Knowledge of the Early Universe (SYEU)

Symposium des
Arbeitskreises Philosophie der Physik
und der Fachverbände
Teilchenphysik
Theoretische und Mathematische Grundlagen der Physik
und
Gravitation und Relativität

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Übersicht der Plenarvorträge und Fachsitzungen

(KIP Gr. HS)

Plenarvorträge

SYEU 1.1	Mo	14:15–15:15	KIP Gr. HS	**A Landscape of Universes?** — •Karl Mannheim
SYEU 1.2	Mo	15:15–16:15	KIP Gr. HS	**Loop Quantum Gravity** — •Thomas Thiemann
SYEU 1.3	Mo	16:45–17:45	KIP Gr. HS	**Darker than Vacuum** — •Rainer Verch
SYEU 1.4	Mo	17:45–18:45	KIP Gr. HS	**Time and the Cosmic Measurement Problem** — •Henrik Zinkernagel

Fachsitzungen

SYEU 1.1–1.4	Mo	14:15–18:45	KIP Gr. HS	**Knowledge of the Early Universe**

SYEU 1: Knowledge of the Early Universe

Zeit: Montag 14:15–18:45 Raum: KIP Gr. HS

Plenarvortrag SYEU 1.1 Mo 14:15 KIP Gr. HS

A Landscape of Universes? — •Karl Mannheim — Lehrstuhl für Astronomie, Universität Würzburg, Am Hubland, D-97074 Würzburg

The discovery of a non-vanishing vacuum energy density in the universe has lead to an unprecedent showdown between the followers of the anthropic principle and the positivistic physicists. In the wake of the anthropic principle, "intelligent design" and other non-scientific conceptions entangle destructively with the rationality of the scientific method. The contribution will review the important steps that lead to the idea of the string theory landscape, and show possible ways out of the debate.

Plenarvortrag SYEU 1.2 Mo 15:15 KIP Gr. HS

Loop Quantum Gravity — •Thomas Thiemann — Max Planck Institute for Gravitational Physics (Albert Einstein Institute), Am Mühlenberg 1, D-14476 Potsdam

In order to resolve challenging puzzles in fundamental physics such as in modern cosmology, a quantum theory of gravity is required. One candidate for such a theory is Loop Quantum Gravity to which we give an introduction. We then investigate what LQG has to say about the quantum physics of the early universe.

30 Minuten Pause

Plenarvortrag SYEU 1.3 Mo 16:45 KIP Gr. HS

Darker than Vacuum — •Rainer Verch — Institut für Theoretische Physik, Universität Leipzig, Postfach 100920, D-04009 Leipzig

It is known that systems described by quantum mechanics and by quantum field theory have the peculiar property that density-like properties, whose integrals are non-negative, can violate positivity at single points in space and time to arbitrary extent. The expectation value of the energy density at a point, for example, is unbounded below as a function of the state. In this sense, there are states which are local sinks for the energy, and they are thus, locally, "darker than vacuum". This opens a priori the possibility to encounter spacetime structures with exotic causal behaviour, such as wormholes or warp-drive scenarios, as solutions to the semiclassical generalization of Einstein's equations where matter is treated in terms of quantum field theory but the spacetime geometry is described classically. However, the principle of stability of matter puts constraints on the amount and duration of positivity violation for, e.g., energy densities; these contraints have come to be known as Quantum (Energy) Inequalities. We will report on results obtained in the recent years on this circle of issues. We are also planning to discuss some aspects of local energy concepts in this context.

Plenarvortrag SYEU 1.4 Mo 17:45 KIP Gr. HS

Time and the Cosmic Measurement Problem — •Henrik Zinkernagel — Department of Philosophy, Faculty of psychology, Campus de Cartuja, University of Granada, E-18071 Granada, Spain

The spectacular success of quantum theory is often taken as a pointer towards the 'quantum fundamentalist' idea that the theory should be able to describe everything in the universe, and perhaps even the universe in its entirety. It is well known, however, that quantum fundamentalism ought to provide a satisfactory answer to what may be called the cosmic measurement problem: If the universe – either its content or in its entirety – was once (and perhaps still is) quantum, how come that there are classical structures now? In cosmology, the gradual emergence of classicality is framed in terms of a cosmic time parameter associated with the standard Fridmann-Lemaître-Robertson-Walker model. In this talk I examine the physical foundations for setting up the FLRW model – and I examine what is required for interpreting the t parameter of the model as time. I discuss how the definition of cosmic time in the FLRW model is related to the behaviour of the material constituents of the universe (e.g. via the Weyl principle), and how this point threatens to undermine the physical basis for the comoving reference frame if the material constituents of the universe are to be described exclusively in terms of quantum theory at some early stage of the universe. As a possible response to this threat I reconsider Bohr's interpretation of quantum mechanics which – contrary to the quantum fundamentalist point of view – reserves a privileged role for classical physics.