AGPhil 5: Quantum Theory 4

Time: Wednesday 16:30–18:30 Location: H8

AGPhil 5.1 Wed 16:30 H8

Mereological Atomism's Quantum Problems — •Ryan Miller — University of Geneva, Switzerland

The popular metaphysical view that concrete objects are grounded in their ultimate parts is often motivated by appeals to realist interpretations of contemporary physics (Feynman et al., 2015; Fine, 1992; Pettit, 1993; Loewer, 2009). Given that appeals to small-scale physics are fundamentally quantum mechanical, this paper argues first that mereological atomism is only plausible in conjunction with Bohmianism, and second that it exacerbates Bohmianism's existing tensions with serious Lorentz invariance. Neither of Bohmianism's leading realist competitors yields a decomposition of the physical world into a multiplicity of non-overlapping fundamental concrete objects. Everettians can't rely on decoherence for such a decomposition (Wallace, 2012; Crull, 2013; pace Ney, 2021) and none of the proposed ontological elements for GRW (mass density, flashes, flash families) can play the role of multiple synchronic atomic parts.

Bohmian particles, on the other hand, provide a natural set of ultimate parts for atomists. The trouble is that different reference frames have different particle numbers (Unruh & Wald, 1984), and in classical mereology concrete objects are invariant fusions of determinate parts, so the Bohmian hidden privileged reference frame corresponds to a set of hidden privileged macroscopic concrete objects. Mereological atomism is thus undercut rather than supported by contemporary physics.

AGPhil 5.2 Wed 17:00 H8

Non-Accessible Mass and the Ontology of GRW — •Cristian Mariani — Institut Néel (CNRS), Grenoble, FRANCE

The Mass Density approach to GRW (GRWm for short) has been widely discussed in the quantum foundations literature. A crucial feature of GRWm is the introduction of a Criterion of Accessibility for mass, which allows to explain the determinacy of experimental outcomes thus also addressing the tails problem of GRW. However, the Criterion of Accessibility leaves the ontological meaning of the non-accessible portion of mass utterly unexplained. In this paper I discuss two viable approaches to non-accessible mass, which I call anti-realist and realist, and will defend the latter. First, I show that the anti-realist approach suffers from various objections. Second, I develop an account of non-accessible mass density states as objectively indeterminate states of affairs. Finally, I discuss the main conceptual consequences of the realist approach to non-accessible mass with respect to the current debate on the Primitive Ontology of GRW.

AGPhil 5.3 Wed 17:30 H8

Master equations for Wigner functions with spontaneous collapse and their relation to thermodynamic irreversibility* — •Michael te Vrugt[1,2], Gyula I. Tóth[3], and Raphael Wittkowski[1] — [1]Institut für Theoretische Physik, Center for Soft Nanoscience, Westfälische Wilhelms-Universität Münster, D-48149 Münster, Germany — [2]Philosophisches Seminar, Westfälische Wilhelms-Universität Münster, D-48143 Münster, Germany — [3]Interdisciplinary Centre for Mathematical Modelling and Department of Mathematical Sciences, Loughborough University, Loughborough, LE11 3TU, United Kingdom

Wigner functions allow for a reformulation of quantum mechanics in phase space. They are, as shown in our recent work [1], very useful for understanding effects of spontaneous collapses of the wavefunction as predicted by the Ghirardi-Rimini-Weber (GRW) theory. We derive the dynamic equations for the Wigner function in the GRW theory and its most important variants. The results are used to test, via computer simulations, David Albert's suggestion that the stochasticity induced by spontaneous collapses is responsible for the emergence of thermodynamic irreversibility. We do not observe the equilibration mechanism proposed by Albert, suggesting that GRW theory cannot explain the approach to thermal equilibrium.

[1] M. te Vrugt, G. I. Tóth, R. Wittkowski, arXiv:2106.00137 (2021)

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AGPhil 5.4 Wed 18:00 H8

Does Physics study the concrete? — •Samuel Dickson — University of York, York, UK

Metaphysicians classically divide objecthood into two categories, the abstract and the concrete. Physicists investigate the physical, and this is often taken to be part of the concrete. So physicists are investigating concrete objects. I think, however, that this is debatable. Concrete objects are typically taken to be both spatiotemporal and causal. However, I think the objects of fundamental physics, things like quarks and electrons, are not concrete objects, but this does not mean I think they are abstract. I think there is a middle ground between the abstract and concrete, and I think the objects of fundamental physics are in this middle ground, what I am calling exotic objects. For example, electrons are not categorised accurately with what we generally mean by spatial. Using the general sense, electrons do not exist in space (in that way). If this is the sense of spatial relevant for something to be a concrete object, then electrons are not concrete. If we soften what we mean by concrete to avoid this, then we will find equal need to soften what we mean by temporal and causal, meaning many things classed as abstract would become concrete. That is why we need a middle ground, the exotic.