Zkušenosti z účasti na mezinárodní konferenci QIP'2014

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QIP'2014

Název konference: 17th Conference on Quantum Information Processing

Datum konání: 3.2. - 7. 2. 2014

Místo: Barcelona, Španelsko

Počet účastníků: >400
Počet přednášek: 45
Počet posterů: ~250

Zajímavé příspěvky na konferenci QIP'2014

D. Reeb
An improved Landauer principle with finite-size corrections and applications to statistical physics
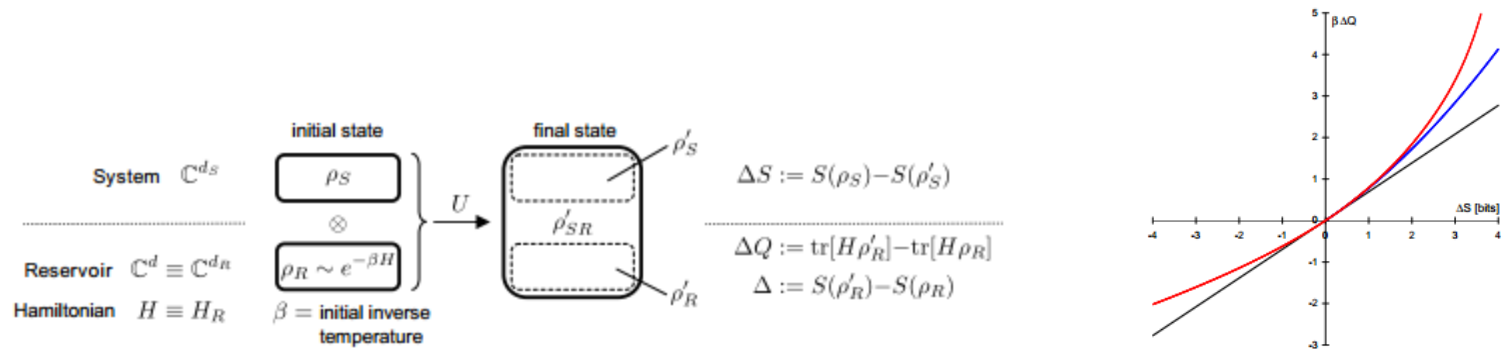

Fig. 1. Left: author's r formalization of the "process". Right: Comparison of lower bounds on the heat dissipation, for a reservoir consisting of n = 4 qubits (d = 16)

• The principle can be applied to the logically irreversible erasure of information, stored physically in the degrees of freedom of a memory register
• The Landauer bound in this case lower limits the heat to be dissipated with the entropy decrease in the memory through the inverse temperature [1].
• An improved version of the Principle derived, formulated as an equality rather than an inequality. The proof of the principle is based on quantum statistical physics concepts rather than on thermodynamic argumentation.
• From the equality version the explicit improvements of Landauer's bound are obtained. They depend on the effective size of the thermal reservoir and reduce to Landauer's bound only for in the fnite-sized reservoirs [2].

[1] R. Landauer, "Irreversibility and heat generation in the computing process", IBM J.
Res. Dev. 5, 183 (1961).
[2] D, Reeb, and Michael M. Wolf, arXiv:1306.4352 (2013).

Carlo Ottaviani
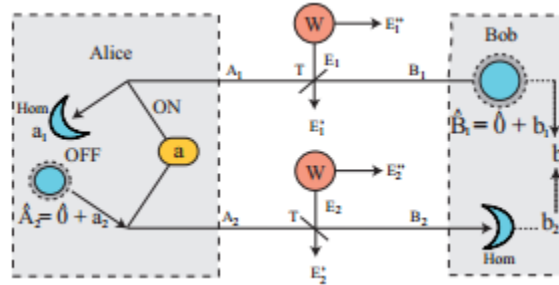## Two-way quantum cryptography at different wavelengths

Fig. 2. Two-way CV QKD.

- The study of the two-way quantum cryptography protocol at different wavelengths was presented.
- The aim of the two-way quantum key distribution protocols is to provide the increased stability against channel noise by sending the quantum states form one trusted party and the back with the proper state manipulations and homodyne detection at the both sides of the channel [1].
- Two-way quantum communication protocol where Gaussian-modulated thermal states is considered. The states are subject to random Gaussian displacements and then measured.
- The security threshold of the protocol (in reverse reconciliation) is shown to be extremely robust with respect to the preparation noise and is able to outperform the security thresholds of one-way protocols at any wavelength.
- Improved security distances are claimed to be accessible for implementing quantum key distribution at the very challenging regime of infrared frequencies [2].

[1] S. Pirandola, S.Mancini, S. Lloyd, and S. L. Braunstein, Nature Phys. 4, 726 (2008).
[2] Ch. Weedbrook, C. Ottaviani, and S. Pirandola, Phys. Rev. A 89, 012309 (2014)

Vlastní prezentace
Squeezing can minimize information leakage in countinuous-variable quantum key distribution.
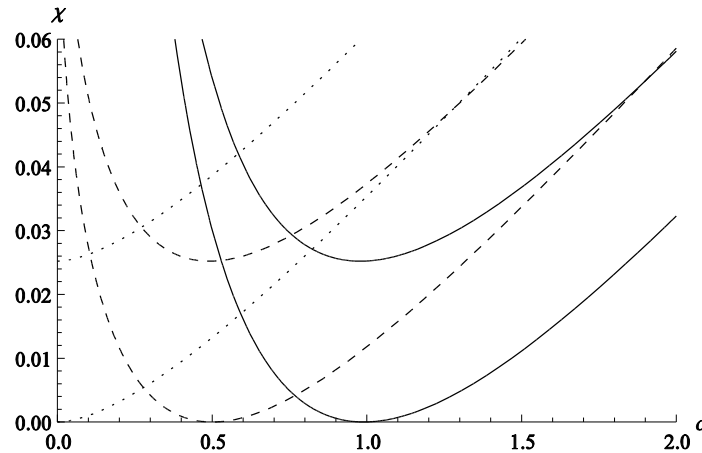

Fig. 3. Holevo bound in a Gaussian channel versus modulation for strongly squeezed (solid lines), moderately squeezed (dashed lines) and coherent states (dotted lines).

• The role of nonclassicality in the security of the continuous-variable quantum key distribution (CV-QKD) protocols with Gaussian modulation [1] was addressed.
• Considering generalized preparation scheme the rolve of the classical and quantum resources in providing the robustness of the protocol to loss and noise was revealed [2].
• It is shown that information leakage i.e. information which is available to an eavesdropper upon collective attacks can be minimized or completely canceled by proper combination of a nonclassical resource (namely squeezing) and Gaussian modulation.
• The result opens possibility to build optimal Gaussian protocols which are stable against imperfections, such as low error correction efficiency and finite-size effects.

[1] C. Weedbrook, S. Pirandola, R. Garcia-Patron, N. J. Cerf, T. C. Ralph, J. H. Shapiro, and S. Lloyd, Rev. Mod. Phys. 84, 621 (2012).
[2] V. Usenko, and R. Filip, New J. Phys. 13 (11), 113007 (2011)

Zkušenosti z účasti na mezinárodní konferenci SPIE Photonics Europe 2014

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SPIE Photonics Europe 2014

Název konference: SPIE Photonics Europe 2014

Datum konání: 14.4. - 17. 4. 2014

Místo: Brusel, Belgie

Počet účastníků: >1200
Počet přednášek: >800
Počet posterů: ~400

Zajímavé příspěvky na konferenci
SPIE Photonics Europe 2014

G. J. de Valcarcel
Optical four-wave mixing and generation of squeezed light in an optomechanical cavity driven by a bichromatic field.
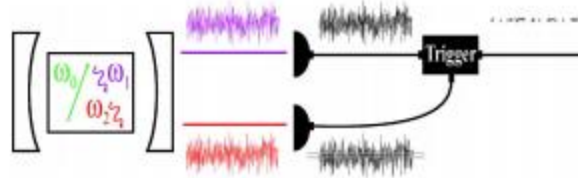

Fig. 1. Typical conditional measurement protocol in the CV regime based on ND-OPO

- The study of the generation of quadrature and intensity optical squeezing in optical cavities [1] was [resented.
- The authors propose to use a new type of modulated driving consisting of two components, whose beat note is not related to the frequency of the mechanical oscillator.
- The authors show that a threshold exists for the input power at which the (non-injected) mid-frequency becomes generated due to four-wave mixing of the drive frequencies.
- The threshold (which is a static bifurcation, unlike the parametric instability of the mirror motion) high levels of optical squeezing – ideally perfect– are predicted, which do not depend critically on the temperature of the device.

[1] J. Laurat, T. Coudreau, N. Treps, A. Maitre, C. Fabre, Phys. Rev. A 69 033808 (2004)

Roman L. Kolesov
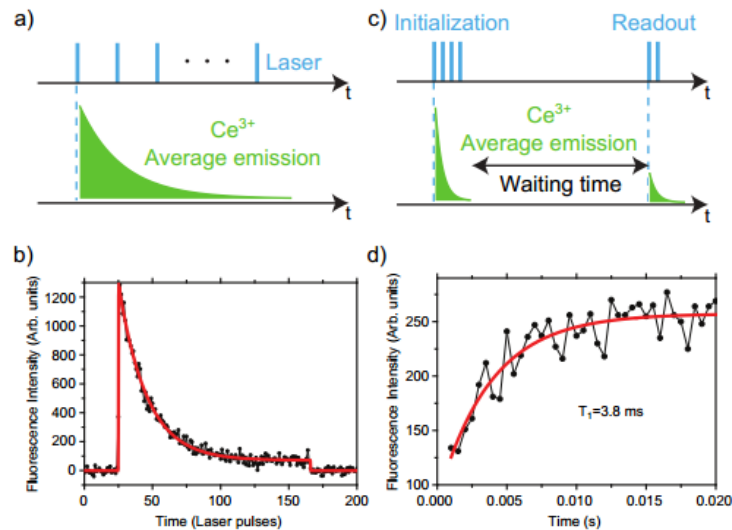## Single rare-earth ion in a crystal as a spin qubit

Fig. 2. Initialization and thermalization of electronic spin

- The study and the experimental results on high-fidelity optical initialization, efficient coherent manipulation, and optical readout of a single electron spin in rare-earth doped YAG crystal was presented.
- The research is motivated by the potential use of such physical systems as the quantum memories for storage of optical information. Strong hyperfine coupling to aluminium nuclear spins suggests that cerium electron spins can be exploited as an interface between photons and long-lived nuclear spin memory.
- The authors shown that combined with high brightness of rare dope emission and a possibility of creating photonic circuits out of the host material, this makes cerium spins an interesting option for integrated quantum photonics.

[1] Kolesov, R., Xia, K., Reuter, R., Sthr, R., Zappe, A., Meijer, J., Hemmer, P.R., and Wrachtrup, J. Optical detection of a single rare-earth ion in a crystal. Nature Communications 3, 1029 (2012)

Vlastní prezentace
Towards continuous-variable quantum key distribution with multi-mode entangled states of light.
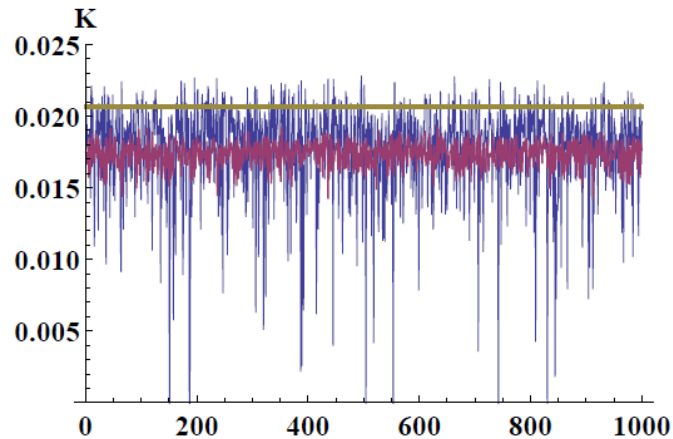

Fig. 3. Key rate stabilization with the use of the fluctuating multimode entangled states

- The presentation was dedicated to the proposal of the continuous-variable (CV) quantum key distribution protocol (QKD) [1] based on the multimode homodyne detection and multimode entangled states of light.
- The case of the multi-mode measurement of the single-mode entangled source, which effectively means additional security-breaking side-channel loss prior to detection, was studied.
- The entangled states may be as well multi-mode, which is observed in particular in the case of the bright squeezed vacuum states of light [2]. In this casethe positive effect of the mode balancing on the side of the source or mode selection on the side of detection is shown.
- Finally, the case of the heavily multi-mode states with fluctuating energy per mode was considered and the positive effect of increasing number of the modes was shown, which leads to averaging of the Gaussian entanglement of the states and stabilization of the key rate.
- The result opens a promising pathway towards the realization of CV QKD with the multi-mode states of light.

[1] C. Weedbrook, S. Pirandola, R. Garcia-Patron, N. J. Cerf, T. C. Ralph, J. H. Shapiro, and S. Lloyd, Rev. Mod. Phys. 84, 621 (2012).
[2] T. Iskhakov, M. Chekhova, G. Leuchs, Phys. Rev. Lett. 102, 183602 (2009)