Q 60: Quantum effects: Entanglement and decoherence I

Time: Friday 11:00–12:30 Location: A 310

Group Report Q 60.1 Fri 11:00 A 310

Energetic consequences of pure decoherence in ultrafast collisions — •C. Aris Dreismann[1], Evan MacA. Gray[2,3], and Tom P. Blach[4] — [1]Institute of Chemistry, TU Berlin — [2]Griffith University, Brisbane, Australia — [3]Queensland Micro- and Nanotechnology Centre — [4]Queensland University of Technology, Brisbane, Australia

We consider the dynamics of open quantum systems exhibiting pure decoherence (without disipation) as described by the well known master equations of the so-called Lindblad form. They ensure positivity of the system's reduced density operator, but they also exhibit an unexpected feature: an intrinsic increase of the system's energy [1]. Recently this effect of decoherence has been theoretically shown [2,3] to be of more general character, under the condition that the characteristic time of the process is sufficient short. Here we report first experimental evidence of this surprising effect, in the frame of attosecond neutron Compton scattering (NCS) from protons and deuterons (of gaseous H2 and D2 at 40 K) [4]. Additionally we provide a qualitative theoretical understanding of the experimental results [4]. The observations stand in blatant contradiction to conventional theory, which is based on the Golden Rule and in which quantum correlations [5] and decoherence between probe particle and scatterer play no role.

[1] L. E. Ballentine, Phys. Rev. A 43 (1991) 9. [2] L. S. Schulman and B. Gaveau, Phys. Rev. Lett. 97 (2006) 240405. [3] N. Erez et al., Nature 452 (2008) 724. [4] C. A. C.-Dreismann, E. MacA. Gray and T. P. Blach, AIP Advances 1 (2011) 022118; and Nucl. Instr. Meth. A 676 (2012) 120. [5] K. Modi et al., Rev. Mod. Phys. 84 (2012) 1655.

Q 60.2 Fri 11:30 A 310

Robust entangled qutrit states in atmospheric turbulence — •Tobias Brünner[1] and Filippus Stef Roux[2] — [1]Institute of Physics, Albert-Ludwigs University of Freiburg, Hermann-Herder Str. 3, 79104 Freiburg, Germany — [2]CSIR National Laster Centre, P.O. Box 395, Pretoria 0001, South Africa

We consider propagation of entangled photon pairs through atmospheric turbulence, and seek for the entangled qutrit states that are most robust against entanglement decay. Performing optimization of the initial state, we obtain expressions for bipartite qutrit states that retain their initial entanglement longer than the initially maximally entangled states. (arxiv.org/abs/1211.3203)

Q 60.3 Fri 11:45 A 310

Adaptive Resummation of Open Quantum Dynamics — •Felix Lucas[1,2] and Klaus Hornberger[1,2] — [1]Max Planck Institute for the Physics of Complex Systems, Nöthnitzer Straße 38, 01187 Dresden, Germany — [2]University of Duisburg-Essen, Faculty of Physics, Lotharstraße 1-21, 47057 Duisburg, Germany

We introduce a scheme for obtaining analytic approximations to the evolution of Markovian open quantum systems based on the lowest orders of a highly convergent, generalized Dyson series. The expansion is performed in terms of the number of environment-induced quantum jumps, and its rapid convergence is ensured by a resummation that makes use of adaptive transformations of the jump operators. The resulting lowest order terms can be evaluated analytically and provide an effective description of the full open system dynamics. The power of this approach is demonstrated by means of two examples: a free particle, reflected upon detection and the Landau-Zener system in the presence of dephasing. The derived approximations are asymptotically exact and show errors on the per mil level.

Q 60.4 Fri 12:00 A 310

Quantum trajectory description of entanglement dynamics — •Ivonne Guevara[1,2] and Carlos Viviescas[1] — [1]Departamento de Física, Universidad Nacional de Colombia, Carrera 30 No.45-03, Bogotá D.C., Colombia — [2]Centre for Quantum Dynamics, Griffith University, Brisbane, Queensland 4111, Australia

We present and overview of the characterization of the dynamical evolution of entanglement in open quantum system by means of diffusive quantum trajectories. We show how this method allows for a complete description of this phenomenon providing deterministic evolution equations for some experimentally relevant cases, and excellent upper bounds for the entanglement dynamics in some other cases. Remarkably, for a family of entanglement measures, all the information of the entanglement dynamics can be recovered from a single trajectory. For some of the cases considered we propose quantum optical experimental setups which allow for a real time measurement of the entanglement time evolution.

Q 60.5 Fri 12:15 A 310

Entanglement evolution of two entangled OAM photons under the effect of atmospheric turbulence — •Nina Leonhard, Vyacheslav Shatokhin, and Andreas Buchleitner — Physikalisches Institut, Albert-Ludwigs-Universität Freiburg, Germany

Quantum information can be encoded into wave fronts of photons carrying orbital angular momentum (OAM), with an experimentally achieved Hilbert space dimension of several hundred [1]. As such, photons with OAM are very promising for free-space quantum communication. However, free-space links are intrinsically noisy due to atmospheric turbulence, causing distortion of the photon's wave fronts and deterioration of quantum information. In this talk we will discuss the impact of the atmospheric turbulence on the propagation of two OAM-entangled qudits.

[1] R. Fickler et al., Science, **338**, 6107 (2012)