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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 stáži

Datum konání stáže: 30.05.2012 – 22.06.2012  
Navštívené pracoviště: Max Planck Institute for the Science of Light, Erlangen,  
Nemecko  
Zahraniční garant: prof. Gerd Leuchs  
Účastník stáže: Vladyslav Usenko, Ph.D.

#### **Stručný popis navštíveného pracoviště**

The Max Planck Institute for the Science of Light (MPL) is one of the world leading institutions in the field of quantum optics and quantum information. It is one of 80 Max Planck Institutes in Germany, which is the most prestigious status for a research Institute. Max Planck Institutes conduct basic research in the service of the general public in the natural sciences, life sciences, social sciences, and the humanities. Max Planck Institutes focus on research fields that are particularly innovative, or that are especially demanding in terms of funding or time requirements. And their research spectrum is continually evolving: new institutes are established to find answers to seminal, forward-looking scientific questions, while others are closed when, for example, their research field has been widely established at universities. This continuous renewal preserves the scope the Max Planck Society needs to react quickly to pioneering scientific developments.

The Max Planck Institute for the Science of Light (MPL) was founded in January 2009 and is thus one of the youngest Max Planck Institutes. Currently it consists of three divisions, several independent research groups and three Technical Development and Service Units (TDSU). A fourth division is planned. Each independent research group is established for a limited amount of time and is lead by a younger scientist, enabling them to lay the cornerstone for his or her future scientific career. The TDSUs have a dual task: they pursue their own research based on the high technical standard of their groups and they provide service to the divisions and research groups.

The visit was performed to the Division of Prof. Gerd Leuchs, which is well known as the outstanding experimental group conducting fundamental and applied research in the field of quantum optics and quantum information. It achieved numerous great scientific results, which were published in multiple articles in the high impacted journals.

Recently the Division established an open-space quantum optical link, operated by the experimental group of Dr. Christoph Marquardt. It uses a grating-stabilized diode laser, with wavelength of 809 nm that lies within an atmospheric transmission window. The linearly polarized laser beam is transferred to a circularly polarized state and sent through the 1.6 km free-space channel from the institute's building to a tall university building, after having been expanded. This unique experimental set-up was of the particular interest for the research, carried out before and during the visit.

### **Průběh stáže**

The visit was dedicated to the joint scientific research in the field of Gaussian states of light and continuous-variable quantum key distribution (CV QKD). In particular, the project aimed at the investigation of nonclassical properties of Gaussian states of light and the possibility to establish CV QKD channel in conditions of a turbulent atmosphere. The channel characterization data obtained at MPL was used to test the theoretical predictions of the entanglement evolution in the free-space channels and to show the sensitivity of secure CV QKD to the atmospheric turbulence. Further the method of sub-channels post-selection was introduced and shown useful to restore entanglement of the Gaussian states and security of the respective protocol.

### **Publikace rozpracované během stáže**

The experimental and theoretical results were arranged into the manuscript entitled "Entanglement of Gaussian states and the applicability to quantum key distribution over fading channels", which was recently accepted for publication in impacted New Journal of Physics.

### **Navázání kontaktů**

The visit led to further intensification of the fruitful collaboration between the Department of Optics of the Palacky University in Olomouc and the Max Planck Institute for the Science of Light in Erlangen..

### **Shrnutí stáže**

The visit indeed achieved its goals, the scientific collaboration with one of the leading European institutions in the field of quantum optics and quantum information was successfully extended and intensified. The new knowledge on the current research trends in the mentioned field was obtained and will be further disseminated to the target group within the scientific seminars.

### **Fotografická dokumentace**



Photo taken during the scientific discussion within the stay, depicted are and Dr. Usenko (left) and Dr. Marquardt (right).



Dr. Usenko (left) and Dr. Marquardt (right).