AGPhil 9: Quantum Theory III

Time: Thursday 16:30–18:00 Location: H-HS III

AGPhil 9.1 Thu 16:30 H-HS III

Changing worlds through quantum mechanics — •Tina Wachter — Universität Siegen, Germany — Leibniz Universität Hannover, Germany

Based on Kripke's(1972/80) approach I present a distinction between 'possible worlds' and 'counterfactual situations' which must be distinguished for proper examinations of quantum mechanical interpretations and questions concerning the Identity of Indiscernibles. Whereby the first are important for thinking about 'ways the world might have been' (Lewis) by considering a whole world, somehow similar to our actual world but far enough to be as different as we wish it to be; the latter, counterfactual situations, (Kripke) are the relevant ones giving proper evidence for 'what happens to objects if certain circumstances have changed'. For possible worlds are much broader and not directly dependent on our actual world, counterfactual situations, understood as 'miniworlds' or 'ministates' as focussed cuttings of our actual world, are directly related to our understanding of actual world objects or properties. Therefore, descriptions must be sharpened with respect to this distinction, because only counterfactual situations provide proper evidence and (epistemologically) relevant results for our actual world, for they truly speak about the 'things we have' in our world. Even possible worlds considered as equivalent examples cannot provide the same relevant results for our world as counterfactuals do, neither with respect to QM nor the Identity of Indiscernibles.

AGPhil 9.2 Thu 17:00 H-HS III

From metaphysical postulates to dissipative quantum field theory — •Hans Christian Öttinger — ETH Zürich, Switzerland

Four metaphysical postulates concerning (i) mathematical images of Nature, (ii) space and time, (iii) infinities, and (iv) irreversibility are used to motivate a fundamental quantum master equation (QME) for quantum field theory (QFT) [1]. This thermodynamically consistent QME provides conceptually clear and mathematically rigorous foundations for QFT, as well as a distinct particle ontology. UV regularization is provided by dissipative smearing, IV regularization results for a finite Universe. The distinction between free and interacting particles gets a deeper meaning going far beyond perturbation theory or the interaction picture. Particles are not localized in space, but all interactions are strictly local; therefore, a high-energy collision in a particle accelerator, followed by many low-energy collisions in a detector, can be used to visualize a bunch of particle trajectories emerging from a vertex.

In the limit of weak dissipation, when the length scale associated with dissipation is smaller than any observable length scale, dissipative QFT reproduces the results of conventional approaches to effective field theories. As a benefit of dissipative QFT, in addition to conceptual clarity and rigor, one is led to a new dynamic simulation methodology based on stochastic unravelings of QMEs in Fock space. Dissipation at the Planck scale might even be considered as the origin of gravity.

[1] H. C. Öttinger, A Philosophical Approach to Quantum Field Theory (Cambridge University Press, 2017).

AGPhil 9.3 Thu 17:30 H-HS III

Limits of human knowledge and the relationship between mind and matter — •Matthias Hanauske — Frankfurt Institute for Advanced Studies — Institut für Theoretische Physik, Frankfurt, Germany

Fundamental metaphysical questions, like the human limits of knowledge have been discussed in the context of the confinement of quarks and the event horizon of black holes. Due to the strong gluonic interaction of QCD, the color space of quarks is not directly accessible by an external observer and black holes shield their inner area through event horizons. However, in future gravitational wave (GW) detections of binary neutron star merger systems it might be possible to detect the QCD phase transition by analysing the spectrum of the post-merger GW of the differentially rotating hypermassive hybrid star (HMHS). During the collapse of the HMHS to a Kerr black hole the color degrees of freedom of the pure quark core gets macroscopically confined by the formation of the event horizon. The second example focuses on metaphyisical problems of socio-economic complex networks and addresses the relationship between mind and matter by focusing on evolutionary quantum game theoretical concepts. Through a potential quantum-theoretical entanglement of the decision paths of the underlying players of the actor network, a population can escape a dilemma-like situation, if the value of entanglement is above a certain threshold.