AGPhil 7: Quantum-Classical Divide V

Time: Friday 14:15–17:30 Location: SPA SR22

AGPhil 7.1 Fri 14:15 SPA SR22

Big bang causality as quantum-classical transition — •Rüdiger Vaas — bild der wissenschaft, Ernst-Mey-Str. 8, D – 70771 Leinfelden

Explaining the beginning of our universe is a delicate and difficult task, not only from a cosmological point of view, but also from an epistemological, conceptual, and philosophy of science perspective. To search for a causal explanation of the big bang could even be meaningless, if causality is understood only as a kind of regularity, or in terms of counterfactuals, interventionism, or (dispositional) perturbation pragmatism, or indeed just as a feature of human cognition (cf. Schaffer 2007, Hüttemann 2013). My talk argues that a physical notion of causality – if any – associated with a transfer of conserved quantities such as energy or momentum (as proposed, e.g., by Salmon 1998, Dowe 2007, 2009) is needed for a causal big bang explanation, and that this is consistent with at least some recent big bang models in physical cosmology. This is closely related to the hypothesis of a cosmological origin of the arrow(s) of time, i.e. irreversibility. If pseudo-beginning models are correct – in contrast to models of an absolute beginning of time or a past-eternal time –, the big bang can be causally explained as a quantum fluctuation within a time-reversible quantum vacuum, creating quasi-classicality along with an arrow of time. My talk argues that such models can be interpreted in the framework of physicalistic causation mentioned above. However, there could be a paradox lurking here: If the big bang created causality and classicality in the first place, how can it itself have a causal and classical explanation? – L. Mersini-Houghton, R. Vaas (eds.): The Arrows of Time. Springer, 2012.

AGPhil 7.2 Fri 14:45 SPA SR22

The Quantum-Classical Divide and the Kochen-Specker Theorem: A Case for the Nonlocality of Time? — •Martin Schüle — IHPST, 13, rue du Four 75006 Paris

In quantum physics, the properties of two systems can exhibit long-range correlations although there is no direct contact between the systems. Bell's analysis of the situation led to his famous no-go theorem which says that it is not possible to introduce additional variables that would explain these correlations. The additional variables must thereby satisfy certain intuitive constraints such as "locality". The impossibility of such a "hidden" or additional variable theory thus firmly established the issue of nonlocality in physics and philosophy of physics, which may be seen as a central characteristic of the quantum-classical divide.

In my contribution, I will discuss the no-go theorem by Kochen and Specker and claim that it is in a certain sense more fundamental than Bell's theorem, providing some evidence that Bell's theorem is historically and conceptually based on the Kochen-Specker theorem. Interpreted this way, the Kocher-Specker theorem does not only allow for a Bell-type argument implying nonlocality in space, but possibly also "nonlocality" in time, that is, correlations between time- like separated events that cannot be causally connected. I will then discuss some experimental evidence of this "nonlocality" and its conceptual and philosophical implications.

AGPhil 7.3 Fri 15:15 SPA SR22

Decoherence and the Many Worlds Interpretation — •Carsten Thomas Weigelt — University, Bonn, Germany

The theory of decoherence gives us a good account (at least for open systems) of how classical properties emerge from the quantum world. Recent experiments based on decoherence offers strong arguments against the quantum-classical division proposed by the early Copenhagen Interpretation.

But even if decoherence may support the view that quantum mechanics can be considered as fundamental theory the question remains if this sheds new light to the question of how a realistic interpretation of quantum theory can be achieved? In the last years proponents of decoherence pointed out that the theory fits perfectly into the framework of many worlds interpretations (Zurek 2003, Wallace 2012).

The question that I will address is, in what sense these interpretations can be considered as realistic interpretations? To answer this question I will argue that in the context of decoherence we have strong reasons to interpret quantum states in a realistic sense. A problem for many worlds interpretations arises when the meaning of Everett's relative states is considered since these interpretations strongly dependent on the interpretation of relative states. I will show that einselection proposed by the decoherence theory will determine Everett's relative states in an objective sense but these states must be interpreted as epistemic states. I will conclude that this ambiguity between realistic interpreted quantum states and epistemic relative states limits the strict realistic character of many worlds interpretation.

AGPhil 7.4 Fri 15:45 SPA SR22

On the ontological emergence from quantum regime — •Damian Luty — Adam Mickiewicz University, Poznań, Poland

There are several views on the relation between quantum physics and theory of relativity (especially General Relativity, GR). A popular perspective is this: GR with its macroscopic gravitational effects will turn out to be a limit of a more fundamental theory which should consider discrete physics and not deal with continuity (like theory of relativity). Thus, GR will emerge from a more basic theory, which should be quantum-like. One could call this an epistemic emergence view towards fundamental theories. The question is, given that scientific realism is valid: should emergence be a fundamental notion in our ontological view about the evolving, physical Universe? Is there an ontological emergence fully compatible with the notion of fundamentality?

I would like to argue that if we want to defend ontological emergence (from quantum to macroscopic regime) as something fundamental, we will arrive at the position of metaphysics of dispositions (and I shall argue, why this is undesirable), or conclude, that we cannot square fully fundamental ontology with the notion of emergence, and that we have to accept an ontological pluralism relativised to a certain scale. I shall defend the latter proposition, showing, that epistemic emergence doesn't entail (logically) ontological emergence.

15 min. break

AGPhil 7.5 Fri 16:30 SPA SR22

The quantum-classical divide understood in terms of Bohm's holographic paradigm — •Vera Matarese — The University of Hong Kong, Hong Kong

This paper aims to interpret the problem of the quantum-classical divide following Bohm's holographic model and to reformulate it as an indication of a new physical order.

First of all I will briefly outline the differences between the classical world and the quantum one (such as locality against nonlocality, determinism against indeterminism and continuity against discontinuity); then I will claim that in order to understand the divide between the two domains we should start from what is common, and regard them as two abstractions and limiting cases of a general theory.

In particular, following Bohm, I will show that the central notion of this new theory is an undivided whole characterized by a general order consisting of a holomovement from an implicate order - the quantum domain - to an explicate order - in the classical domain. This part will be explained with the aid of the structure of the hologram and will be supported by a reflection on some key terms such as 'order', 'structure', 'implicate' and 'explicate'.

Finally I will propose that this movement of unfoldment and enfoldment can explain the apparent incompatibility of the two physical domains and the passage from one to the other.

AGPhil 7.6 Fri 17:00 SPA SR22

Measurement and Uncertainty in Classical Physics — •Lukas Nickel[1] and Tobias Jung[2] — [1]LMU München, Fakultät für Physik. Steinsdorfstr. 18, 80538 München — [2]TU München, Lehrstuhl für Philosophie und Wissenschaftstheorie. Forststr. 7, 82547 Eurasburg

We discuss the consequences it has for classical physics if one includes the measurement process in the theory. The terms measurement and error thereof are explained and it is argued that every measurement can be reduced to a measurement of position and/or time. The statement that every measurement carries a finite inaccuracy implies that, also in classical mechanics, only probabilistic predictions are possible. Hence we find a similarity between classical and quantum physics that is mostly misconceived: By including measurements in the theory itself, one can view the former exactly like the latter as an indeterministic theory, as well as both theories can be formulated deterministicly without inlcuding measurements.