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Ultrafast downconversion quantum interface for a single quantum dot spin and 1550-nm single-photon channel L. YU, J.S. PELC, K. DE GREVE, P.L. MCMAHON, M.M. FEJER, E. L. Ginzton Laboratory, Stanford University, Y. YAMAMOTO, E. L. Ginzton Laboratory, Stanford University and National Institute of Informatics, Tokyo, S. MAIER, C. SCHNEIDER, M. KAMP, S. HOFLING, A. FORCHEL, Technische Physik, Physikalisches Institut, Wilhelm Conrad Rontgen Research Center for Complex Material Systems, Universitat Wurzburg, C.M. NATARAJAN, R.H. HADFIELD, Scottish Universities Physics Alliance and School of Engineering and Physical Sciences, Heriot-Watt University — Long-distance quantum communication networks require appropriate interfaces between matter qubit-based nodes and low-loss photonic quantum channels. Quantum frequency conversion (QFC), whereby a photonic qubit's carrier frequency is translated while maintaining its quantum state, is well-suited to the task. Quantum dots have been studied extensively as potential quantum network nodes, but they do not emit indistinguishable single photons at telecomm wavelengths. We report an ultrafast, low-noise downconversion quantum interface, in which 910-nm single photons from a quantum dot are downconverted to the 1.5-μm lowest-loss telecom band, showing near-perfect preservation of antibunched photon statistics. Moreover, the resulting time resolution could also improve photon indistinguishability. Together with the III-V semiconductor quantum dot spin system, this ultrafast downconversion quantum interface provides new possibility to realize long-distance quantum communication networks.

L. Yu
E. L. Ginzton Laboratory, Stanford University

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