SYRP 2: The Concept of Reality in Physics II

Time: Wednesday 16:30–18:30 Location: HSZ 01

Invited Talk SYRP 2.1 Wed 16:30 HSZ 01

What can we learn from Bell's inequalities violations: the answers of Einstein and Feynman — •Alain Aspect — Institut d'Optique, Palaiseau, France

In 1935, with Podolsky and Rosen, Einstein discovered an amazing quantum situation, where particles in a pair are so strongly correlated that Schrödinger called them "entangled". By analyzing that situation, Einstein concluded that the quantum formalism had to be completed in order to be compatible with his world view, local realism. Niels Bohr immediately opposed that conclusion, and the debate lasted until the death of these two giants of physics, in the 1950's. In 1964, John Bell produced his famous inequalities which would allow experimentalists to settle the debate, and to show that local realism is untenable.

What can we conclude? Reading Einstein's argument in defense of local realism, we can find hints about what to abandon among concepts inherited from classical physics. But according to Feynman, this renouncement actually opens new possibilities...

Invited Talk SYRP 2.2 Wed 17:00 HSZ 01

Physics and Narrative — •David Albert — Department of Philosophy, Columbia University, New York City, NY, USA

I will discuss a simple, striking, and previously unnoticed tension between quantum-mechanical entanglement and the special theory of relativity. This new tension has nothing to do with the quantum-mechanical non-locality discovered by Bell - it arises (unlike Bell's non-locality) prior to any attempt at solving the measurement problem, in the context of the linear unitary quantum-mechanical equations of motion. I will show (in particular) that quantum-mechanical entanglement, together with the principle of relativity, entails that there can be no comprehensive account of the history of any multiple-particle quantum-mechanical system in the form of a 1-parameter assignment of instantaneous states - it will be shown (that is) how quantum-mechanical entanglement together with the equivalence of all inertial frames of reference entails that there can be no comprehensive account of the history of any such system in the form of a narrative. Some of the implications of this new tension for our understanding of the metaphysics of relativistic quantum theories will be considered.

Invited Talk SYRP 2.3 Wed 17:30 HSZ 01

The relativity of inertia and reality of nothing — •Alexander Afriat — Département de Philosophie, Université de Brest, France

We first see that the inertia of Newtonian mechanics is absolute and troublesome. General relativity can be viewed as Einstein's attempt to remedy, by making inertia relative, to matter – perhaps imperfectly though, as at least a couple of freedom degrees separate inertia from matter in his theory. I consider ways the relationist (for whom it is of course unwelcome) can try to overcome such underdetermination, dismissing it as physically meaningless, especially by insisting on the right transformation properties.

Invited Talk SYRP 2.4 Wed 18:00 HSZ 01

Obtaining Information about and Controlling Quantum Particles: Quantum Engineering — •Dieter Meschede — Institut für Angewandte Physik, Universität Bonn, Germany

Beginning with the observation of a single trapped ion in 1978, single particles have been widely used to experimentally illustrate concepts of quantum physics once considered purely abstract, e. g. quantum jumps. Since the 1990s, experimentalists have left the position of an observer and have begun to explore a new role as quantum engineers, exploiting the special properties of quantum dynamics and attempting to implement relevant processes in quantum information science. In this talk I will discuss the question how information about a simple atomic quantum system is obtained and can be used to steer it to a given state. Explicit examples include observation of atomic trajectories, quantum walks, and feedback schemes.