Q 38: Quanteneffekte (Verschränkung und Dekohärenz)

Zeit: Donnerstag 11:00–13:15 Raum: 2D

Gruppenbericht Q 38.1 Do 11:00 2D

Operational monitoring of multi-qubit entanglement classes via tuning of local operations — •Thierry Bastin[1], Christoph Thiel[2], Joachim von Zanthier[2], Lucas Lamata[3], Enrique Solano[4], and Girish S. Agarwal[5] — [1]Institut de Physique Nucléaire, Atomique et de Spectroscopie, Université de Liège, Belgium — [2]Institut für Optik, Information und Photonik,Max-Planck Forschungsgruppe, Universität Erlangen-Nürnberg, Germany — [3]Max-Planck-Institut für Quantenoptik, Garching, Germany — [4]Physics Department, ASC, and CeNS, Ludwig-Maximilians-Universität, Munich, Germany — [5]Department of Physics, Oklahoma State University, Stillwater, USA

We introduce a physical setup consisting of N emitters, incoherently radiating single photons that may be absorbed remotely by detectors equipped with polarizers and producing long-lived multiqubit entangled states in the internal ground levels of the emitters. By using optical fibers our system offers also access to remote entangled matter qubit states.

We show that it is possible to associate well-defined sets of locally tuned polarizer orientations with multiqubit entanglement classes, allowing their monitoring in an operational manner. Our method is not restricted to two or three particles but can monitor entanglement classes even for a four particle system. Hereby, multipath quantum interference, associated with qubit permutation symmetry, plays a key role in explaining the underlying physics.

Q 38.2 Do 11:30 2D

Entanglement screening by nonlinear resonances — •Ignacio Garcia-Mata[1], Andre R. R. Carvalho[2], Florian Mintert[3,4,5], and Andreas Buchleitner[3,4] — [1]Laboratoire de Physique Theorique, UMR 5152 du CNRS, Universite Toulouse III — [2]Department of Physics, Faculty of Science, Australian National University ACT 0200, Australia — [3]Albert-Ludwigs-Universitaet Freiburg, Physikalisches Institut, Hermann-Herder-Str. 3, D-79104 Freiburg, Germany — [4]Max-Planck-Institut fur Physik komplexer Systeme, Noethnitzerstrasse 38, D-01187, Dresden, Germany — [5]Department of Physics, Harvard University, 17 Oxford Street, Cambridge Massachusetts, USA

We show that nonlinear resonances in a classically mixed phase space allow us to define generic, strongly entangled multipartite quantum states. The robustness of their multipartite entanglement increases with the particle number, i.e., in the semiclassical limit, for those classes of diffusive noise which assist the quantum-classical transition. Numerical results are shown for the quantum Harper map.

Q 38.3 Do 11:45 2D

Estimation of multipartite entanglement — •Florian Mintert[1], Leandro Aolita[2], and Andreas Buchleitner[1] — [1]Albert-Ludwigs-Universität Freiburg, Hermann-Herder-Str. 3, 79104 Freiburg — [2]Universidade Federal do Rio de Janeiro, Caixa Postal 68528, 21941-972 Rio de Janeiro, RJ, Brasil

We present an efficient estimation of the multipartite entanglement of mixed quantum states in terms of simple parity measurements. Similarly to the bipartite case [1] also multipartite generalizations of concurrence can be bounded by expectation values of simple parity projections on two identically prepared quantum states [2].

[1] F. Mintert and A. Buchleitner, Phys. Rev. Lett. **98**, 140505 (2007)
[2] L. Aolita, A. Buchleitner and F. Mintert, quant-ph/0710.3529

Q 38.4 Do 12:00 2D

The role of atom-cavity detuning in cavity QED experiments — •Denis Gonta[1] and Stephan Fritzsche[1,2] — [1]Max–Planck–Institut für Kernphysik, Postfach 103980, D–69029 Heidelberg — [2]Physikalisches Institut der Universität Heidelberg, Philosophenweg 12, D-69120 Heidelberg

Cavity QED provides an excellent control of the atom-field interaction, when Rydberg atoms reside or pass through the cavity. This opens up a way to obtain the coherent coupling of the atomic and photonic qubits as associated with the two-level Rydberg atoms and the cavity field states, respectively.

In this contribution, we explore the coherent evolution of the cavity states superposition in bimodal cavities and how this evolution is affected if a realistic atom-cavity detuning is considered. Comparison of our model computations has been made with experiment [1] in which the entanglement of the two field modes has been demonstrated using a bimodal cavity. A better agreement with experiment is obtained if a 'finite switch' of the atomic resonance frequency from one to the second mode of a bimodal cavity is combined with the mutual interaction between the cavity modes. We shall consider also experimental setup [2] in which the entanglement of two Rydberg atoms has been demonstrated by the cavity assisted collision.

[1] A. Rauschenbeutel *et al.*, Phys. Rev. A **64**, 050301 (2001).
[2] S. Osnaghi *et al.*, Phys. Rev. Lett. **87**, 037902 (2001).

Q 38.5 Do 12:15 2D

Semiclassical simulation of open quantum systems — •Florian Mintert[1,2] and Eric Heller[2] — [1]Albert-Ludwigs-Universität Freiburg, Hermann-Herder-Str. 3, 79104 Freiburg — [2]Department of Physics, Harvard University, 17 Oxford Street, Cambridge, MA 02138, USA

We present an approach for the semiclassical treatment of open quantum systems. An expansion into localized states allows to restrict a simulation to a fraction of the environment that is located within a predefined vicinity of the system. Our approach allows to add and drop environmental particles during the simulation what provides the basis for an effective reduction of the size of the system that is being treated.

Q 38.6 Do 12:30 2D

Generation of arbitrary Dicke states in remote qubits using linear optics — •Andreas Maser[1], Christoph Thiel[1], Uwe Schilling[1], Thierry Bastin[2], Enrique Solano[3], and Joachim von Zanthier[1] — [1]Institut für Optik, Information und Photonik, Max-Planck-Forschungsgruppe, Universität Erlangen-Nürnberg, Germany — [2]Institut de Physique Nucléaire, Atomique et de Spectroscopie, Université de Liège, Belgium — [3]Physics department, ASC, and CeNS, Ludwig-Maximilians-Universität, Munich, Germany

We propose a method for generating any state out of the whole family of Dicke states (symmetric and non-symmetric) for an arbitrary number of remote qubits: The method uses the long-lived internal ground levels of remote particles as qubits and is based on linear optics and single photon detection. The scheme offers thus access to the complete basis of the Hilbert space of an N spin-1/2 particle compound system and its not yet investigated entanglement classes.

In particular, we consider a system of N localized atoms, e.g. ions stored in a Paul trap, where each of them is characterised by a Λ-configuration. All atoms are initially coherently excited into the upper state and the spontaneously emitted photons are collected by photonic fibres which are connected to photon detectors with polarization sensitive analyzers placed in front. The latter determine the polarization state of the registered photons.

Q 38.7 Do 12:45 2D

Single-Particle Interference Can Witness Bipartite Entanglement — •Torsten Scholak[1], Florian Mintert[2,3], and Cord A. Müller[1] — [1]Physikalisches Institut, Universität Bayreuth, 95440 Bayreuth, Germany — [2]Max-Planck-Institut für Physik Komplexer Systeme, Nöthnitzerstraße 38, 01187 Dresden, Germany — [3]Physikalisches Institut, Albert-Ludwigs-Universität Freiburg, 79104 Freiburg, Germany

We propose to realize entanglement witnesses in terms of the interference pattern of a single quantum probe [1]. After giving a conceptional recipe, we discuss possible realizations both with electrons in mesoscopic Aharonov-Bohm rings and with photons in standard Young's double-slit or coherent-backscattering interferometers.

[1] arXiv:0710.0825

Q 38.8 Do 13:00 2D

Decoherence properties of entangled single nuclear spins and one electron spin at room temperature in diamond — •Philipp Neumann, Torsten Gaebel, Florian Rempp, Christian Zierl, Fedor Jelezko, and Jörg Wrachtrup — 3. Physikalisches Institut, Universität Stuttgart, Germany

Generation of long-lived entanglement between single qubits is at the heart of quantum information processing. Since the coherence between single qubits in solid state systems is rather fragile one is looking for qubits with long coherence lifetimes. Those could be nuclear spins. In our case we use the electron spin of the NV-center in diamond to generate Bell States between two qubits associated with two proximal ^{13}C nuclear spins. Eventually the electron spin itself is used as a qubit and 3-particle entanglement is generated. The decoherence properties of these entangled states are investigated.