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Quantum communication with coherent states (I)

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The use of quantum mechanical signals in communication opens up the opportunity to build new communication systems that accomplishes tasks that communication with classical signals structures cannot achieve. Prominent examples are Quantum Key Distribution Protocols, which allows the generation of secret keys without computational assumptions of adversaries. Over the past decade, protocols have been developed that achieve tasks that can also be accomplished with classical signals, but the quantum version of the protocol either uses less resources, or leaks less information between the involved parties. The gap between quantum and classical can be exponential in the input size of the problems. Examples are the comparison of data, the scheduling of appointments and others. Until recently, it was thought that these protocols are of mere conceptual value, but that the quantum advantage could not be realized. We changed that by developing quantum optical versions of these abstract protocols that can run with simple laser pulses, beam-splitters and detectors. [1-3] By now the first protocols have been successfully implemented [4], showing that a quantum advantage can be realized. The next step is to find and realize protocols that have a high practical value.
We are at the early stages of the development of optical quantum communication protocols with quantitative advantages. In this presentation I will give an overview of our progress
[1] J.M. Arrazola, N. Lütkenhaus, Quantum fingerprinting with coherent states and a constant mean number of photons, Phys. Rev. A, 89, 062305 (2014)
[2] B. Lovitz, N. Lütkenhaus, Families of Quantum Fingerprinting Protocols, arXiv:1712.02895.
[3] D. Touchette, B. Lovitz, N. Lütkenhaus, Practical Quantum Appointment Scheduling, in preparation.
[4] F. Xu, J.M. Arrazola, K. Wei, W.Y. Wang, P. Palacios-Avila, C. Feng, S. Sajeed, N. Lütkenhaus, H.K. Lo, Experimental quantum fingerprinting with weak coherent states, Nature Communications 6, 8735, (2015)

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