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Einladung zum Vortrag

Quantum theory from simple principles

anlässlich des Habilitationsverfahrens
für das Fach " Theoretische Physik "

von

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Termin: Dienstag, 02.11.2021, 11:00 Uhr

Ort: Christian-Doppler-Hörsaal, Boltzmanngasse 5, 3. Stock

Abstract:

Quantum theory is one of our most successful physical theories, but its standard textbook formulation is mysterious. For example, why are states described by complex vectors in a Hilbert space, and why do observables correspond to self-adjoint operators? In this talk, I describe how the Hilbert space formalism of quantum theory can be reconstructed from simple physical or information-theoretic principles, without presupposing any of the usual mathematical machinery. This is conceptually similar to the derivation of the Lorentz transformations from the principles of relativity and the constancy of the speed of light. To this end, I introduce the framework of "generalized probabilistic theories" which generalizes both classical and quantum probability theory and which describes all possible consistent ways in which preparations and measurements can interact statistically in a laboratory. I give an explicit example of a set of principles that implies quantum theory, describe how the hunt for "higher-order interference" led to a scientific detective story, and show how these insights and techniques can shed surprising light on the relation between quantum theory and spacetime. If time permits, I will finally give an outlook on future work and briefly speculate what all this might tell us about the question of interpretation of quantum mechanics.