Großes Physikalisches Kolloquium an der Universität zu Köln

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Tensor Networks: entanglement and the simulation of quantum many-body problems

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HS III

The term Tensor Network (TN) States designates a number of ansatzes that can efficiently represent quantum many-body states. Ground states and thermal equilibrium of local Hamiltonians, and, to some extent, real time evolution, can be numerically studied with TNs. Quantum information theory provides tools to understand why they are good ansatzes for physically relevant states, and some of the limitations connected to the simulation algorithms.

The potential applications of TNS nowadays extend far beyond quantum many-body physics, for which they were originally introduced, into disciplines as quantum chemistry or quantum field theory. But out-of-equilibrium dynamics poses serious challenges for these techniques, due to the scaling of entanglement with time and system size. However, pushing TNS beyond the standard algorithms can open new windows onto interesting dynamical properties, such as thermalization of quantum systems evolving in isolation, which probes the intersection of statistical mechanics and quantum physics.