WED-ID 7: Quantum Enabling II

Time: Wednesday 15:10–16:45 Location: ZHG104

WED-ID 7.1 Wed 15:10 ZHG104

Enabling Robust Quantum Technologies - Compact Fiber Optics With Highest Thermal Stability — •Tobias Kroker — Schäfter + Kirchhoff GmbH, Hamburg, Germany

Quantum technologies are on the cusp of moving from laboratory experiments to commercial applications. This poses new requirements on the scalability, thermal stability, and wavelength range of fiber optic systems used to transport, distribute, and modulate laser light.

As an experienced manufacturer in the field, Schäfter + Kirchhoff GmbH develops and produces fiber optic solutions ranging from specialty fiber cables and fiber couplers to complex optomechanical light distribution and modulation units.

Here we report on new developments in compact fiber-coupled optomechanical systems for light distribution and modulation. These systems exhibit such high thermal stability that they can be reliably used in an un-climatized environment, which is tested by harsh thermal cycles in a climatic chamber. This is a crucial step for quantum technologies to leave the optical laboratory.

In addition, active components such as acousto-optic modulators are gradually increasing the functionality of these devices. As a result, they enable the miniaturization and scalability of complex optical systems, making them attractive for quantum computers and technologies being built around the world.

5 min. break

WED-ID 7.2 Wed 15:35 ZHG104

Enabling optical quantum characterization with Photonic Sources — •Ole Peters[1], Hoon Jang[2], Enkeleda Balliu[2], and Korbinian Hens[1] — [1]HÜBNER GmbH & Co. KG, Division HÜBNER Photonics, Kassel, Germany — [2]Cobolt AB, Division HÜBNER Photonics, Solna, Sweden

Within the scope of the second quantum revolution, laboratories and companies around the world focus on the search for the perfect quantum system suitable for applications of 'quantum technology 2.0'. Those applications range from quantum sensing, via quantum communication to quantum simulation and computing using Qubits opening up a vibrant research field to unveil materials with the perfect properties meeting the various requirements has evolved.

In this work, we discuss the optical setup and performance characteristics of commercially available Watt level, narrow linewidth Optical Parametric Oscillators (OPOs), tunable across the visible spectrum. We show several tuning mechanisms based on internal and external frequency stabilization and illustrate their deployment in quantum research applications. We also present a concept for compact laser systems, with narrower tunability, that can be tailored in wavelength to the desired application, as well as an extremely low-noise fiber amplifier platform, dedicated to quantum research. Experimental datasets from a selection of recently published studies on single-photon emitters of various types are presented.

5 min. break

WED-ID 7.3 Wed 16:00 ZHG104

Squeezed Light for Quantum Sensing — •Axel Schönbeck[1], Jan Südbeck[1], Jascha Zander[1], and Roman Schnabel[2] — [1]Noisy Labs GmbH, Luruper Hauptstrasse 1, 22547 Hamburg — [2]Universität Hamburg, Institut für Quantenphysik, Luruper Chaussee 149, 22761 Hamburg

High-precision laser-based measurements are often limited by photon shot noise across various power levels (mW to kW). Conventionally, the signal-to-noise ratio has been enhanced by increasing the optical power.

However, this approach can introduce undesirable side effects. Biological samples may be damaged or exhibit photo-bleaching and delicate mechanical devices may experience thermal effects. Thermal lensing, induced by high power, can misalign measurement devices. Moreover, exceeding eye-safe laser power levels necessitates additional laser safety measures. Economic considerations, including development and energy costs, can also limit the feasibility of power increases.

Squeezed light offers an alternative solution by reducing photon shot noise without significantly increasing the optical power. Noise reductions exceeding a factor of 10 are achievable when detecting most of the light. Gravitational-wave detection is a prominent example for the application of squeezed light.

This presentation will discuss squeezed light technology and its applications in high-precision quantum sensing.

5 min. break

WED-ID 7.4 Wed 16:25 ZHG104

Automated cryogenic test platform for benchmarking superconducting quantum processors — •Thorsten Last, Adam Lawrence, Koushik Kumaran, Gerben Erens, Kelvin Loh, Garrelt Alberts, and Adriaan Rol — Orange Quantum Systems B.V., Elektronicaweg 2, 2628 XG Delft, The Netherlands

Scaling transmon-based quantum processors beyond 100 qubits remains a challenge, especially as traditional R&D methods struggle to keep pace due to scalability limits. Achieving this demands improvements in reproducibility, yield, and low component variability. To support these process aspects, an industry-grade qubit manufacturing cycle must be paired with high-throughput testing and metrology to maintain a high development cadence. Here we introduce an automated cryogenic test system designed for high-throughput characterization of superconducting quantum processors and which can test 150-qubit devices within a 10-day cycle. Its fully integrated cryogenic and quantum control hardware enables advanced diagnostics and feedback. Critical device parameters are automatically extracted across multiple domains such as readout circuits, properties of transmons and tunable couplers, crosstalk, and qubit fidelities, using a graph-based automation protocol that dynamically sequences tests and extracts key metrics. In addition, the system can also provide thermometric analysis of qubits to assess environmental interactions and cryogenic scalability because as system complexity grows, identifying and mitigating thermal decoherence becomes critical.