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Einladung zum Vortrag

Quantum foundations meets complex systems

anlässlich des Habilitationsverfahrens
für das Fach " Theoretische Physik "

von

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Termin: **Dienstag, 19.03.2024, 12:00 Uhr**

Ort: **Lise-Meitner-Hörsaal**
9. Boltzmanngasse 5, 1. Stock

Abstract:
I will summarize my work at the intersection of quantum foundations and complex systems in the last seven years. We will start with Bayes networks, which model causal relations between different events in complex experimental situations. I will introduce the causal compatibility problem, widely studied in modern probability theory, and explain how a bunch of quantum physicists solved it in the course of a few years. Some of those physicists, myself included, later identified causal scenarios where the predictions of standard and real-number quantum mechanics differ, which led to the experimental disproof of real quantum mechanics. The notion of Bayes networks also inspired a new definition of multipartite entanglement; one that cannot be "cheated" with bipartite sources of states. In the second part of the talk, I will focus on condensed matter systems and the different variants of the marginal problem they give rise to. In this scenario, the goal is to infer global properties, such as entanglement, non-classicality or consistency with quantum theory, of a many-body system, given just near-neighbor information. I will prove that, in translation-invariant spin chains, both entanglement and Bell non-classicality are non-local features: sometimes they can be detected even when near-neighbor statistics is reproducible with classical devices. We will discuss new advances on the classical marginal problem in the 2D square lattice and their consequences for statistical physics, as well as techniques to detect entanglement on tensor network states, based on renormalization group flows. Finally, I will comment on recent progress on the quantum marginal problem: namely, a correspondence between renormalization flows and convex relaxations of the set of near-neighbor density matrices of a many-body quantum system.