AGPhil 6: Philosophy of Cosmology VI

Zeit: Mittwoch 14:00–15:45 Raum: HS 10

Hauptvortrag AGPhil 6.1 Mi 14:00 HS 10

The cosmological constant as a quantum gravity effect. — •Fay Dowker — Imperial College, London, UK

By treating the whole universe as a quantum system, and using features of the causal set approach to quantum gravity, Sorkin predicted the magnitude of the cosmological "constant", Lambda, today should be of the order of the ambient matter density today. This prediction was verified in the late 1990s and is the only prediction from quantum gravity that has been verified. I will review Sorkin's argument which uses the path integral or sum-over-histories approach as the fundamental framework for quantum theory. I will review the state of play on models based on Sorkin's original heuristic argument and their phenomenology, for example fits to the CMB and other data sets.

AGPhil 6.2 Mi 14:45 HS 10

Time's Arrow in a Quantum Universe: On the Nature of the Initial Quantum State — •Eddy Keming Chen — Rutgers University, New Brunswick, NJ, USA

In a quantum universe with an arrow of time, we postulate a low-entropy boundary condition (the Past Hypothesis) to account for the temporal asymmetry. In this talk, I show that we can use the Past Hypothesis to determine a natural initial quantum state of the universe. First, I introduce the idea that the quantum state of the universe can be impure. This stands in sharp contrast to the standard view, according to which the quantum state of the universe is pure. Second, I suggest that the Past Hypothesis is sufficient to determine a natural density matrix, which is simple and unique. This is achieved by what I call the Initial Projection Hypothesis: the initial density matrix of the universe is the (normalized) projection onto the Past Hypothesis subspace (in the Hilbert space). Third, because the initial quantum state is unique and simple, we no longer need to postulate fundamental statistical-mechanical probabilities to rule out anti-entropic quantum states (because there is only one possible initial state), and moreover we can interpret the quantum state to have the same status as laws of nature (because it is simple enough to be nomological). Hence, it offers a simple and unified answer to several open questions in philosophy of cosmology, including a natural choice for the universal quantum state (cf: Hartle and Hawking 1984), the status of the quantum state (cf: Durr et al. 1997), and the reduction of statistical mechanical probabilities (cf: Albert 2000 and Wallace 2012).

AGPhil 6.3 Mi 15:15 HS 10

Geodesic Motion in General Relativity and in Weyl Geometry — •Dennis Lehmkuhl — Institut für Philosophie, Universität Bonn, Am Hof 1, 53113 Bonn

In 1918, Hermann Weyl and Albert Einstein exchanged almost two dozen letters. In the majority of them, they focus on comparing general relativity (GR) with Weyl's unified field theory. The latter is based on a generalisation of pseudo-Riemannian geometry that we now call Weyl geometry. One of the most interesting aspects of this correspondence is the discussion of the motion of test particles in GR as compared to Weyl's theory. I will first outline the different positions advocated by Weyl and Einstein and the arguments they name in their favour. In the 1920s, Einstein and Weyl then independently argued that the geodesic motion of test particles in GR could be derived rather than assumed. In 1975, Geroch and Jang provided a new type of proof for such a 'geodesic theorem'. I will argue that the Geroch-Jang theorem can be generalised to Weyl geometry if the latter is decoupled from the project of a unified field theory, and that it can then shed new light on the positions advocated by Einstein and Weyl in the 1910s and 1920s.