SFB/TRR 21 - Colloquium

5. Mai 2017, Stuttgart

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Experimental superposition of causal orders and investigation of hyper-complex quantum theories

The advantages of the photons makes optical quantum systems ideally suited for fundamental quantum physics experiments and a variety of applications in quantum information processing. Here I will discuss new experimental insights into new quantum computational concepts that superimpose the order of quantum gates [1,2] as well as experimental benchmark values for hyper-complex extension of quantum mechanics that relay on quaternions instead of complex numbers) [3].
As outlook I will briefly discuss the current status of (a) new fundamental quantum experiments that aim to test the interface between quantum mechanics and gravity [4], and (b) photonic quantum technology for truly scalable quantum computers.
[1] "Experimental Superposition of Orders of Quantum Gates", L.M. Procopio, A. Moqanaki, M. Araújo, F. Costa, I.A. Calafell, E.G. Dowd, D.R. Hamel, L.A. Rozema, C. Brukner, P. Walther; Nature Communications 6, 7913 (2015).
[2] "Experimental Verification of an indefinite Causal Order", G. Rubino, L.A. Rozema, A. Feix, M. Araújo, J.M. Zeuner, L.M. Procopio, C. Brukner, P. Walther, Science Advances 3, e1602589 (2017).
[3] "Single-Photon Test of Hyper-Complex Quantum Theories Using a Metamaterial", L.M. Procopio, L.A. Rozema, Z. J. Wong, D. R. Hamel, K.O'Brien, X. Zhang, B. Dakic, P. Walther, Nature Communications, DOI: 10.1038/ncomms15044 (2017).
[4] "Gravitationally induced phase shift on a single photon", C. Hilweg, F. Massa, D. Martynov, N. Mavalvala, P.T. Chruściel, P. Walther, New Journal of Physics 19, 033028 (2017).

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