Q 13: Quanteninformation: Konzepte III

Zeit: Montag 16:30–18:00 Raum: VMP 6 HS-D

Q 13.1 Mo 16:30 VMP 6 HS-D

Quantitative verification of entanglement from incomplete measurement data — •Harald Wunderlich[1,2] and Martin B. Plenio[2,3] — [1]Fachbereich Physik, Universität Siegen, Siegen — [2]Institute for Mathematical Sciences, Imperial College London, London, UK — [3]QOLS, Blackett Laboratory, Imperial College London, London, UK

Many experiments in quantum information aim at creating multipartite entangled states. Quantifying the amount of actually generated entanglement can, in principle, be accomplished using full-state tomography. However, this method requires a number of measurement settings growing exponentially in the number of qubits. Non-trivial bounds on experimentally achieved entanglement can also be obtained from partial information on the density matrix. The fundamental question is then formulated as: What is the entanglement content of the least entangled quantum state that is compatible with the available measurement data?

We formulate the problem mathematically employing methods from the theory of semi-definite programming and then address this problem for the case, where the goal of the experiment is the creation of graph states. The observables that we consider are the generators of the stabilizer group, thus the number of measurement settings grows only linearly in the number of qubits. We provide analytical solutions as well as numerical methods that may be applied directly to experiments, and compare the obtained bounds with results from full-state tomography for simulated data.

Q 13.2 Mo 16:45 VMP 6 HS-D

Detection of entanglement with high statistical significance — •Sönke Niekamp, Bastian Jungnitsch, Matthias Kleinmann, and Otfried Gühne — Institut für Quantenoptik und Quanteninformation, Technikerstraße 21a, 6020 Innsbruck, Austria

A witness operator is a tool which allows to verify whether a given state is entangled. In a typical experiment, only a limited number of copies of the entangled state is available for this task. In order to detect entanglement with high certainty, it is therefore of advantage to decrease the statistical error involved in the measurement of the witness.

We investigate strategies to improve witness operators in order to minimize the error, focusing on experiments with trapped ions.

Q 13.3 Mo 17:00 VMP 6 HS-D

Detector-level entanglement of identical particles — •Malte Christopher Tichy[1], Fernando de Melo[1], Florian Mintert[1], Marek Kuś[2], and Andreas Buchleitner[1] — [1]Albert-Ludwigs-Universität Freiburg, Hermann-Herder-Str. 3, 79104 Freiburg im Breisgau — [2]Center for Theoretical Physics, Polish Academy of Sciences, Aleja Lotników 32/46, 02-668 Warszawa, Poland

We study the impact of the (anti)symmetrization of the wave function of two identical bosons (fermions) on the entanglement measured at two spatially separated detectors.

Ambiguous spatial detector settings induce uncertainty on the outcome of spin-measurements of two spatially overlapping particles. We show that this uncertainty manifests itself as classical entropy in the case of distinguishable particles and as entanglement in the case of identical particles. We explore the transition between distinguishable and indistinguishable particles by tuning of the *effective indistinguishability*, a quantity which depends on the physical arrangement of the detectors. Due to two-particle interference, initially entangled particles may gain or loose correlations when detected in a certain setting and show strong quantum statistical effects.

Q 13.4 Mo 17:15 VMP 6 HS-D

Triplet-like correlation symmetry of 2-mode continuous variable entangled states — •Gerd Leuchs, Ruifang Dong, and Denis Sych — Institute for Optics, Information and Photonics, Max-Planck Institute for Science of Light, University Erlangen-Nuernberg, Guenther-Scharowsky-Str. 1, 91058, Erlangen, Germany

We report on a remarkable similarity of arbitrary two-mode continuous variable entangled states and two-qubit triplet Bell states. Both are shown to have the similar "mirror-reflection" correlation symmetry. By analogy with the qubit language we refer to the two-mode continuous variable entangled states as being triplet-like. The geometry of these quantum states is closely related to the so-called UxU* symmetry and these states show corresponding correlations. This triplet-like geometrical correlation property is demonstrated experimentally in the continuous variable regime for the first time.

Q 13.5 Mo 17:30 VMP 6 HS-D

Global Effects of Locally Noneffective Unitary Operations — •Hermann Kampermann[1], Sevag Gharibian[1,2], and Dagmar Bruss[1] — [1]Theoretische Physik III, Universität Düsseldorf, Germany — [2]Institute for Quantum Computing, University of Waterloo, Canada

We study the effect of locally noneffective unitary operations on bipartite quantum states, i.e. unitary operations applied to one party which leave the reduced density operator invariant. We investigate the distance between the bipartite state before and after such a local operation as an indicator for entanglement and non-locality [L.B. Fu, Europhys. Lett., vol. 75, 1 (2006)]. Closed formulae for the maximal distance induced by such operations (Fu-distance) are derived for pseudo pure quantum states, Werner states, and two-qubit states. The capabilities and limitations of the Fu-distance for entanglement detection is discussed as well as the connection to the CHSH inequality for specific classes of two-qubit states.

Q 13.6 Mo 17:45 VMP 6 HS-D

Concepts of simultaneity in quantum measurements — •Michael Busshardt and Matthias Freyberger — Institut für Quantenphysik, Universität Ulm, 89069 Ulm, Germany

The concept of simultaneous measurements of conjugate variables is reviewed. We especially focus on setups in the optical domain, where the quadratures of the electromagnetic field do not commute and, therefore, cannot be precisely measured simultaneously. However, by allowing the system under investigation to interact with certain classes of additional ruler systems, we can still obtain information about non-commuting observables in a simultaneous measurement. The question arises, which kinds of ruler states are optimal to gain specific knowledge about the system at hand. We focus on the advantage of entangled ruler states, as well as on the possibility to use such setups for state preparation. Moreover, in order to understand the true meaning of simultaneity, we explicitely consider time-dependent interactions.