SFB/TRR 21 - Colloquium

21. Oktober 2016, Stuttgart

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Quantum networking tools with single ions and photons

We are developing a comprehensive set of experimental tools, based on ion-trapping and photonic technologies, that enable controlled generation, storage, transmission, and conversion of single photons, thereby integrating single photons and single atoms into a quantum network. Specifically, we implemented a programmable atom-photon quantum interface, employing the controlled quantum interaction of a single trapped 40Ca+ ion and single photons [1,2]. Depending on its mode of operation, the interface serves as a bi-directional atom-photon quantum state converter, as a source of entangled atom-photon states, or as a quantum frequency converter of single photons [3,4]. It can be extended to photon-to-atom entanglement transfer [5]. The interface lends itself particularly to integrating ions with single-photon sources or entangled photon-pair sources based on spontaneous parametric down-conversion [6,7]. Recently we transferred photon-photon entanglement to atom-photon pairs. We also realized single-photon absorption heralded by a telecom photon [6], and quantum frequency conversion of ion-resonant single photons into the telecom regime.

[1] M. Schug et al., Phys. Rev. A 90, 023829 (2014) [2] P. Müller, J. Eschner, Appl. Phys. B 114, 303 (2014) [3] C. Kurz et al.,Nat. Commun. 5, 5527 (2014) [4] C. Kurz et al.,Phys. Rev. A 93, 062348 (2016) [5] N. Sangouard et al., New J. Phys. 15, 085004 (2013) [6] A. Lenhard et al., Phys. Rev. A 92, 063827 (2015) [7] J. Brito et al., Appl. Phys. B. (2016), 122:36

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