SYFA 1: Foundational Aspects of Quantum Theory

Time: Monday 10:45–12:45 Location: ZHG010

Invited Talk SYFA 1.1 Mon 10:45 ZHG010
Towards a Completion of Quantum Mechanics — •Jürg Fröhlich — ETH Zurich, 8093 Zurich, Switzerland

A basic physical mechanism, dubbed Principle of Declining Potentialities (PDP), underlying the dissipative nature of Heisenberg-picture time-evolution in systems of matter coupled to the quantized radiation field is exhibited. When combined with a natural State-Reduction Postulate PDP gives rise to a natural theory of quantum jumps, more precisely to a general law governing the stochastic time-evolution of states of individual systems in non-relativistic quantum electrodynamics. Our approach appears to lead to solutions of the so-called measurement problem and unitarity paradox. Some generalizations of our ideas to relativistic quantum theory will be sketched.

Invited Talk SYFA 1.2 Mon 11:25 ZHG010
Locality and its generalizations in quantum field theory — •Kasia Rejzner — University of York, York, UK

The principle of locality has been one of the guiding principles underlying quantum field theory (QFT). It is crucial in the Haag-Kastler framework of algebraic quantum field theory (AQFT) and it has been generalized to curved spacetimes through the principle of general local covariance. However, the simple idea of localization in relatively compact regions fails already in gauge theories (e.g. Dirac string or Wilson loops) and in quantum gravity one expects observables that are relational in nature, hence non-local. In this talk I will argue that non-locality enters QFT in a natural way when we consider measurements and introduce quantum reference frames.

Invited Talk SYFA 1.3 Mon 12:05 ZHG010
Heisenberg's Operational Program — •Reinhard Werner — Leibniz Universität Hannover

To build the new quantum theory just on observable quantities was an important guideline for Heisenberg's early work. In the Uncertainty Paper (1927) he tried to make this the principle of theory construction, in close analogy to Einstein's critical evaluation of simultaneity, which turned out to be the core of relativity theory. Heisenberg declares success of this program, although in hindsight one has to admit that he failed miserably, with the famous microscope thought experiment the only surviving bit of that chapter. I will retrace his arguments, and put them in the context of operational thinking in physics before and after Heisenberg. Indeed, operational ideas were current in Born's group quite independently of Heisenberg. On the other hand, modern quantum mechanics, especially quantum information theory, is much more radical than Heisenberg in its operational stance