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EVROPSKÁ UNIE



MINISTERSTVO ŠKOLSTVÍ,  
MLÁDEŽE A TĚLOVÝCHOVY



OP Vzdělávání  
pro konkurenceschopnost

INVESTICE DO ROZVOJE VZDĚLÁVÁNÍ

Název projektu: Mezinárodní centrum pro informaci a neurčitost

Registrační číslo: CZ.1.07/2.3.00/20.0060

## Zpráva z účasti na konferenci

Název konference: Continuous Variable Quantum Information Processing 2012  
Datum konání: 27.4. - 30. 4. 2012  
Místo: Lyngby, Dánsko  
Účastník konference: Mgr. Vladyslav Usenko Ph.D.

### Stručný popis konference:

The Continuous Variable Quantum Information Processing workshop (CVQIP) is the traditional event aimed at bringing together the researchers in the field of quantum information with continuous variables. It is organized by the Danish Technical University, Graduate School in Advanced Optical Technologies in Erlangen and the Centre for Quantum Information and Communication of the University of Brussels, which were also represented by few participants. The scope of the conference covers many areas of quantum information processing, such as quantum metrology, quantum key distribution, quantum communication etc.

### Základní údaje:

Počet účastníků: 57  
Počet přednášek: 23  
Počet posterů: cca 20

### Zajímavé přednášky

Maria Chekhova et al.: *Entangled bright squeezed vacuum*

The presentation of Dr. Chekhova from Max-Planck Institute for the Science of Light in Erlangen was dedicated to the preparation and manipulation of the mesoscopic bright squeezed vacuum states, produced in the process of parametric down-conversion. The entanglement properties of the states were described in terms of the Schmidt number, which is the useful tool to characterize entanglement of the bipartite multiphoton states of light. The strong polarization entanglement, resulting in the sub-shotnoise correlation of the Stokes parameters measurements was experimentally observed. The technique of possible Schmidt mode selection of the initially multimode bright squeezed vacuum light was presented and is

aimed at providing possibility of implementation of the quantum information processing with the bright squeezed vacuum states in the single-mode regime.

#### **Literatura:**

- [1] Timur Sh. Iskhakov, Ivan N. Agafonov, Maria V. Chekhova, Georgy O. Rytikov, and Gerd Leuchs, Phys. Rev. A 84, 045804 (2011)
- [2] Timur Sh. Iskhakov, Maria V. Chekhova, Georgy O. Rytikov, and Gerd Leuchs, Phys. Rev. Lett. 106, 113602 (2011)

#### Stefano Pirandola et al.: *Unconditional security of two-way quantum cryptography*

Dr. Pirandola made a talk on an advanced scheme of continuous-variable quantum key distribution, based on the usage of an optical switch, which changes the scheme topology depending on the properties of the channel. In case of memoryless channel the trusted parties are able to send the quantum state through twice, while if the memory is present the scheme turns to the two separate prepare-and-measure schemes. Such design of the protocol allows one to achieve higher capacity and, possibly, higher robustness against noise. However, the more general study of security of the protocol in case of channels with memory could be essential and may be the subject for the future work.

#### **Literatura:**

- [1] Stefano Pirandola, Stefano Mancini, Seth Lloyd, Samuel L. Braunstein, Nature Physics 4, 726 - 730 (2008)
- [2] Stefano Pirandola, Stefano Mancini, Seth Lloyd, Samuel L. Braunstein, Proc. SPIE, Vol. 7092, 709215 (2008).

#### Roman Schnabel et al.: *A gravitational wave observatory operating beyond the quantum shot-noise limit: Squeezed light in application*

Prof. R. Schnabel is the head of the experimental group, which achieved the strongest degrees of squeezing to date. His talk was concerned with the usage of squeezed states in the gravitational wave detectors. The main ideas of super-sensitivity with the squeezed states upon the energy constraints imposed by the minimization of back-action of light in gravitational wave detectors were reminded to the audience. The usage of a strongly squeezed light source produced in Hannover in a particular gravitational wave observatory aimed at minimization of the apparatus noise was described. Also the future projects of the gravitational observatories using squeezed light were mentioned. The talk gave an insight into another application of squeezed light such as the detection of the gravitational waves.

#### **Literatura:**

- [1] Roman Schnabel, Nature Physics 4, 440 (2008)
- Roman Schnabel, Nergis Mavalvala, David E. McClelland, and Ping K. Lam, Nature Communications 1, 121 (2010)

#### **Vlastní prezentace**

##### V. Usenko et al., *Advancing Gaussian Quantum Key Distribution*

The poster was presented at the conference during the poster sessions (and was exhibited during the whole conference). The poster represented a review on the recent research in the field of Gaussian quantum key distribution (QKD) performed in collaboration with doc. R. Filip from Palacký University, experimental group at Max Planck Institute for the science of

Light in Erlangen (group of Prof. Leuchs) and the Danish Technical University (group of Prof. Andersen). Four projects were covered, first of them being the investigation of the negative role of trusted noise in the coherent-state based quantum key distribution and the possibilities to purify such noise. The second project was dedicated to the role of nonclassicality in Gaussian QKD and the possibility to effectively decouple eavesdropper from the signal states using squeezing and optimized weak modulation. The third project, prepared in collaboration with the group from Lyngby, represented the optimized Gaussian QKD protocol, in which the entangled resource is optimally enforced by the coherent modulation. The paper based on the experimental results on this project, was recently submitted. The fourth project concerned with the negative effect of fluctuating atmospheric channels on the coherent-state based Gaussian QKD, and the possibility to compensate the effect using optimal post-selection of sub-channels in the particular transmittance window. The poster stimulated the fruitful discussions with Prof. Paris (University of Milano), Dr. Chekhova (MPI Erlangen), Dr. Husk (DTU Lyngby) and others.

### **Mezinárodní vědecká spolupráce**

The visit to the conference was effectively used to enforce and broaden the scientific collaboration with the leading groups in quantum information and quantum optics.

The running projects were discussed with Prof. Andersen and Mr. Lassen from DTU Lyngby as well as with Prof. Leuchs, Dr. Heim and Dr. Marquardt from MPI Erlangen.

The discussion on the properties of non-Gaussian states and the possibility to use them in quantum information processing was carried out with Prof. Paris from the University of Milano and may lead to the future collaboration.

The properties of bosonic quantum capacity and Holevo bound on the leaking information were actively discussed with Dr. Pilyavets from Brussels University.

During the conference the participants were informed on the project of International Center for Information and Uncertainty, supported by the OP VK program.

## Fotografická dokumentace



Presentation of Dr. Usenko at CVQIP'12 workshop.

## Přílohy

Conference program