MP 3: Quantentheorie großer Systeme

Zeit: Dienstag 14:00–15:00 Raum: M010

MP 3.1 Di 14:00 M010

Viewing Markovian Quantum Channels as Lie Semigroups and GKS-Lindblad Generators as Lie Wedge: New Perspectives and Applications — •Thomas Schulte-Herbrüggen[1], Gunther Dirr[2], Indra Kurniawan[2], and Uwe Helmke[2] — [1]Technical University Munich (TUM), Dept. Chemistry — [2]University of Würzburg, Institute of Mathematics

Optimal control of Markovian and non-Markovian open quantum systems cuts errors typically by one order of magnitude [1] in realistic settings. Yet open systems require more intricate theoretical concepts of controllability than their closed counterparts [2,3]. We present such new concepts in terms of Lie semigroups and Lie semialgebras [3].

On a general scale, Markovian quantum channels (with det>0) recently characterised by their divisibility [4] can now be defined in the more general frame of invariant cones by their Lie-semigroup properties [3] with the GKS-Lindblad generators as Lie wedge. Its geometry proves powerful for addressing reachability as well as for numerical algorithms both in optimal control and in optimisation on various types of reachable sets within quantum state-space manifolds [2,3].

[1] Schulte-Herbrüggen, Spörl, Khaneja, Glaser, quant-ph/0609037; Rebentrost, Serban, Schulte-H., Wilhelm, quant-ph/0612165
[2] Schulte-Herbrüggen, Dirr, Helmke, Glaser, arXiv:0802.4195
[3] Dirr, Helmke, Kurniawan, Schulte-Herbrüggen, arXiv:0811.3906
[4] Wolf and Cirac, Commun. Math. Phys. 279, 147 (2008); Wolf, Eisert, Cubitt, Cirac, PRL 101, 150402 (2008)

MP 3.2 Di 14:20 M010

Structural response properties of interacting quantum fields — •Lev Plimak[1] and Stig Stenholm[1,2,3] — [1]Abteilung Quantenphysik, Uni Ulm, D-89069 Ulm, Germany. — [2]Physics Department, Royal Institute of Technology, KTH, Stockholm, Sweden — [3]Laboratory of Computational Engineering, HUT, Espoo, Finland

We analyse nonperturbatively signal transmission patterns in Green's functions of interacting quantum fields, bosonic as well as fermionic. Quantum field theory is re-formulated in terms of the nonlinear quantum-statistical response of the field. This formulation applies equally to interacting relativistic fields and nonrelativistic models. Of crucial importance is that all causality properties to be expected of a response formulation indeed hold. Being by construction equivalent to Schwinger's closed-time-loop formalism, this formulation is also shown to be related naturally to both Kubo's linear response and Glauber's macroscopic photodetection theories, being a unification of the two with generalisation to the nonlinear quantum-statistical response problem.

MP 3.3 Di 14:40 M010

Instantons in Noncommutative U(1) Gauge Theory in Even Dimensions on the Lattice — Arifa Ali Khan[1] and •Harald Markum[2] — [1]Institute of Theoretical Physics, University of Regensburg — [2]Atominstitut, Vienna University of Technology

Theories with noncommutative space-time coordinates represent alternative candidates of grand unified theories. We discuss U(1) gauge theory in 2 dimensions on a lattice with N sites. The mapping to a U(N) one-plaquette model in the sense of Eguchi and Kawai can be used for computer simulations. We performed quantum Monte Carlo simulations and calculated the topological charge for different matrix sizes and several values of the coupling constant. We constructed classical gauge field configurations with large topological charge and used them to initialize quantum simulations. It turned out that the value of the topological charge is decreasing during a Monte Carlo history. Our results show that the topological charge is in general supressed. The situation is similar to lattice QCD where quantum gauge field configurations are topologically trivial and one needs to apply some cooling procedure on the gauge fields to unhide the integer number of the instantons. At present we are working out the definition of instantons and monopoles in 4 dimensions. Concerning the topological charge it seems straightforward. and one can transcribe the plaquette and hypercube formulation to the matrix theory. The monopole observable seems to be more difficult. The analogy to commutative U(1) theory of summing up the phases of an elementary cube might need a projection on the abelian part of the U(N) theory in the matrix model.