MP 9 Quantum Information Theory

Zeit: Mittwoch 14:00–15:20 Raum: TU MA141

Fachvortrag MP 9.1 Mi 14:00 TU MA141

Quantum state estimation and large deviations — •Michael Keyl — Univ. Pavia, QUIT Group, Dipartimento Di Fisica "A. Volta", via Bassi 6, I-27100 Pavia, Italy

In this paper we propose a method to estimate the density matrix ρ of a d-level quantum system by measurements on the N-fold system in the joint state $\rho^{\otimes N}$. The scheme is based on covariant observables and representation theory of unitary groups and it extends previous results concerning the estimation of the spectrum of ρ. We show that it is consistent (i.e. the original input state ρ is recovered with certainty if $N \to \infty$) and analyze its large deviation behavior. In addition we calculate explicitly the corresponding rate function which describes the exponential decrease of error probabilities in the limit $N \to \infty$. For pure input states, or if ρ is mixed but only information about its spectrum is required, we then show that the proposed scheme is optimal in the sense that it provides the fastest possible decay of error probabilities. In the general case, however, the optimality question remains open.

Fachvortrag MP 9.2 Mi 14:20 TU MA141

Entanglement in fermionic systems and its application to spin chain models — •Dirk Schlingemann — Institute for Mathematical Physics, Technical University of Braunschweig

The concept of entanglement in fermionic systems is investigated. We consider a bipartite fermionic system, that is, the fermion fields of Alice's system anti-commute with the fermion fields of Bob's. Thus Alice's observables, which are generated by even products of fermion fields, commute with the observables of Bob. Restricting to observables, we are faced with a bipartite system in the usual sense.

The entanglement of a bipartite fermion state is given by the entanglement of its restriction to the corresponding observable algebras. The main problem is now to compute explicitly the standard entanglement measures, like entanglement of formation, for the restricted state. Note that the restricted state is not pure in general although it may be pure on the fermion algebra. Even if the given state is quasi-free (determined by the correlation function of two fermi field operators), we need to find optimal convex decompositions into pure states which need not to be quasi-free.

To overcome this difficulty we show, by using the concept of "twisted EPR doubles", that there is a quasi-free state for which the restriction to the observable part is indeed maximally entangled. Then we introduce an appropriate fidelity which measures how much a given pure state (pure on the fermion algebra) deviates from the maximally entangled one.

The results are applied to ground states of spin chain models which are related to quasi-free states via the Jordan-Wigner transformation.

Fachvortrag MP 9.3 Mi 14:40 TU MA141

Automatic ensemble teleportation even under sub-optimal conditions — •Thomas Krüger — Theoretische Physik, Fakultät für Naturwissenschaften, Universität Paderborn, Warburger Str. 100, 33098 Paderborn

The possibility of teleportation is surely the most interesting consequence of quantum non-separability. So far, however, teleportation schemes have been formulated by use of state vectors and considering individual entities only. In the present contribution the feasibility of teleportation is examined on the basis of the rigorous ensemble interpretation of quantum mechanics (not to be confused with a mere treatment of noisy EPR pairs) leading to results which are unexpected from the usual point of view. Emphasis is laid on realistic situations where mixed and/or semi-separable states come into play.

Fachvortrag MP 9.4 Mi 15:00 TU MA141

Die Topologie der unitären Gruppen und die Hamilton-Darstellung von unitären Gattern — •Torsten Asselmeyer-Maluga, Matthias Kolbe, Helge Rose und Andreas Schramm — FhG FIRST, Kekulestr. 7,12489 Berlin

In dem Vortrag soll das Problem behandelt werden, wie man aus einer gegebenen unitären Transformation den zugehörigen Hamiltonian bestimmt. In den meisten Fällen führt das Standardverfahren des Logarithmieren zu einem Ergebnis, bei dem der Hamiltonian mehr als Paarwechselwirkungen aufweist. Natürlich sind solche Hamiltonian praktisch nicht realisierbar. Es gibt aber eine Uneindeutigkeit in dem Verfahren des Logarithmieren und nun besteht die Hoffnung, daß sich durch eine entsprechende Wahl des Hamiltonian alle oder fast alle unitären Transformationen ohne Mehrfach-Wechselwirkungen realisieren. Im Vortrag wird ein Beweis vorgestellt, der genau das Gegenteil zeigt. Durch eine Analyse der Topologie und Geometrie der unitären Gruppe kann gezeigt werden, daß man immer nur mit Mehrfach-Wechselwirkungen alle unitären Gatter darstellen kann.