AGPhil 9: Philosophy of Physics 1

Time: Wednesday 11:30–13:00 Location: PTB SR AvHB

AGPhil 9.1 Wed 11:30 PTB SR AvHB

What is fundamental in fundamental physics? — •Alexander Niederklapfer — London School of Economics and Political Science, London, UK

Metaphysicians as well as philosophers of science often turn to particle physics for a description of the most fundamental level of the material world. The common assumption is that it describes one clear account of what the basic building blocks of our universe are, and how they compose with one another to form more complex objects. I argue that this picture contains a major difficulty, because particle physics allows for more than one metaphysically meaningful procedure to decompose a system into (fundamental) parts. I identify and interpret two widely used decomposition relations appearing in quantum theories: the first relies on Wigner's "definition'" of particles and decomposes a quantum system based on the theory of group representations into a direct sum of parts, which is popular amongst recent structuralist interpretations of quantum theories. The second is the decomposition into a tensor product of statistically independent components, common in the literature on entanglement and quantum information. I then show that these two decompositions lead to different results for what the parts of a given system might be. I argue that these considerations show that there are conventional choices involved in finding the fundamental parts of an object which have not yet been widely recognised by either metaphysicians or philosophers of science. I also take this to provide a sense in which, as a result, a physical theory on its own is not enough to determine the fundamental ontology of the world.

AGPhil 9.2 Wed 12:00 PTB SR AvHB

Do atemporal theories of quantum gravity presuppose the notion of time? — •Anastasiia Lazutkina — University of Wuppertal, Wuppertal, Germany

I examine an argument proposed by Henrik Zinkernagel against quantum fundamentalism (QF), the view that everything is fundamentally of a quantum nature (ontological QF) and can be described exclusively in quantum theoretical terms (epistemological QF). According to Zinkernagel, the absence of time in the main approaches in quantum gravity (QG) leads to a problem for QF. The central claim is that timeless QG cannot be more fundamental than general relativity (GR) because its central field of application, the early universe, is defined by a classical relativistic time concept - global time. And global time is based on Weyl's principle that requires well-defined notions of local time and length, which lose their physical basis in the early universe. Thus, QG relies on GR and cannot be more fundamental. I propose two readings of the argument: the first fails, while the second is successful but requires accepting a broad set of epistemological commitments like Niels Bohr's holism and Peter Zinkernagel's conditions of objectivity. Even if these commitments are accepted, I conclude that in this second extended form the argument only refutes the epistemological but not ontological version of QF.

AGPhil 9.3 Wed 12:30 PTB SR AvHB

LatticeQCD - between approximation and foundation — •Nico Formánek — HLRS, Stuttgart

LatticeQCD can be viewed as a clever approximative method to extract numerical predictions from QCD. But it also serves as a discrete foundation to define the QCD path integral. Philosophy of Science has focused mainly on the first aspect, worrying about the uncontrolled black box nature of the approximations, while lattice practitioners explicitly point to the foundational character. This apparent tension goes back, I argue, to the inception of LatticeQCD. Symanzik's conjecture on which the foundational character of the lattice relies was later developed into a numerical improvement programme. LatticeQCD is therefore not only conceptually but also historically a foundation and approximation. I will briefly spell out what this means for traditional views of physical theories in philosophy of science and how they might need to adapt.