derive Einstein's equations. Hilbert, Klein and Noether started with GR and found such a split; Noether proved the converse. Did Noether invent spin 2 derivations of GR?

Perturbative expansions can be conceptually illuminating. They diagnose Einstein's 1917 'graviton mass'-Lambda confusion. Ogievetsky and Polubarinov invented an infinity of massive spin 2 gravities. Maheshwari showed one to be nonlinearly ghost-free in 1971, but no one noticed. Since 2010-11, 3 ghost-free mass terms are known.

Weyl said that GR spinors couldn't be spinorial in coordinates and used a tetrad. Ogievetsky and Polubarinov invented a nonlinear metric-dependent group realization of spinors in coordinates (near the identity) in 1965. What happens far from the identity?

AGPhil 4.2 Di 17:30 VMP6 HS G
Energy Conditions in Quantum Field Theory on Curved Spacetime — •Erik Curiel — MCMP, Munich

The standard energy conditions play a central, fundamental role in general relativity: as assumptions in essentially all of the deepest and farthest-reaching results (e.g., all singularity theorems and the Laws of Black-Hole Mechanics); and their failure allows for every kind of pathological behavior (e.g, closed timelike curves, white holes, naked singularities). The status and physical interpretation of those energy conditions is still an open problem. Their status in quantum field theory on curved spacetime (QFT-CST) is yet more problematic. First, it is not clear even how to formulate them in a clear and precise way, given the technical and interpretational problems attending attempts to represent stress-energy in a way that respects both the quantum nature of the fields and the classical nature of the underlying metrical structure. Second, once one has fixed any of the known formulations, it is almost ridiculously easy to construct physically reasonable generic violations of it. The problems raised by these two issues ramify into essentially every philosophically important question surrounding the relationship between quantum physics and gravitational phenomena, including: whether quantum field theory and general relativity are necessarily inconsistent; whether the semi-classical approximation of QFT-CST is physically well motivated and, if so, what the proper interpretation of its results are; and whether or how the effects of QFT-CST (e.g., Hawking radiation) can give insight into a possible theory of quantum gravity.

AGPhil 4.3 Di 18:00 VMP6 HS G
Taking up superspace- What would it take to be a realist about superspace? — •Tushar Menon — Balliol College, University of Oxford

Modern supersymmetric theories present an interesting interpretative challenge. As a result of consistency conditions on the algebra of the supersymmetry (SUSY) generators, one is led to the idea that SUSY, although traditionally defined as a dynamical symmetry between bosons and fermions, could also be thought of as a spacetime symmetry in some extended spacetime, known as superspace. Supersymmetry is, among other things, a crucial part of the string theoretic framework for a theory of quantum gravity. This paper focuses on what it would take to argue for an interpretation that favours the superspace formulation. After setting up the relevant terminology and distinctions, I introduce a stripped down toy model of a supersymmetric field theory and argue for a special case of a more general thesis— that one needs some pre-existing philosophical commitment to favour one mathematical formulation over another. I then consider three extant arguments from the literature on the philosophy of spacetime as candidates for such a position in the context of supersymmetric theories.

AGPhil 4.4 Di 18:30 VMP6 HS G
Particles creation and annihilation: A Bohmian approach — •Andrea Oldofredi — Université de Lausanne, Switzerland — Faculté des Lettres, Section de Philosophie — 1015 Lausanne

Though standard Quantum Field Theory (QFT) is generally defined as the combination of the axioms of Quantum Mechanics (QM) and Special Relativity (SR), there exists a class of non-relativistic models which are generalizations of Bohmian Mechanics (BM) to the phenomena of particles creation and annihilation reproducing the statistics of QFT experiments. These models share a common particle ontology being insensible to the conclusions of several no-go theorems which exclude the possibility of a proper particle theory in the context of QFT (they involve specific relativistic constraints which are violated in BM). In this talk my aim will be to present two different models of Bohmian QFTs with different physical content as serious alternatives to the standard formulation of QFT. These models are the Bell-type QFT and the Dirac sea approach. The virtue of these theories is the clear mathematical and ontological structure. They specify a primitive ontology (determination of the fundamental entities the theory is about) and dynamical variables which constraint the motion of the primitive variables. These models reproduce the experimental results of QFT since the Born's distribution holds. They exemplify how a clear metaphysical stance could help in constructing rigorous physical theories.