AGPhil 10: Quantum Mechanics II

Time: Thursday 14:00–16:00 Location: AGPhil-H14

AGPhil 10.1 Thu 14:00 AGPhil-H14

How to distinguish between indistinguishable particles — •Michael te Vrugt — Institut für Theoretische Physik, Center for Soft Nanoscience, Philosophisches Seminar, Westfälische Wilhelms-Universität Münster, 48149 Münster, Germany

A long and intense debate in philosophy is concerned with the question whether there can be haecceistic differences between possible worlds, that is, nonqualitative differences that only arise from different de re representations. According to haecceitism, it can give rise to a different situation if the positions of two qualitatively identical particles are exchanged, while according to anti-haecceitism, this is not the case. It has been suggested that classical statistical mechanics might provide evidence for one of these positions. However, most philosophers of physics argue that it does not. In this work [1], I show that order-preserving dynamics, a novel method from statistical mechanics developed for the description of nonergodic systems, changes this situation: It is intrinsically haecceistic and makes different experimental predictions than non-haecceistic alternatives. Thereby, it provides an empirical argument for the existence of modality de re.

[1] M. te Vrugt, British Journal for the Philosophy of Science (forthcoming), https://doi.org/10.1086/718495

AGPhil 10.2 Thu 14:30 AGPhil-H14

Who's afraid of retrocausation? A retrocausal explanation of Bell-type correlations — •Matthias Ackermann — Leibniz University Hanover

Bell's theorem is commonly understood to have demonstrated that the observed statistics in quantum experiments rule out a 'locally causal' explanation. However, almost always the temporal aspect of 'local causality' seems to be implicitly assumed, rather than explicitly defined. Recent work by Wharton and Argaman (2020) does just that and with it offers a retrocausal framework that accounts for the correlations at the cost of an explicit relaxation of the usually implicit arrow-of-time—thus, the argument goes, operationally saving Bell-compatible locality. This work assesses their proposal based on the central aspects of causal modelling (Pearl, 2009) and an influential no-go theorem by Wood and Spekkens (2015). Taking seriously the relaxation of the standard past-to-future description of physical systems, one can defend causal fine-tuning from being deemed 'unnatural' (Wood and Spekkens, 2015) or 'unsatisfactory' (Allen et al., 2017). Although Wharton and Argaman's (2020) retrocausal model indeed does fall victim to fine-tuning, this is due to an assumed underlying symmetry. The main finding is that taking these underlying symmetry considerations seriously lets one reasonably entertain the possibility that causes and signals do not necessarily co-occur. It is concluded that the framework of classical causal modelling is too restrictive of a framework to be home to and therefore to capture the notion of retrocausality.

AGPhil 10.3 Thu 15:00 AGPhil-H14

Configuration Space Realism and Fundamentality — •Gabrielle Kerbel[1] and Nina Emery[2] — [1]University of Michigan — [2]Mount Holyoke College

The central question of quantum ontology is: what does the wavefunction represent? According to configuration space realism, the wavefunction represents a field (the 'wavefunction field') in a high-dimensional space (what we call 'cf-space'). According to the standard version of configuration space realism, which we call configuration space fundamentalism, the wavefunction field and cf-space are fundamental. We present a novel version of configuration space realism, called configuration space non-fundamentalism, according to which the wavefunction field and cf-space are non-fundamental. Instead, the wavefunction field and cf-space depend on three-dimensional space and the entities therein. We argue that configuration space non-fundamentalism should be taken at least as seriously as configuration space fundamentalism. Along the way we show how choosing between these different versions of configuration space realism will encourage metaphysicians and philosophers of physics alike to confront significant questions about the structure of grounding relations, the importance of locality and separability, and the nature of supervenience and scientific explanation.

AGPhil 10.4 Thu 15:30 AGPhil-H14

Change and Time in Quantum Mechanics — •Brittany Gentry — Utah State University, Logan, USA

While it is apparent that leading physical theories such as Relativity Theory and standard interpretations of Quantum Mechanics do not posit a real, or fundamental, time, the search for real time persists. One reason for continuing to posit real time is the concern that time is necessary to change. Examples of this concern as well as confusing claims that may lead others to that concern abound in philosophy of physics, even from physicists who agree that real time is unnecessary to physical theories. To address that concern, this paper argues that one way to separate time and change is to understand time as a construct that we use to slice up 4-dimensional Hilbert space into 3-dimensional space for the purpose of further distinguishing differences in the basic stuff occupying Hilbert space–namely, particles. On such a view, changes are the differences in positions that we observe in the stuff of Hilbert space and time is a construct that we sometimes place on this space to articulate these differences–and this conception of our QM models allows us to conceive of changes in a way that is independent of time. Time is a helpful feature of the model that we apply at certain levels, but not essential to the existence of the changes that we study. It leaves unaddressed the question of whether changes are real or apparent. However, this explanation makes progress in tidying up concerns regarding time in QM by removing the confusions surrounding the relationship between time and change.