Q 46: Quantum information: Concepts and methods IV

Time: Thursday 11:00–12:45 Location: E 001

Q 46.1 Thu 11:00 E 001

Are General Quantum Correlations Monogamous? — •Alexander Streltsov[1], Gerardo Adesso[2], Marco Piani[3], and Dagmar Bruss[1] — [1]Institut für Theoretische Physik III, Heinrich-Heine-Universität Düsseldorf — [2]School of Mathematical Sciences, University of Nottingham — [3]Institute for Quantum Computing and Department of Physics and Astronomy, University of Waterloo

Quantum entanglement and quantum nonlocality are known to exhibit monogamy; that is, they obey strong constraints on how they can be distributed among multipartite systems. Quantum correlations that comprise and go beyond entanglement are quantified by, e.g., quantum discord. It was observed recently that for some states quantum discord is not monogamous. We prove, in general, that any measure of correlations that is monogamous for all states and satisfies reasonable basic properties must vanish for all separable states: only entanglement measures can be strictly monogamous. Monogamy of other than entanglement measures can still be satisfied for special, restricted cases: we prove that the geometric measure of discord satisfies the monogamy inequality on all pure states of three qubits. See also Phys. Rev. Lett. 109, 050503 (2012)

Q 46.2 Thu 11:15 E 001

Device independent entanglement quantification — •Tobias Moroder[1], Jean-Daniel Bancal[2], Yeong-Cherng Liang[2], Martin Hofmann[1], and Otfried Gühne[1] — [1]Theoretische Quantenoptik, Department Physik, Universität Siegen — [2]Group of Applied Physics, University of Geneva

Most experiments require a rather precise characterization of the employed equipment or of the underlying model generating the data. However and presumably quite surprising at first, many tasks in quantum information processing can be made completely independent of this necessity. This has become the beauty of device independence, and there is a variety of tasks which have been investigated more thoroughly recently, including, for instance, different entanglement verification schemes or witnesses of the underlying quantum dimension.

We present a method for device independent entanglement quantification for the bi- and multipartite case, which directly provides non-trivial information about the underlying quantum dimension or the type of entanglement. This becomes possible by a novel technique to device independently characterize correlations if the quantum state has for instance a positive partial transpose or a biseparable structure. With this technique we additionally derive bounds on the maximal violation of a Bell inequality if the underlying state is PPT (and thus bound) entangled, which provides new insights into the bipartite Peres conjecture.

Q 46.3 Thu 11:30 E 001

Multipartite entanglement and high precision metrology — •Géza Tóth — Theoretical Physics, University of the Basque Country UPV/EHU, E-48080 Bilbao, Spain — IKERBASQUE, Basque Foundation for Science, E-48011 Bilbao, Spain — Wigner Research Center for Physics, H-1525 Budapest, Hungary

We present several entanglement criteria in terms of the quantum Fisher information that help to relate various forms of multipartite entanglement to the sensitivity of phase estimation. We show that genuine multipartite entanglement is necessary to reach the maximum sensitivity in some very general metrological tasks using a two-arm linear interferometer. We also show that it is needed to reach the maximum average sensitivity in a certain combination of such metrological tasks.

Q 46.4 Thu 11:45 E 001

A quantitative witness for Greenberger-Horne-Zeilinger entanglement — •Christopher Eltschka[1] and Jens Siewert[2,3] — [1]Institut für Theoretische Physik, Universität Regensburg, D-93040 Regensburg, Germany — [2]Departamento de Química Física, Universidad del País Vasco UPV/EHU, 48080 Bilbao, Spain — [3]IKERBASQUE, Basque Foundation for Science, 48011 Bilbao, Spain

Along with the vast progress in experimental quantum technologies there is an increasing demand for the quantification of entanglement between three or more quantum systems. Theory still does not provide adequate tools for this purpose. We provide a simple procedure to quantify Greenberger-Horne-Zeilinger-type multipartite entanglement in arbitrary three-qubit states [1]. The method is based on the recently introduced GHZ symmetry [2] and exact results for the states which are invariant under this symmetry [3], and generally gives a good lower bound to the three-tangle. A generalization both to more parties and to higher-dimensional systems is possible.

[1] C. Eltschka, J. Siewert. Sci. Rep. 2, 942 (2012)
[2] C. Eltschka, J. Siewert, PRL 108, 020502 (2012)
[3] J. Siewert, C. Eltschka, PRL 108, 230502 (2012)

Q 46.5 Thu 12:00 E 001

A classification scheme of pure multipartite states — Markus Johansson[1,3], •Andreas Osterloh[2], Marie Ericsson[3], and Eric Sjöqvist[3] — [1]Centre for Quantum Technologies, National University of Singapore, 3 Science Drive 2, 117543 Singapore, Singapore. — [2]Fakultät für Physik, Universität Duisburg-Essen, Lotharstr. 1, 47048 Duisburg, Germany. — [3]Department of Quantum Chemistry, Uppsala University, Box 518, Se-751 20 Uppsala, Sweden.

We present a classification scheme based on balancedness of a state. Since the c-balanced states classify the SL-semistable states, a-balanced states are the bridge towards those states, which are characterized by unbalanced states. Together with U-invariants of bi-degree (m, n) which are known to have a topological phase, we have a complete characterization scheme from maximal genuinely entangled states that are representatives of the SL group $(2n, 0)$ down to the SU group (n, n). As a by-product we distill generalizations to the W-state, states that are entangled, but contain only globally distributed entanglement of parts of the systems.

Q 46.6 Thu 12:15 E 001

Non-Contextual Evolution: Generalizing and Testing the Kochen-Specker Theorem — •Jochen Szangolies, Matthias Kleinmann, and Otfried Gühne — Naturwissenschaftlich-Technische Fakultät, Walter-Flex-Str. 3, Universität Siegen

The Kochen-Specker theorem establishes the impossibility of completing quantum mechanics using noncontextual hidden variables. However, its experimental testability has been subject to some controversy. A reason for this is that (non-)contextuality in the Kochen-Specker sense is only applicable in the case of perfectly compatible observables. However, in real experiments, this cannot be achieved. We address this problem by introducing a generalized notion of noncontextuality that applies to a system subject to stochastic noncontextual evolution, and thus, is applicable even in the case of incompatible observables. This can be seen as a combination of the ideas behind the Leggett-Garg and Kochen-Specker 'no-go' results. On these grounds we then propose inequalities that are obeyed by any noncontextually evolving system, but violated by quantum mechanics. Since the class of hidden variable theories we consider includes the Kochen-Specker noncontextual ones, observing such a violation implies an experimental test of the Kochen-Specker theorem free from the problem of compatibility.

Q 46.7 Thu 12:30 E 001

Quantum phase space and its entropies — •Kedar S. Ranade — Institut für Quantenphysik, Universität Ulm

Quantum phase space functions are known to be an alternative representation of quantum mechanics, which in some sense appears to be more "classical" than the usual Hilbert space formalism with density matrices and operators. Similar to the concept of Shannon and von-Neumann entropies on probability distributions or density matrices, the Wehrl and Rényi-Wehrl entropies make use of the so-called Husimi-Kano phase space function. Certain analogues of these functions exist for the Wigner function. In this talk we give an overview on these concepts and their interpretation and discuss how relations between different phase space functions may be exploited to give new insights.