HL 44: Focus Session: Quantum Technologies in Deployed Systems I

Recent advancements in quantum cryptography, quantum computing, and quantum sensing are driving researchers to develop a universal quantum network*known as the quantum internet, which will enable secure connections among quantum computers, as well as to networks of quantum sensors, through quantum cryptography. Building a functional quantum internet is one of the most ambitious goals in quantum technology for the coming decades.

The focus sessoin aims to provide a comprehensive overview of the corresponding platforms and advances in quantum technologies, and is organized by Simone L. Portalupi (U. Stuttgart), Michal Vyvlecka (U. Stuttgart) and Michael Zopf (U. Hannover).

Time: Wednesday 18:00–18:45 Location: H13

HL 44.1 Wed 18:00 H13

Advancing Quantum Communication with Deterministic Quantum Light Sources from Laboratory- to Field-Experiments — •Mareike Lach, Koray Kaymazlar, Pratim Saha, Martin von Helversen, and Tobias Heindel — Institut für Festkörperphysik, Technische Universität Berlin, 10623 Berlin, Germany

The advances in the field of non-classical light generation using solid-state quantum light sources fostered the exploration of applications in quantum communication and networking. This interdisciplinary field thereby increasingly evolves from laboratory-scale to field-experiments [1]. In this contribution we address the design, set-up and characterization of stand-alone compact modules for field-deployable quantum communication systems. In this context key components of the transmitter- and receiver-stations for quantum key distribution protocols are discussed, including mobile quntum light sources, fast qubit-state encoders, and qubit-state analyzers. Advancing the field-deployment of quantum technologies will foster both the progress in explorativ research projects as well as the transfer to their commercialization.

[1] D.A. Vajner et al., Advanced Quantum Technologies, doi:10.1002/qute.202100116 (2022)

HL 44.2 Wed 18:15 H13

Automated in situ optimization and disorder mitigation in a quantum device — •Jacob Benestad[1], Torbjørn Rasmussen[2,3], Bertram Brovang[2], Oswin Krause[4], Saeed Fallahi[5,6], Geoffrey C. Gardner[6], Michael J. Manfra[5,6,7,8], Charles M. Marcus[2], Jeroen Danon[1], Ferdinand Kuemmeth[2], Anasua Chatterjee[2,3], and Evert van Nieuwenburg[9] — [1]Department of Physics, Norwegian University of Science and Technology — [2]Center for Quantum Devices, Niels Bohr Institute, University of Copenhagen — [3]QuTech and Kavli Institute of Nanoscience, Delft University of Technology — [4]Department of Computer Science, University of Copenhagen — [5]Department of Physics and Astronomy, Purdue University — [6]Birck Nanotechnology Center, Purdue University — [7]Elmore Family School of Electrical and Computer Engineering, Purdue University — [8]School of Materials Engineering, Purdue University — [9]Lorentz Institute and Leiden Institute of Advanced Computer Science

We investigate automated in situ optimisation of a quantum point contact (QPC) device with 9 adjustable electrostatic gates atop the split-gate constriction, using the Covariance Matrix Adaptation Evolutionary Strategy (CMA-ES) with a metric for how “step-like” the conductance is when the channel is constricted. The optimization algorithm is first tested on tight-binding simulations to show how it could adapt to a disorder potential, followed by implementing it in an experiment to show a marked improvement in the quantization of device conductance.

HL 44.3 Wed 18:30 H13

Fast and high-fidelity composite gates in superconducting qubits: Beating the Fourier leakage limit — •Hristo Tonchev[1], Boyan Torosov[2], and Nikolay Vitanov[1] — [1]Center for Quantum Technologies, Department of Physics, Sofia University, James Bourchier 5 blvd., 1164 Sofia, Bulgaria — [2]Institute of Solid State Physics, Bulgarian Academy of Sciences, 72 Tsarigradsko chaussée, 1784 Sofia, Bulgaria

We present a method for quantum control in superconducting transmon qubits, which overcomes the Fourier limit for the gate duration imposed by leakage to upper states. The technique utilizes composite pulses, which allow for the correction of various types of errors that naturally arise in a system. We use our approach to produce complete and partial population transfers between the qubit states, as well as two basic single-qubit quantum gates. Our simulations show a substantial reduction of the typical errors and gate durations. Three different independent verifications are made to justify these claims.