SFB/TRR 21 - Colloquium

23. Januar 2015, Stuttgart

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Quantum information processing with photons: networks, verification, and algorithms

Quantum physics has revolutionized our understanding of information processing and enables computational speed-ups that are unattainable using classical computers. In this talk I will present a series of experiments in the field of photonic quantum information processing. In the first part of the talk, I will introduce a new concept in quantum computing, the blind quantum computing protocol [1,2]. Blind quantum computing enables a nearly-classical client to access the resources of a more computationally-powerful quantum server without divulging the content of the requested computation. I will show results on experimental implementations of delegated quantum computations. I will then present how the concept of blind quantum computing can be applied verify the computations [3]. Furthermore, I will show how a classical client with limited capacity can delegate a classical computation securely using quantum resources. In the second part of the talk, I will present different experiments realizing photonic two-qubit gates. I will present the implementation of the quantum algorithm for solving of systems of linear equations [4] and of a quantum simulation of the two-site XY model [5].

[1] A. Broadbent, J. Fitzsimons and E. Kashefi, in Proceedings of the 50th Annual Symposium on Foundations of Computer Science, 517 (2009) [2] S. Barz, E. Kashefi, A. Broadbent, J. Fitzsimons, A. Zeilinger, and P. Walther, Science 335, 303 (2012) [3] S. Barz, J. Fitzsimons, E. Kashefi, and P. Walther, Nature Physics 9, 727 (2013) [4] S. Barz, I. Kassal, M. Ringbauer, Y. O. Lipp, B. Dakic, A. Aspuru-Guzik, P. Walther, Scientific Reports 4, 6115 (2014) [5] S. Barz, B. Dakic, Y. O. Lipp, F. Verstraete, J. D. Whitfield, P. Walther, arXiv:1410.1099

23. Januar 2015, 15:30 Uhr

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