MP 5: Gittertheorien und Spinmodelle

Zeit: Dienstag 14:00–16:10 Raum: HS 23

Hauptvortrag MP 5.1 Di 14:00 HS 23

Tensor Networks and their use for Lattice Gauge Theories — •Maria Carmen Banuls — Max-Planck-Institut für Quantenoptik, Garching b. München, Germany

Tensor Network States (TNS) are Ansätze for the efficient description of the state of a quantum many-body system. They can be used to study static and dynamic properties of strongly correlated states.

Lattice Gauge Theories, in their Hamiltonian version, offer a challenging scenario for these techniques. While the dimensions and sizes of the systems amenable to TNS studies are still far from those achievable by Monte Carlo simulations, Tensor Networks can be readily used for problems which more standard techniques cannot easily tackle, such as the presence of a chemical potential, or out-of-equilibrium dynamics.

In this talk I will present some recent work on the application of these techniques to study Lattice Gauge Theories. In particular, using the Schwinger model as a testbench, we have shown that TNS are suitable to approximate low energy states precisely enough to allow for accurate finite size and continuum limit extrapolations of ground state properties, mass gaps and temperature dependent quantities. The feasibility of the method has already been tested also for non-Abelian models, out-of-equilibrium scenarios, and non-vanishing chemical potential.

MP 5.2 Di 14:40 HS 23

Inhomogeneous Phases at Finite Flavor Numbers in 2D Gross-Neveu Models — •Julian Lenz[1], Laurin Pannullo[2], Marc Wagner[2], Björn Wellegehausen[1], and Andreas Wipf[1] — [1]Theoretisch-Physikalisches Institut, FSU Jena — [2]Institut für theoretische Physik, Universtiät Frankfurt

In the limit of infinite number of flavors Nf the Gross-Neveu model in two dimensions becomes solvable analytically. About 15 years ago Thies et al. found inhomogeneous phases for non-vanishing chemical potential in that limit and since then a revisited phase diagram for infinite Nf was established. However, for a long time it was unclear if this is an artifact of the infinite flavor number or survives the transition to finite Nf. We present lattice Monte-Carlo results that indicate the existence of inhomogeneous condensates for all (even) flavor numbers Nf.

10 Minuten Pause

MP 5.3 Di 15:10 HS 23

On Phase-Space Representations of Spin Systems and Their Relations to Infinite-Dimensional Quantum States — •Bálint Koczor, Robert Zeier, and Steffen J. Glaser — Technische Universität München, Garching, Germany

Classical phase spaces have been widely applied in physics, engineering, economics or biology. I will give an overview of our recent works on phase spaces of quantum systems, which are a powerful tool for describing, analyzing, and tomographically reconstructing quantum states. We provide a complete phase-space description of (coupled) spin systems including their time evolution, tomography, large-spin approximations and their infinite-dimensional limit, which recovers the well-known case of quantum optics. We calculate time evolutions using spin-weighted spherical harmonics of Newman and Penrose and approximate phase-space representations of quantum states that are challenging to calculate for large spin numbers.

Refer to the recent preprints arXiv:1711.07994 and arXiv:1808.02697.

MP 5.4 Di 15:30 HS 23

Lattice gauge theory: operator algebras and renormalization — •Alexander Stottmeister — Mathematisches Institut, Westfälische Wilhelms-Universität Münster

We discuss Hamiltonian lattice gauge theory and the implementation of Wilson's approach to the renormalization group from an operator-algebraic perspective. We indicate how the problem of identifying suitable continuum limits can be used to construct interesting examples of von Neumann algebras. Moreover, we relate the latter with a recent proposal of Jones for the construction of representations of the Thompson groups. As a working example, we present the construction of Yang-Mills theory on a space-time cylinder and relate it with quantum stochastic processes.

MP 5.5 Di 15:50 HS 23

Hamilton's equations of motion for quantum systems — •Michael Beyer[1], Jeanette Köppe[2], Markus Patzold[1], and Wolfgang Paul[1] — [1]Martin-Luther-Universität Halle-Wittenberg — [2]Westfälische Wilhelms-Universität Münster

Quantum systems can be described in terms of kinematic and dynamic equations within the stochastic picture of quantum mechanics where the particles follow some conservative diffusion process. We show that the reformulation of the quantum Hamilton principle as a stochastic optimal control problem allows us to derive these quantum Hamilton equations of motion for multidimensional systems which can be seen as a generalization of Hamilton's equations of motion to the quantum world. Due to their similar structure it is possible to draw analogies to classical mechanics where one encounters some similarities for quantum systems, e.g. the decoupling of the center-of-mass motion in multi-particle systems or the Kepler problem as the special case of the two-body problem where we present numerical results for the hydrogen atom.