Call 2019

QuICHE

Quantum Information and Communication with High-Dimensional Encoding

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PROJECT PROGRESS (highlights)

Main achievements:

- *High-dimensional witnesses and entanglement verification*.

Construction of a new Schmidt-number witness requiring fewer measurements than other existing witnesses for fidelity evaluation.

- *High-dimensional Quantum Key Distribution*.

Analytical and numerical results for asymptotic secret key rates in high dimensions, showing that a slight dimension enhancement (i.e. d = 3) significantly improves the asymptotic secret key rate and the error tolerance.

- *Quantum temporal imaging*.

Development of theory of noiseless compression and stretching of temporal waveforms carrying high-dimensional quantum encoding

- transformation of quantum intensity correlations of light, observed by direct photodetection, by a single-lens temporal imaging scheme
- proof that such an imaging scheme performs noiseless stretching or contraction of the second-order intensity correlation function without deteriorating its nonclassical features: antibunching and sub-Poissonian statistics of the photons.

PROJECT PROGRESS (highlights)

Main achievements:

- *Storage and retrieval of different temporal modes.*

Experimental demonstration of storage & retrieval of a number of different temporal modes from a quantum memory, observing that the memory works as a single-temporal-mode filter – by using different temporal mode pulses for the control field – and that the memory can be used for bandwidth compression.

- *Multi-output quantum pulse gate*

Development and realization of a multi output quantum pulse gate (mQPG), which serves as a decoder for high-dimensional QKD. The device is compatible with single-photon level inputs at telecommunication wavelengths and can features five outputs. A complete detector tomography reveals intrinsic fidelities in excess of 95%.

- *Single-photon detection*

Achievement of single-photon detection with compatible spectral and temporal resolutions, where both the temporal envelope and spectral power density of an optical pulse can be experimentally probed.

IMPACT (RRI aspects)

GENDER: particular attention to gender balance (50% female PIs and 33% project contracts)

SCIENCE EDUCATION: promotion & involvement in activities for spreading QT concepts & education to high school students and teachers (e.g. European Quantum Week)

PUBLIC ENGAGEMENT: Active collaboration between theoretical and experimental physicsts.

Active widening country involvement in the project.

Focus on real-world applications (QKD and q. networks).

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