TRR 142
Tailored Nonlinear Photonics

TRR Guest Scientist Lecture / Seminar

Date/Time: 13.02.2017 / 13:00 Uhr
Location: Paderborn, A3.301

Prof. Dr. Maria Chekhova
Max Planck Institute for the Science of Light, Erlangen

Bright squeezed vacuum in a nonlinear interferometer

Abstract:

Bright squeezed vacuum (BSV) is a macroscopic state of light featuring nonclassical properties, from photon-number entanglement and quadrature squeezing to the violation of certain types of Bell's inequalities.
By generating BSV through high-gain parametric down-conversion in two subsequent coherently pumped crystals, one obtains a nonlinear SU(1,1) interferometer, which offers various interesting possibilities. Among others, this is shaping the BSV in space/angle, by spatially separating the two crystals, and in time/frequency, by introducing a dispersive material between the two crystals. In particular, in recent experiments we were able to change the number of spatial modes from few hundreds to 1.1 [1] and frequency modes from about 50 to 1.8 [2].

Another important feature of an SU(1,1) interferometer is that it enables phase measurement below the shot-noise limit (supersensitive phase measurement) with high tolerance to detection losses. Especially advantageous is its unbalanced configuration in which the second nonlinear crystal has the parametric gain much higher than the first one. By pumping the second crystal strong enough, one can compensate for any amount of detection loss and reach phase super-sensitivity [3]. This theoretical conclusion has been confirmed by our recent proof-of-principle experiment.

[1] A. M. Pérez, T. Sh. Iskhakov, P. Sharapova, S. Lemieux, O. V. Tikhonova, M. V. Chekhova, and G. Leuchs, Opt. Lett. **39**, 2403 (2014).
[2] Samuel Lemieux, Mathieu Manceau, Polina R. Sharapova, Olga V. Tikhonova, Robert W. Boyd, Gerd Leuchs, and Maria V. Chekhova, Phys. Rev. Letters **117**, 183601 (2016).
[3] Mathieu Manceau, Farid Khalili and Maria Chekhova, New Journal of Physics **19**, 013014 (2017).

Contact: **J.-Prof. Dr. Polina Sharapova**
polina.sharapova@upb.de

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technische universität dortmund