# Quantum 2.0 Conference Session Guide

**Disclaimer**: this guide is limited to technical program with abstracts and author blocks as of 24 June. For updated and complete information with special events, reference the online schedule or mobile app.

## Monday, 24 June

**08:30 -- 09:30**
**Room: Rotterdam Hall 2**
**QM1A • Introductory and Keynote Session I**
*Presider: Eden Figueroa, SUNY Stony Brook, USA*

**08:30 (Keynote)**
**New Avenues for Quantum Simulation With Ultracold Atoms, Molecules and Photons,** Immanuel Bloch[1]; *[1]Max-Planck-Institut fur Quantenoptik, Germany.* 40 years ago, Richard Feynman outlined his vision of a quantum simulator for carrying out complex calculations of physical problems. Today, his dream has become a reality and a highly active field of research across different platforms ranging from ultracold atoms and ions to superconducting qubits and photons. In my talk, I will outline how ultracold atoms in optical lattices started this vibrant and interdisciplinary research field 20 years ago and now allow probing quantum phases in- and out-of-equilibrium with fundamentally new tools and single particle resolution. Novel (hidden) order parameters, entanglement properties, full counting statistics or topological features can now be measured routinely and provide deep new insight into the world of correlated quantum matter. I will introduce the measurement and control techniques in these systems and delineate recent applications regarding quantum simulations of strongly correlated electronic systems, experiments on new dynamical phases of matter, novel quantum optical light-matter interfaces and progress towards realizing ultracold quantum matter of polar molecules.

**10:00 -- 12:00**
**Room: Rotterdam Hall 2**
**QM2A • Single Photon Detectors**
*Presider: Ben Dixon, MIT Lincoln Laboratory, USA*

**QM2A.1 • 10:00 (Invited)**
**Advanced Superconducting Nanowire Single-Photon Detectors,** Boris Korzh[1]; *[1]Jet Propulsion Laboratory, USA.* This talk will review the advances and outlook for SNSPDs in terms of the main performance metrics as well as their scalability to large-scale cameras, which will be an impactful development for quantum technologies.

**QM2A.2 • 10:30**
**High-Efficiency Photon-Number Resolution and 250 Mcps Detection Rate With a 28-Pixel Superconducting Nanowire Single-Photon Detector,** Lorenzo Stasi[1,2], Towsif Taher[2], Giovanni Resta[1], Hugo Zbinden[2], Rob Thew[2], Félix Bussières[1]; *[1]ID Quantique SA, Switzerland; [2]Univ. of Geneva, Switzerland.* A 28-pixel superconducting nanowire single-photon detector in a parallel configuration is presented, displaying high photon-number efficiencies and 250 Mcps detection rate using only one coaxial cable.

**QM2A.3 • 10:45**
**Multi-Photon Fock State Generation Using a Single-Pixel Ultrafast Photon-Number-Resolving Detector,** Tatsuki Sonoyama[1], Kazuma Takahashi[1], Takefumi Nomura[1], Tomoki Sano[1], Fumihiro China[2], Masahiro Yabuno[2], Sigehito Miki[2], Hirotaka Terai[2], Kan Takase[1,3], Warit Asavanant[1,3], Mamoru Endo[1,3], Akira Furusawa[1,3]; *[1]The Univ. of Tokyo, Japan; [2]National*

*Inst. of Information and Communications Technology, Japan; [3]RIKEN Center for Quantum Computing, Japan.* Single-pixel superconducting nanostrip photon detectors (SNSPDs) have both low timing jitter of 50 ps and photon-number-resolving capability. We generate multiphoton Fock states with Wigner negativities using SNSPDs, establishing key technologies for sub-THz quantum information processing.

**QM2A.4 • 11:00**

**High-Rate Photon-Number Resolved Detection With Transition-Edge Sensors Enabled by Machine Learning,** Zhenghao Li[1], Matthew J. Kendall[1], Ruidi Zhu[1,2], Ewan Mer[1], Shang Yu[1], Ian A. Walmsley[1], Raj B. Patel[1]; *[1]Department of Physics, Imperial College London, UK; [2]Department of Applied Physics, Yale Univ., USA.* We report a machine-learning-based algorithm that allows transition-edge sensors to distinguish photon number traces at a repetition rate that overcomes their slow recovery time. Detector tomography is performed to benchmark the algorithm's performance.

**QM2A.5 • 11:15**

**Photon-Number Resolution With SNSPDs via Statistical Analysis of Electrical Traces,** Timon Schapeler[1,2], Niklas Lamberty[1], Thomas Hummel[2], Fabian Schlue[3], Michael Stefszky[3], Benjamin Brecht[3], Christine Silberhorn[3], Tim J. Bartley[1,2]; *[1]Department of Physics, Paderborn Univ., Germany; [2]Inst. for Photonic Quantum Systems, Paderborn Univ., Germany; [3]Integrated Quantum Optics Group, Inst. for Photonic Quantum Systems (PhoQS), Paderborn Univ., Germany.* We present a large, high-precision data set of SNSPD traces. Statistical analysis tools can identify relevant features to gain optimized photon-number resolution with SNSPDs. Rising edge and peak amplitude show photon-number resolution up to n=4.

**QM2A.6 • 11:30**

**Compressive Tomography of Unstructured High-Dimensional Photonic Entanglement,** Will McCutcheon[1], Suraj Goel[1], Natalia Herrera Valencia[1], Euan Mackay[1], Saroch Leedumrongwatthanakun[1], Mehul Malik[1]; *[1]Heriot-Watt Univ., UK.* Entanglement-based quantum networks require characterising resources shared between distant nodes. We distribute high-dimensional (d=131x131>2^14) entangled states through multi-mode fibres, characterise them using compressive sensing (compression ratios < 0.00103) and certify reconstruction fidelity (F > 0.9441).

**QM2A.7 • 11:45**

**Certification of Quantum non-Gaussian Photon Coincidences Through Lossy Channels,** Riccardo Checchinato[1], Jan-Heinrich Littmann[1,2], Lukas Lachman[3], Jaewon Lee[1], Sven Hoefling[5], Christian Shneider[4], Radim Filip[3], Ana Predojevic[1]; *[1]Stockholm Univ., Sweden; [2]Justus-Liebig-Univ., Germany; [3]Palacky Univ., Czechia; [4]Univ. of Oldenburg, Germany; [5]Universitat Wurzburg, Germany.* Quantum non-Gaussianity is a stricter criterion and the next step after non-classicality in the classification of quantum states. We will present our experimental results on the certification of quantum non-Gaussian coincidences through a noisy channel.

**10:00 -- 12:00**
**Room: Mees I**
**QM2B • Quantum Network I**
*Presider: Mehdi Namazi, Qunnect Inc., USA*

**QM2B.1 • 10:00 (Invited)**
**Quantum Repeater Node Based on a Trapped-Ion Processor,** Victor Krutyanskiy[1]; [1]*Leopold-Franzens-Universität Innsbruck, Austria.* We present a realization of quantum network node, based on a register of trapped ions interfaced with photons via an optical cavity. The node's operation as a quantum repeater over 50 km channel is demonstrated.

**QM2B.2 • 10:30**
Withdrawn.

**QM2B.3 • 10:45**
**Highly Indistinguishable Photons Emitted From Dissimilar Atomic Quantum Nodes,** Felix Hoffet[1], Jan Lowinski[1], Lukas Heller[1], Auxiliadora Padrón-Brito[1], Hugues de Riedmatten[1,2]; [1]*ICFO-The Inst. of Photonic Sciences, Spain;* [2]*ICREA – Institucio Catalana de Recerca i Estudis Avançats, Spain.* We demonstrate the generation of highly-indistinguishable single photons from two independent quantum nodes. Node 1 is a quantum repeater node based on a quantum memory and Node 2 is a fully blockaded cold Rydberg ensemble.

**QM2B.4 • 11:00**
**Cavity-Quantum Electrodynamics With Single Diamond Tin-Vacancy Centers,** Yanik Herrmann[1,2], Julius Fischer[1,2], Julia M. Brevoord[1,2], Colin Sauerzapf[1,2], Leonardo G. Wienhoven[1,2], Laurens J. Feije[1,2], Matteo Pasini[1,2], Martin Eschen[3,1], Maximilian Ruf[1,2], Matthew J. Weaver[1,2], Ronald Hanson[1,2]; [1]*QuTech, Delft Univ. of Technology, Netherlands;* [2]*Kavli Inst. of Nanoscience, Delft Univ. of Technology, Netherlands;* [3]*Netherlands Organisation for Applied Scientific Research (TNO), Netherlands.* We show diamond Tin-Vacancy centers, coherently-coupled to a tunable microcavity. The exceptional optical properties of this emitter in combination with a stable, high quality cavity enables a cavity transmission signal modulated by a single emitter.

**QM2B.5 • 11:15**
**Waveguide-Based Reconfigurable Quantum Network at Telecom Wavelength,** Raul L. Rincon Celis[1], David Fainsin[1], Peter Namdar[1], Victor R. Roman[3], Guilherme Zanin[2], Nicolas Treps[1], Eleni Diamanti[4], Valentina Parigi[1]; [1]*Laboratoire Kastler Brossel, Sorbonne Université, France;* [2]*Instituto de Física, Universidade de Goiás, Brazil;* [3]*ICFO, Spain;* [4]*LIP6, Sorbonne Universite, France.* We present a source of frequency multipartite entangled states, which can be tailored into a quantum network through oriented measurements of its nullifiers.

**QM2B.6 • 11:30**
**Hong-Ou-Mandel Interference of two Photons of Vastly Different Color,** Felix Mann[1], Helen M. Chrzanowski[1], Felipe Gewers[2], Marlon Placke[1], Sven Ramelow[1,3]; [1]*Humboldt Univ. of Berlin, Germany;* [2]*Instituto de Física, Universidade de São Paulo, Brazil;* [3]*IRIS Adlershof, Germany.* Hong-Ou-Mandel interference is a quantum phenomenon that underlies quantum information processing with single photons. Using a quantum frequency converter as an active beam splitter we demonstrate Hong-Ou-Mandel interference of two photons of vastly different colors.

**QM2B.7 • 11:45**
**Quantum Control and Waveguide Integration of Diamond Tin-Vacancy Spin Qubits,** Hans K. Beukers[1], Christopher Waas[1], Matteo Pasini[1], Nina Codreanu[1], Julia M. Brevoord[1], Tim Turan[1], Ronald Hanson[1]; [1]*QuTech, Delft Univ. of Technology, Netherlands.* We show coupling of an SnV center to a diamond waveguide of 20% with almost transform-limited optical transitions. Besides, we show control over the SnV spin qubit and extend its coherence to over a millisecond.

**10:00 -- 12:00**
**Room: Mees II**
**QM2C • Frontiers in Quantum Sensing**
*Presider: Zhe-Yu Ou, City University of Hong Kong, Hong Kong*

**QM2C.1 • 10:00 (Invited)**
**Radio Wave, Microwave and THz Sensing and Imaging Using Rydberg Atoms,** Kevin J. Weatherill[1]; [1]*Durham Univ., UK.* We describe experiments where radio frequency, microwave and terahertz fields are mapped onto optical signals using Rydberg atoms in atomic vapor. We demonstrate THz imaging at kilohertz frame rates and RF detection spanning twelve octaves.

**QM2C.2 • 10:30**
**Continuous Microwave to Optical Conversion and Detection Based on Warm Rydberg Atoms,** Mateusz Mazelanik[1], Sebastian Borowka[1], Wojciech Wasilewski[1], Michal Parniak[1]; [1]*Uniwersytet Warszawski, Poland.* We demonstrate a wideband continuous microwave-to-optical conversion scheme based on a warm atomic system. The scheme enables counting microwave photons with 57dB dynamic range, reaching 4K thermal radiation limit, and allows all-optical phase-sensitive detection of weak microwave fields.

**QM2C.3 • 10:45**
**Comparing Weak References for Quantum Long-Baseline Telescopy,** Matthew R. Brown[1], Markus Allgaier[2], Michael Raymer[1], Brian J. Smith[1]; [1]*Univ. of Oregon, USA;* [2]*Univ. of North Dakota, USA.* We compare the signal-to-noise ratio for different measurements that could be used for stellar interferometry. We find that single-photon sources with number-resolved detection outperform other weak local oscillator states.

**QM2C.4 • 11:00**
**The Synthesis: High Precision Sensing in Quantum Astrometry, Super-Resolution Microscopy and Beyond,** Stephen Vintskevich[1]; [1]*Quantum Sensing Lab, Technology Innovation Inst., United Arab Emirates.* We propose a new approach to quantum-assisted astrometry with the potential to improve their astrometric precision by orders of magnitude. We extend our framework to super-resolution microscopy and sensor networks and demonstrate novel experimental capabilities.

**QM2C.5 • 11:15**
**Limited Quantum Advantage for Stellar Interferometry via CV Teleportation,** Zixin Huang[1], Ben Baragiola[2], Nicolas C. Menicucci[2], Mark M. Wilde[3]; [1]*Macquarie Univ., Australia;* [2]*RMIT, Australia;* [3]*Cornell Univ., USA.* We consider stellar interferometry in continuous-variable

quantum information and compare three key strategies: direct interferometry (DI), local heterodyne, and CV teleportation. Teleportation outperforms DI in high loss, but this advantage is small and practically challenging, limiting its usefulness for stellar interferometry.

**QM2C.6 • 11:30**
Withdrawn.

**QM2C.7 • 11:45**
**Experimental Device-Independent Certification of GHZ States,** Mariana Schmid[1], Michael Antesberger[1], Huan Cao[1], Wen-hao Zhang[2], Borivoje Dakic[1], Lee Rozema[1], Philip Walther[1]; *[1]Univ. of Vienna, Austria; [2]Anhui Univ., China.* We experimentally demonstrate a device-independent verification and certification of tripartite GHZ states in a sample-efficient way. Our high-performance table-top multiphoton source promises high fidelity and high confidence level, by consuming only a few hundred samples.

**13:00 -- 14:30**
**Room: Rotterdam Hall 2**
**QM3A • Ion QC**
*Presider: Victor Krutyanskiy, Leopold-Franzens-Universität Innsbruck, Austria*

**QM3A.1 • 13:00 (Invited)**
**Blind Tomography and Molecular Vibronic Simulation With Trapped Ions,** Norbert Linke[1]; *[1]Duke Univ., USA.* With our trapped-ion quantum computer, we realize a new tomography method for imperfect measurement bases and use it to distinguish system errors. We further demonstrate the fitting of vibronic molecular spectra in the same system.

**QM3A.2 • 13:30**
**Development of a Compact Trapped ion Quantum Computer,** Christopher Caron[1], Jacob Myers[1], Nitesh Chauhan[2], Jiawei Wang[2], Andrei Isichenko[2], Nishat Helaly[1], Kaikai Liu[2], Daniel J. Blumenthal[2], Robert Niffenegger[1]; *[1]Univ. of Massachusetts Amherst, USA; [2]Univ. of California Santa Barbara, USA.* We report progress developing a compact trapped ion quantum computer and optical clock, based on a photonic integrated direct-drive visible wavelength Brillouin laser stabilized to an integrated 3-meter coil-resonator reference cavity.

**QM3A.3 • 13:45**
**Integration of Surface Ion Traps and Metalens With a High Collection Efficiency,** Hae M. Lim[1], Johannes Froech[1], Minho Choi[1], Arka Majumdar[1], Sara Mouradian[1]; *[1]Univ. of Washington at Seattle, USA.* We present a system integrating metalenses with surface ion traps, simultaneously achieving a large FOV and a high NA. We describe the fabrication process and report simulation results on the trapping properties and collection efficiency.

**QM3A.4 • 14:00**
**Scalable Electronic Control of Trapped-ion Qubits,** Maciej Malinowski[1], David Allcock[1,2], Christopher Ballance[1]; *[1]Oxford Ionics, UK; [2]Univ. of Oregon, USA.* One of the most formidable challenges of scaling up quantum computers is that of control-signal delivery. In this Paper, we present the recent results on integrated and scalable control of trapped-ion qubits at Oxford Ionics.

### 13:00 -- 14:30
### Room: Mees I
### QM3B • Quantum Optics / New Frontiers

*Presider: Brian Smith, University of Oregon, USA*

**QM3B.1 • 13:00**

**High-Rate Generation and Ultrafast Real-Time Observation of Optical non-Gaussian States Encoded in sub-Nanosecond Wavepackets,** Akito Kawasaki[1], Ryuhoh Ide[1], Hector Brunel[1,2], Takumi Suzuki[1], Rajveer Nehra[1,3], Katsuki Nakashima[1], Takahiro Kashiwazaki[4], Asuka Inoue[4], Takeshi Umeki[4], Fumihiro China[5], Masahiro Yabuno[5], Sigehito Miki[5], Hirotaka Terai[5], Taichi Yamashima[1], Atsushi Sakaguchi[6], Kan Takase[1,6], Mamoru Endo[1,6], Warit Asavanant[1,6], Akira Furusawa[1,6]; *[1]The Univ. of Tokyo, Japan; [2]Ecole Normale Superieure, France; [3]Department of Electrical and Computer Engineering, Univ. of Massachusetts-Amherst, USA; [4]NTT corporation, Japan; [5]National Inst. of Information and Communications Technology, Japan; [6]RIKEN Center for Quantum Computing, Japan.* We generate and observe optical non-Gaussian states defined in wavepackets of sub-nanosecond time width---O($10^3$)faster than previous research---using waveguide optical parametric amplifier made of PPLN crystal, enabling ultrafast quantum information processing.

**QM3B.2 • 13:15**

**Direct Detection of Quantum Superposition at a Distance,** Daniel Kun[1,2], Teodor Strömberg[1,2], Michele Spagnolo[1,2], Lee Rozema[2,3], Philip Walther[1,4]; *[1]Universitat Wien, Austria; [2]Vienna Center for Quantum Science and Technology, Austria; [3]Research Network Quantum Aspects of Space Time (TURIS), Austria; [4]Faculty of Physics, Christian Doppler Laboratory for Photonic Quantum Computer, Austria.* Employing an XOR game, we verify quantum superposition with local measurements only, consisting of photon-counting and coincidence detection and using a second, indistinguishable photon as a shared resource, without the need to re-interfere the superposition.

**QM3B.3 • 13:30**

**Continuous Variable Entanglement in a Cold-Atoms Mirrorless Optical Parametric Oscillator,** Gabriel da Cruz Borba de Andrade[1,2], Raoni S. N. Moreira[3,2], Luciano S. Cruz[4], Marcelo Martinelli[1], Daniel Felinto[2], José W. R. Tabosa[2]; *[1]Instituto de Física, Universidade de São Paulo, Brazil; [2]Departamento de Física, Universidade Federal de Pernambuco, Brazil; [3]Centro de Ciências, Tecnologia e Saúde, Universidade Estadual da Paraíba, Brazil; [4]Centro de Ciências Naturais e Humanas, Universidade Federal do ABC, Brazil.* We explore both the internal and external atomic degrees of freedom to demonstrate the observation entangled light via multiple cascading parametric FWM in a sample of cold cesium atoms.

**QM3B.4 • 13:45**

**Purification of Heralded Single Photons by Conditional Pumping,** Yung-Cheng Kao[1,2], Chin-Sung Chuu[1,2]; *[1]Department of Physics, National Tsing Hua Univ., Taiwan; [2]Center for Quantum Technology, Taiwan.* We experimentally demonstrated a novel approach to purify the heralded single photons from parametric down conversion. By implementing a conditional pumping scheme, we observed the reduction of $g^2(0)$ without scarifying the generation rates.

**QM3B.5 • 14:00**

**Assessing the Second-Order Correlation Function of a Quantum State From its Wigner Function,** Mojdeh Shikhali Najafabadi[1]; *[1]Max Planck Inst. for the science of, Germany.* We directly relate the second-order correlation function $g^{(2)}(0)$ to the state's phase space shape using a compact formula in terms of its Wigner function. Our experiment measures $g^{(2)}(0)$ via direct photocounting and reconstructs the Wigner function via homodyne tomography, validating our theoretical findings.

**QM3B.6 • 14:15**

**Two-Photon Emission and Correlations in Hybrid Superconductor-Semiconductor Devices,** Shlomi Bouscher[1], Sima Buchbinder[1], Dmitry Panna[1], Krishna Balasubramanian[1,2], Ronen Jacovi[1], Ankit Kumar[1], Christian Schneider[3], Sven Höfling[3], Alex Hayat[1]; *[1]Technion-Israel Inst. of Technology, Israel; [2]Indian Inst. of Technology, India; [3]Universität Würzburg, Germany.* We experimentally demonstrated two-photon emission in GaAs/AlGaAs superconducting light emitting diodes (SLEDs), observing EL spectra and $g^{(2)}$ photon correlations corresponding to Cooper-pair recombination. We utilized a superlattice structure and transparent superconducting contacts to enhance pair emission.

**13:00 -- 14:30**
**Room: Mees II**
**QM3C • Tutorial: Quantum Sensing**
*Presider: Kai Bongs, German Aerospace Center, Germany*

**QM3C.1 • 13:00 (Tutorial)**

**Quantum Sensing,** Kai Bongs[1]; *[1]German Aerospace Center, Inst. for Quantum Technologies, Ulm, Germany.* Most quantum 2.0 sensors are based on utilizing the sensitivity of quantum superposition states to the environment to make exquisitely precise measurements. In this tutorial I will introduce the basic principles of quantum sensors, present quantum clocks and atom interferometers as examples and discuss applications from civil engineering to space.

**15:00 -- 16:30**
**Room: Rotterdam Hall 2**
**QM4A • Quantum Sensing I**
*Presider: Kevin Weatherill, Durham University, UK*

**QM4A.1 • 15:00**

**Phase-Dependent Hanbury Brown-Twiss Effect for the Complete Measurement of the Complex Coherence Function,** Xuan Tang[2], Yunxiao Zhang[1], Xueshi Guo[1], Cui Liang[1], Xiaoying Li[1], Z.Y. Ou[2]; *[1]TianJin Univ., China; [2]Department of Physics, City Univ. of Hong Kong, Hong Kong.* We report a phase sensitive two-photon interference effect when the incoming thermal fields are mixed with weak coherent reference fields. The complex second-order coherence function of the input thermal fields can be extracted.

**QM4A.2 • 15:15**

**Multi-Photon Subtraction From Squeezed Light Toward Full Quantum State Engineering,** Mamoru Endo[1,2], Takefumi Nomura[1], Tatsuki Sonoyama[1], Kazuma Takahashi[1], Kosuke Fukui[1],

Takahiro Kashiwazaki[3], Asuka Inoue[3], Takeshi Umeki[3], Sachiko Takasu[4], Kaori Hattori[4,5], Daiji Fukuda[4,5], Rajveer Nehra[1,6], Petr Marek[7], Radim Filip[7], Kan Takase[1,2], Warit Asavanant[1,2], Akira Furusawa[1,2]; *[1]Univ. of Tokyo, Japan; [2]Optical Quantum Computing Research Team, RIKEN Center for Quantum Computing, Japan; [3]NTT Device Technology Labs, NTT Corporation, Japan; [4]National Inst. of Advanced Industrial Science and Technology, Japan; [5]AIST-UTokyo Advanced Operando-Measurement Technology Open Innovation Laboratory, Japan; [6]Univ. of Massachusetts-Amherst, USA; [7]Department of Optics, Palacky Univ., Czechia.* We have applied up to four annihilation operations to squeezed light by photon subtraction. The presence of negative values in the Wigner function for all states indicates the successful implementation of quantum manipulation.

**QM4A.3 • 15:30**
**7.3 dB Polarization Squeezing Using Kerr Effect in Fibers,** Nikolay Kalinin[1,2], Gerd Leuchs[1,2], Luis Sánchez-Soto[1,3], Alexey V. Andrianov[4]; *[1]MPI for the Science of Light, Germany; [2]Physik Department, Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany; [3]Departamento de Optica, Facultad de Fisica, Universidad Complutense, Spain; [4]Nonlinear Dynamics and Optics Division, Inst. of Applied Physics of the Russian Academy of Sciences, Russian Federation.* We report on a record 7.3 dB polarization squeezing generation using Kerr effect in a polarization-maintaining fiber and propose a way to apply such squeezed states for sensitivity enhancements in Michelson-like interferometers.

**QM4A.4 • 15:45**
**Quantum Steering From Phase Measurements With Limited Resource,** Gabriele Bizzarri[1], Ilaria Gianani[1], Mylenne Manrique[1], Vincenzo Berardi[2], Fabio Bruni[1], Giovanni Capellini[1], Marco Barbieri[1]; *[1]Università degli studi Roma Tre, Italy; [2]Politecnico di Bari, Italy.* We extend a metrology-assisted protocol to certify steering, explicitly accounting for experimental imperfections, in a limited resource scenario. Our results provide guidelines to apply such a metrological approach to the validation of quantum channels.

**QM4A.5 • 16:00**
**Experimental Demonstration of Continuous Variable Measurement-Device-Independent Resource Certification,** Benjamin L. Larsen[1], Adnan Hajomer[1], Paolo Abiuso[2], Antonio Acin[3], Tobias Gehring[1], Jonas Schou Neergaard-Nielsen[1], Ulrik L. Andersen[1]; *[1]Technical Univ. Denmark (DTU), Denmark; [2]Inst. for Quantum Optics and Quantum Information, Austria; [3]ICFO-Institut de Ciencies Fotoniques, Spain.* Relying only on generation of trusted coherent states, we present experimental demonstrations of continuous variable measurement-device-independent (MDI) resource certification of: 1) entanglement, and 2) non-entanglement breaking optical memory.

**QM4A.6 • 16:15**
**Photoinduced Modification of SHG Mediated by NV Centers in a Diamond Microcavity,** Sigurd Flågan[1], Joe Itoi[1], Prasoon K. Shandilya[1], Elham Zohari[2,1], Vinaya K. Kavatamane[1], Joseph E. Losby[1], Paul E. Barclay[1]; *[1]Univ. of Calgary, Canada; [2]Department of Physics, Univ. of Alberta, Canada.* We demonstrate cavity-enhanced second-harmonic generation from a diamond microdisk. We further show that multicolor excitation of nitrogen-vacancy centers strongly affects the observed second-harmonic signal, indicating a difference in $\chi(2)$ between the two possible charge-states.

**15:00 -- 16:30**
**Room: Mees I**
**QM4B • Integrated Photonics Sources I**
*Presider: Pascale Senellart, C2N-CNRS, France*

**QM4B.1 • 15:00 (Invited)**
**Scalable Quantum Photonic Devices Operating in the Telecom C-Band,** Elizaveta Semenova[1,2]; *[1]DTU Electro, Department of Electrical and Photonics Engineering, Technical Univ. of Denmark, Denmark; [2]NanoPhoton − Center for Nanophotonics, Technical Univ. of Denmark, Denmark.* We present the deterministic fabrication of quantum-dot photonic devices emitting high-purity single-photons in the telecom C-band. This will open scalable integration with photonic platforms to enable novel functionalities for on-chip quantum information processing.

**QM4B.2 • 15:30**
**Real-Time Quantum Random Number Generation With Integrated Photonics: Robustness and Scalability for Industrial Deployment,** Davide Marangon[2,1], Peter R. Smith[2], Nathan Walk[2], Taofiq Paraiso[2], James F. Dynes[2], Victor Lovic[2], Mirko Sanzaro[2], Thomas Roger[2], Innocenzo De Marco[2], Marco Lucamarini[3,2], Zhiliang Yuan[2], Andrew Shields[2]; *[1]Dept. Eng. of Information, Univ. of Padova, Italy; [2]Toshiba Europe Ltd, Cambridge Research Laboratory, UK; [3]Department of Physics, York Univ., UK.* We develop a fast quantum random number generator using integrated photonics on electronic platforms. It operates gigahertz speeds, maintaining stability over weeks in real-world conditions. Achieves secure 2 Gbit/s generation.

**QM4B.3 • 15:45**
**InGaP-on-Insulator Integrated Quantum Photonic Devices Fabricated at Wafer-Scale,** Lillian Thiel[1], Joshua E. Castro[1], Trevor Steiner[1], Nicholas Lewis[1], John Bowers[1], Galan Moody[1]; *[1]UC Santa Barbara, USA.* We present 100-mm wafer scale fabrication of the high $\chi^{(2)}$ and $\chi^{(3)}$ InGaP-on-insulator platform. Microring resonators with Q > 340,000 and propagation losses down to 1.72 dB/cm show promise for integrated quantum photonic applications.

**QM4B.4 • 16:00**
**Integrated Photonics for the Monlithinc Generation and Detection of Quantum Continuous Variable States of Light,** Oliver Green[1,2], Jonathan Matthews[1], Giacomo Ferranti[1]; *[1]Quantum Engineering Technology Labs, UK; [2]Quantum Engineering Centre for Doctoral Training, UK.* We present plans to unite sources of continuous variable quantum light and detectors on a single silicon photonics chip. This includes the extension of chip based homodyne detection to the pulsed regime.

**QM4B.5 • 16:15**
**Design of Silicon Quantum Squeezer,** Mouhamad Al-Mahmoud[1,2], Stéphane Clemmen[1,2]; *[1]Department of information Technology (INTEC), Ghent Univ. - IMEC, Belgium; [2]Center for Nano- and Biophotonics (NB-Photonics), Gent Univ., Belgium.* We present a silicon squeezer optimized for high-degree squeezing and integrated balanced detection. This entails fine-tuning waveguides, cladding, bend radii, and couplers to reduce FWM phase mismatch and maximize signal confinement.

**15:00 -- 16:30**
**Room: Mees II**
**QM4C • Tutorial: Fault Tolerant QC**
*Presider: Barbara Terhal, QuTech, Netherlands*

**QM4C.1 • 15:00 (Tutorial)**
**Fault Tolerant QC,** Barbara Terhal[1]; *[1]QuTech, Netherlands.* I will give an introduction into quantum error correction and fault-tolerant quantum computation. I will include a discussion of novel opportunities for using quantum LDPC codes in architectures with mobile qubits or beyond 2D-connectivity.

**17:00 -- 18:30**
**Room: Rotterdam Hall 2**
**QM5A • Quantum Theory**
*Presider: Barbara Terhal, QuTech, Netherlands*

**QM5A.1 • 17:00**
**Many-Body Phases Enabled by Quantum Optical Processes,** Emmanouil Grigoriou[2], Ming Li[2], Yoshitomo Kamiya[3], Germán J. de Valcárcel[1], Carlos Navarrete-Benlloch[1]; *[1]Departament d'Òptica i Optometria i Ciéncies de la Visió, Universitat de València, Spain; [2]Wilczek Quantum Center, Shanghai Jiao Tong Univ., China; [3]School of Physics and Astronomy, Shanghai Jiao Tong Univ., China.* We provide evidence that elusive many-body phases of matter such as supersolids and time crystals can emerge when considering quantum-optical processes in paradigmatic condensed-matter models. Implementations in modern quantum simulators are discussed.

**QM5A.2 • 17:15**
**Entanglement-Efficient Distributed Quantum Computing,** Junyi Wu[1,2], Pablo Andres-Martinez[3], Tim Forrer[4], Daniel Mills[3], Kosuke Matsui[4], Luciana Henaut[3], Kentaro Yamamoto[3], Akihito Soeda[4,5], Ross Duncan[3], Mio Murao[4]; *[1]Tamkang Univ., Taiwan; [2]Physics Division, National Center for Theoretical Sciences, Taiwan; [3]Quantinuum, UK; [4]The Univ. of Tokyo, Japan; [5]National Inst. of Informatics, Japan.* We introduce an embedding-enhanced nonlocal-handling technique to save the entanglement consumption in distributed quantum computing (DQC) between two quantum processing units. The embedding technique is incorporated into the Steiner-tree distribution for DQC over heterogeneous networks.

**QM5A.3 • 17:30**
**Traceable Device-Independent Randomness as a Service,** Gautam A. Kavuri[5,1], Jasper Palfree[5,1], Dileep Reddy[1,5], Yanbao Zhang[2], Michael Mazurek[5,1], Martin Stevens[5], Joshua Bienfang[3], Morgan W. Mitchell[4], Carlos Abellan[4], Richard Mirin[5], Sae Woo Nam[5], Emanuel Knill[6,1], Lynden K. Shalm[1,5]; *[1]Physics, Univ. of Colorado Boulder, USA; [2]Quantum Information Science Section, Oak Ridge National Laboratory, USA; [3]Physical Measurement Laboratory, National Inst. of Standards and Technology, USA; [4]ICFO, Spain; [5]Physical Measurement Laboratory, National Inst. of Standards and Technology, USA; [6]Applied and Computational Mathematics Division, National Inst. of Standards and Technology, USA.* We implement a traceable protocol for device-independent random number generation. Our demonstration

involves transparently integrating a device-independent RNG into a public randomness beacon, and feeding 7434 random number pulses into the beacon over 39 days.

**QM5A.4 • 17:45**
**All-Photonic GKP-Qubit Repeater Using Analog-Information-Assisted Multiplexed Entanglement Ranking,** Filip Rozpedek[1,2], Kaushik Seshadreesan[3,4], Paul Polakos[5], Liang Jiang[2], Saikat Guha[4]; *[1]Univ. of Massachusetts Amherst, USA; [2]Univ. of Chicago, USA; [3]Univ. of Pittsburgh, USA; [4]Univ. of Arizona, USA; [5]Cisco Systems, USA.* We propose a novel strategy of using the bosonic Gottesman-Kitaev-Preskill (GKP) code in a repeater architecture with multiplexing. We also quantify the number of GKP qubits needed for the implementation of our scheme.

**QM5A.5 • 18:00**
**Optoacoustic Entanglement in Brillouin-Active Waveguides,** Changlong Zhu[1], Claudiu Genes[1,2], Birgit Stiller[1,2]; *[1]Max Planck Inst. for the Science of Light, Germany; [2]Department of Physics, Friedrich-Alexander-Universitat Erlangen-Nurnberg, Germany.* Entanglement is a key resource to many emerging quantum technologies. Here, we present a scheme to engineer bipartite entanglement between traveling acoustic phonons and photons in Brillouin-active waveguides at a modest high environment temperature.

**QM5A.6 • 18:15**
**A Denoising Quantum Autoencoder for Noise Mitigation,** Dominick J. Joch[1]; *[1]Griffith Univ., Australia.* Noise in quantum systems significantly impacts their use as a quantum information resource. We aim to experimentally demonstrate noise mitigation of quantum states with an optical quantum autoencoder, using machine learning to compress quantum data.

**17:00 -- 18:30**
**Room: Mees I**
**QM5B • Integrated Photonics Sources I**
*Presider: Elizaveta Semenova, DTU Electro, Denmark*

**QM5B.1 • 17:00 (Invited)**
**Integrated Quantum Photonics in χ^(2) Materials: Development, Fabrication and Their use for on-Chip Quantum Optics,** Laura Padberg[1]; *[1]Univ. of Paderborn, Germany.* We show our development on devices that enable the realization of quantum optical applications on chip. We present the design and fabrication of devices in ferroelectric materials especially in thin-film lithium niobate.

**QM5B.2 • 17:30**
**Interference Between Quantum-dot Emitted Single Photons and Weak Coherent States,** Juan Rafael Alvarez Velasquez[1], Hubert Lam[1], Dario Fioretto[1], Ilse Maillette de Buy Wenniger[2], Petr Steindl[3], Stephen Wein[4], Wolfgang Löffler[3], Nadia Belabas[1], Pascale Senellart[1]; *[1]C2N,*

*Universite Paris Saclay, France; [2]Imperial College London, UK; [3]Univ. of Leiden, Netherlands; [4]Quandela, France.* We determine the mean wavepacket overlap between single photons emitted from a quantum dot device and a weak coherent state from a pulsed laser using auto- and cross-correlation measurements, reaching an 82% mode match.

**QM5B.3 • 17:45**
**Fiber-Pigtailed Quantum Dot Hybrid Circular Bragg Gratings,** Lucas Rickert[4], Daniel Vajner[4], Martin von Helversen[4], Johannes Schall[4], Sven Rodt[4], Stephan Reitzenstein[4], Kinga Zolnacz[1], Anna Musial[2], Grzegorz Sek[2], Shulun Li[3], Zhichuan Niu[3], Tobias Heindel[4]; *[1]Department of Optics and Photonics, Wroclaw Univ. of Science and Technology, Poland; [2]Department of Experimental Physics, Wroclaw Univ. of Science and Technology, Poland; [3]Inst. of Semiconductors, Chinese Academy of Sciences, China; [4]Inst. of Solid State Physics, Technische Universität Berlin, Germany.* We report on the deterministic fabrication of high-performance hCBGs with embedded InAs/GaAs quantum dots permanently fiber-pigtailed to single mode fibers. The devices exhibit spontaneous emission lifetimes <50ps resulting in experimental Purcell factor well beyond 15, temperature stability and unprecedented single photon purity.

**QM5B.4 • 18:00**
**Noise Reduction of a Fiber-Memory Photon Source for Temporal Multiplexing,** Ramy Tannous[1], Philip Bustard[1], Daniel Poitras[1], Duncan England[1], Benjamin Sussman[1,2]; *[1]National Research Council, Canada; [2]Department of Physics, Univ. of Ottawa, Canada.* Multiplexing nonlinear photon pair sources provides a path towards a near-deterministic photon source. Here we present a significant noise reduction in a fiber-cavity integrated spontaneous four-wave-mixing source, designed for temporal multiplexing.

**QM5B.5 • 18:15**
**Mid-Infrared Qubit Entanglement in Silicon,** Sebastian Currie[1,2], Samuel Gears[1,2], Dominic Sulway[1], Joshua Silverstone[3]; *[1]Quantum Engineering Centre for Doctoral Training, UK; [2]Quantum Engineering Technology Laboratories, UK; [3]Big Photon Lab, UK.* We demonstrate the first instance of integrated quantum entanglement in the mid-infrared, using tailored photon pair sources, filters and detectors. We show a 6 sigma violation of the CHSH inequality with S=2.74.

**17:00 -- 18:30**
**Room: Mees II**
**QM5C • Tutorial: Quantum Memory**
*Presider: Margherita Mazzera, Heriot-Watt University, UK*

**QM5C.1 • 17:00 (Tutorial)**
**Photonic Quantum Memories,** Margherita Mazzera[1]; *[1]Heriot-Watt Univ., UK.* Photonic quantum memories are crucial building blocks for quantum communication and computing architectures. In this contribution, I will present the strategies and challenges for the realisation of atomic quantum memories for photonic quantum states.

## Tuesday, 25 June

**08:30 -- 10:00**
**Room: Rotterdam Hall 2**
**QTu1A • Symposium on Definition and Implementation of Quantum Advantage and Keynote Session II**
*Presider: Heike Riel, IBM, Zurich, Switzerland*

**QTu1A.1 • 08:30 (Keynote)**
**From Physical to Logical: Towards Quantum Systems Tailored for Error-Corrected Quantum Computing,** Christopher Eichler[1]; *[1]Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany.* In the last decades, incredible progress has been made in building prototypes of quantum computers and simulators based on trapped ions and atoms, spins in semiconductors, photonic systems, and superconducting circuits. All of today's existing devices, however, suffer from errors occurring typically in every one out of a hundred to a thousand operations. To reach practical quantum advantages, computations ultimately need to become faultless, which requires the correction of errors at the physical level. In my talk, I will review recent advancements in experimentally realizing quantum error correction based on the surface code and discuss possible perspectives towards hardware-efficient implementations of quantum error correction to reduce the massive resource overhead.

**QTu1A.2 • 09:30 (Invited)**
**Project Qu-Gov: Exploration of Quantum Technologies for and Inside Governmental Administration,** Oliver Muth[1]; *[1]Bundesdruckerei GmbH, Germany.* In 2022 Bundesdruckerei started the Project Qu-Gov which includes an overall advising approach of the German Federal ministry of Finance concerning the topics Quantum-Information, Quantum-Communication, Post-Quantum-Security, Quantum-Analytics and the sovereign use of Quantum devices and services. In this lecture we talk about our approach and first results.

**10:30 -- 12:30**
**Room: Rotterdam Hall 2**
**QTu2A • Symposium Definition and Implementation of Quantum Advantage II**
*Presider: Ronald Holzwarth, Menlo Systems GmbH, Germany*

**QTu2A.1 • 10:30 (Invited)**
**Quantum Dots as Resources for Optical Quantum Computing,** Pascale Senellart[1]; *[1]C2N-CNRS, France.* We report on our progresses on the generation of resources states for fault tolerant optical quantum computing. We make use of semiconductor quantum dots, linear gates and spin-photon entanglement to created photonic linear cluster states.

**QTu2A.2 • 11:00 (Invited)**
**Quantum Sensors Based on Atom Interferometry,** Mark A. Kasevich[1]; *[1]Stanford Univ., USA.* This talk will summarize recent progress in the development of ultra-precise gravitational sensors based on atom interferometry. Applications of these sensors to fundamental physics studies of gravitation and to geoscience will be discussed.

**QTu2A.3 • 11:30 (Invited)**
**Quantum Computing and its Applications,** Daniel Egger[1]; *[1]IBM Quantum, IBM Research - Zurich, Switzerland.* Quantum computing may solve complex problems in areas as diverse as natural sciences, optimization, machine learning, and finance. I will briefly introduce the IBM Quantum roadmap and explore some of the applications of quantum computing.

**QTu2A.4 • 12:00 (Invited)**
**Networking Silicon Spin Qubits,** Daniel B. Higginbottom[1]; *[1]Simon Fraser Univ., Canada.* Networked quantum computers provide a route to commercial utility. We demonstrate key elements of distributed quantum computing between optically linked silicon quantum processors, including the distribution and consumption of remote entanglement.

### 14:00 -- 16:00
### Exhibits- Poster Area
### QTu3A • Poster Session I

**QTu3A.1**
**Superconducting Diamond Bus for Defect Centers Coupling,** Sarah Chapnick[1], Jerome Cuenca[2], Oliver Williams[2], Joanna Zajac[1]; *[1]Brookhaven National Laboratory, USA; [2]Physics and Astronomy, Cardiff Univ., UK.* We propose and model a novel material platform for defect coupling n diamond. We use coplanar waveguide resonator made of diamond itself that becomes superconducting when dopped with high concentration of Boron.

**QTu3A.2**
**Bell State Statistics With Post-Selection Loophole,** S. Andrew Lanham[1], Brian R. La Cour[1]; *[1]Applied Research Laboratories, UT Austin, USA.* We demonstrate a classical post-selection-induced violation of a Bell-type inequality using the setup of Q. Zhang et al., Phys. Rev. A 77, 062316 (2008). The results demonstrate how post-selection alone can cause Bell inequality violations.

**QTu3A.3**
**Experimental Simulation of Loop Quantum Gravity on a Photonic Chip,** Malaquías Correa-Anguita[1], Reiner van der Meer[1], Zichuang Huang[2], Dongxue Qu[3], Peter Hooijschuur[1], Hongguang Liu[4], Muxin Han[3,4], Jelmer J. Renema[1], Lior Cohen[5]; *[1]Univ. of Twente, Netherlands; [2]Fudan Univ., China; [3]Florida Atlantic Univ., USA; [4]Friedrich-Alexander Universität Erlangen-Nürnberg, Germany; [5]Univ. of Colorado Boulder, USA.* We experimentally simulate a basic transition amplitude of Loop Quantum Gravity on an integrated photonic chip, and show that this amplitude falls within 4% error from the theoretical prediction.

**QTu3A.4**
**Neutral Atom "Flying Qubits" for Fast, Deterministic, Modular Trapped Ion Quantum Computing,** Boris Blinov[1], Subhadeep Gupta[1]; *[1]Univ. of Washington, USA.* A novel architecture for a scalable trapped ion quantum computer is proposed that uses neutral atoms as flying qubits to deterministically connect multiple trapped ion chains for scaling up the system.

**QTu3A.5**

**Evaluating Cyclic Translational Symmetry in Boson Sampling Systems With Few Detectors,** Tudor-Alexandru Isdraila[1,2], Jun-Yi Wu[1,2]; *[1]Department of Physics, Tamkang Univ., Taiwan; [2]Center for Advanced Quantum Computing, Tamkang Univ., Taiwan.* Tomography of multi-photon states represents a complex procedure requiring a large number of photon number resolving detectors. By expanding an efficient single-photon tomography protocol we recover a reduced density matrix with just two detectors.

**QTu3A.6**

**Spin Squeezing Process for Surface Electrons Over Liquid Helium,** Manish Chaudhary[1]; *[1]School of Physics and Astronomy, Univ. of Nottingham, UK.* In this paper, we analyze the process of the entanglement generation in the spin qubits for electrons floating over liquid Helium. This is achieved by coupling two spins of the electrons with the collective phonon mode of surface vibration. This coupling is useful in realizing Molmer-Sorensen gate that is used in generating entangled states.

**QTu3A.7**

**Monolithic CNOT Gate Between OAM and Polarization,** Aadithya G. Shankar[1], Gaurav M. Vaidya[1,2], Ameen Yasir[3], Sivarama Krishnan[1,4]; *[1]Indian Inst. of Technology Madras, India; [2]Department of Physics, Univ. of Colorado, USA; [3]Inst. of Physics, Johannes-Gutenberg Univ. of Mainz, Germany; [4]Quantum Center of Excellence for Diamond and Emergent Materials (QuCenDiEM), Indian Inst. of Technology Madras, India.* The realization of scalable CNOT gates is an essential landmark in quantum computing using the OAM of light. This work studies the design and demonstration of a monolithic CNOT gate between OAM and polarization.

**QTu3A.8**

**Harnessing Strong Symmetry Breaking Finite-Component System Phase Transition for Quantum Error Correction,** Myung-Joong Hwang[1], Yanzhang Zhu[1]; *[1]Division of Natural and Applied Sciences, Duke Kunshan Univ., China.* We investigate a dissipative finite-component system phase transition induced by two photon loss mechanism, which features a strong symmetry breaking of the Liouvillian. We characterize the mean-field phase diagram and demonstrate that the system could be harnessed to implement passive error correction for a hybrid qubit-oscillator qubit.

**QTu3A.9**

**Beyond Beam Splitters: Efficiently Decomposing Large Unitaries Into Multimode Devices of Arbitrary Size,** Christian Arends[3,2], Lasse Wolf[1], Jasmin Meinecke[4,5], Sonja Barkhofen[2,1], Tobias Weich[1,2], Tim J. Bartley[1,2]; *[1]Universität Paderborn, Germany; [2]Inst. for Photonic Quantum Systems, Paderborn Univ., Germany; [3]Department of Mathematics, Aarhus Univ., Denmark; [4]Max Planck Inst. for Quantum Optics, Germany; [5]TU Berlin, Germany.* Linear optical quantum computing and simulation typically relies on decomposing large unitaries into many 2x2 subunitaries comprising beam splitters and phase shifters. We provide a rigorous decomposition into larger subunitaries, which offer significant scaling improvements.

**QTu3A.10**

**Creation of Multiqubit non-Maximally Entangled States by Linear-Optical Fusion Operations,** Aleksandr A. Melkozerov[1], Michail Y. Saygin[1,2], Sergei P. Kulik[1,2], Stanislav S. Straupe[1,3]; *[1]M. V. Lomonosov Moscow State Univ., Russian Federation; [2]South Ural State Univ.,* *Russian Federation; [3]Russian Quantum Center, Russian Federation.* We propose an approach to linear-optical generation of large non-maximally entangled states by fusion. We show that at certain conditions this method can be more effective than the similar known for maximally entangled states.

**QTu3A.11**
**Tuning Inter-Qubit Coupling Strengths by Sideband Driving,** Wei-Chen Chien[1], Chung-Li Lin[1], Tse-Yu Lai[1], Watson Kuo[1,2], Yen-Chun Chen[2], Chiidong Chen[2]; *[1]National Chung Hsing Univ., Taiwan; [2]Inst. of Physics, Academia Sinica, Taiwan.* We examine the inter-qubit coupling strength using iSWA operation when the qubit frequency is modulated at 80 MHz. The coupling strength between qubits, mediated by various sidebands generated from the frequency modulation, can be dynamically tuned, following the Bessel dependencies.

**QTu3A.12**
Withdrawn.

**QTu3A.13**
**Optomechanical Microcavity With a Tensile-Strained InGaP Membrane,** Alexander Jung[1], Anastasiia Ciers[1], André Strittmatter[2], Witlef Wieczorek[1]; *[1]Department of Microtechnology and Nanoscience (MC2), Chalmers Univ. of Technology, Sweden; [2]Inst. of Physics, Otto von Guericke Universität Magdeburg, Germany.* We characterize a chip-based optomechanical microcavity that confines light between a crystalline DBR and a suspended InGaP photonic crystal high-Q membrane. In the future this approach could enable nonlinear quantum optomechanics.

**QTu3A.14**
**Proposed Optical Test of Continuous-Variable Contextuality,** Zheng-Hao Liu[1], Jonas Schou Neergaard-Nielsen[1], Ulrik L. Andersen[1]; *[1]Technical Univ. of Denmark, Denmark.* Based on the encoding of a qubit into an oscillator, we show how an optical test of continuous-variable quantum contextuality can be achieved using the photon's spatial modes. We provide a concrete state-independent construction.

**QTu3A.15**
**Order-Invariant Quantum Correlations in non-Hermitian Interferometers,** Tom Wolterink[1], Matthias Heinrich[1], Stefan Scheel[1], Alexander Szameit[1]; *[1]Univ. of Rostock, Germany.* We identify sequences of concatenated two-mode systems that perform distinct linear optical transformations, whereas their two-photon behavior is invariant under reversal of the order. We experimentally verify this behavior in non-Hermitian interferometers of varying composition.

**QTu3A.16**
**Heralded Squeezed Coherent State Superpositions From a Catalysis Protocol,** Leon Reichgardt[1], Bahar Ozturk[2], Oliver Benson[1], Roger A. Kögler[1]; *[1]Institut für Physik, Humboldt-Universität zu Berlin, Germany; [2]Bilkent Univ., Turkey.* We computationally investigate a breeding protocol that heralds squeezed coherent state superpositions with high amplitude from experimentally accessible resources. Such states are of interest for fault-tolerant photonic quantum computing.

**QTu3A.17**

**Observing PT-Symmetry Breaking in Integrated Quantum Photonics,** Friederike Klauck[1], Matthias Heinrich[1], Alexander Szameit[1], Tom Wolterink[1]; *[1]Univ. of Rostock, Germany.* In PT-symmetric systems, losses dramatically alter quantum correlations of interfering photons. We study the impact of increased loss on two-photon correlations in lossy couplers and observe changes in Hong-Ou-Mandel interference upon entering the PT-broken phase.

**QTu3A.18**

**Optical Beam Shaping for Robust Quantum Inertial Sensors,** Ulrike Fuchs[1], Henrike Schlutow[1], Joel G. Baptista[2], Leonid A. Sidorenkov[2], Camille Janvier[3]; *[1]asphericon GmbH, Germany; [2]LNE-SYRTE, Observatoire de Paris, Universite PSL, CNRS, Sorbonne Universite, France; [3]Exail Quantum Systems, France.* Inertial sensors based on atom interferometry benefit from laser beams of homogeneous intensity and wavefront. We present a fiber-coupled athermalized beam shaper retaining these properties over an extended temperature range, for a field-deployed quantum gravimetry.

**QTu3A.19**

**Probing NV Center Coupled Metal-Dielectric-Metal Architectures for Quantum Technologies,** Nitesh Singh[1], Rajesh V. Nair[1]; *[1]IIT ROPAR, India.* We experimentally demonstrated the emission rate and intensity enhancement of NV centers mediated by metal-dielectric-metal cavity coupling. Results show the wide tunability of cavity mode, a vital platform for coupling various quantum emitters.

**QTu3A.20**

**Nonclassicality of Seeded Optical Parametric Oscillator in the Single-Photon Regime,** Lee Chanseul[1], Tai Hyun Yoon[1]; *[1]Korea Univ., Korea (the Republic of).* We discuss nonclassicality of nondegenerate optical parametric oscillator operating far below-threshold with weak seed fields. We show nonclassical measure that depends on the seeding amplitude ratio has the same values for intra- and extra-cavity fields.

**QTu3A.21**

Withdrawn

**QTu3A.22**

**Device-Agnostic Single-Emitter Super-Resolution Using Deep Learning,** Dominik Vasinka[1], Filip Juran[1], Jaromir Behal[1], Miroslav Jezek[1]; *[1]Palacký Univ. Olomouc, Czechia.* We demonstrate a device-agnostic deep learning approach for super-resolution single-emitter microscopy. The presented method is calibration-free and directly predicts super-resolved images independently of the optical system.

**QTu3A.23**

**Invariant-Based Control of Quantum Many-Body Systems Across Critical Points,** Hilario Espinós Martínez[1], Loris M. Cangemi[2], Amikam Levy[2], Ricardo Puebla[1], Erik Torrontegui[1]; *[1]Universidad Carlos III de Madrid, Spain; [2]Bar-Ilan Univ., Israel.* We design a control technique that ensures adiabatic-like evolution for the Ising and Kitaev models crossing a critical point. The controls are scalable, do not require extra interactions and are robust against imperfections.

**QTu3A.24**
Withdrawn

**QTu3A.25**
**Measurement-Based Control of the Electron-Photon Coupling Coherence,** Hadar Aharon[1], Ofer Kfir[1]; [1]*Tel Aviv Univ., Israel.* We derive an interaction model between free electrons and cathodoluminescent photons, revealing quantum interference suppression due to distinguishable electron paths. Our proposal and the suggested experiment solve a standing question in the coupling of basic particles.

**QTu3A.26**
**Breaking Rayleigh's Curse Through Photon Distribution Analysis Combined With Point Spread Function Shaping,** Boris Bantysh[1], Stephen Vintskevich[1], Anna Romanova[1], Konstantin Katamadze[1]; [1]*Quantum Research Center, Technology Innovation Inst., United Arab Emirates.* We introduce a novel super-resolution imaging technique, combining photon distribution analysis and point spread function shaping. Resolving unbalanced point sources with unknown parameters is achieved across diverse photon statistics.

**QTu3A.27**
**Light-Field Ghost Imaging,** Alberto Paniate[1,2], Gianlorenzo Massaro[3], Alessio Avella[2], Alice Meda[2], Francesco Pepe[3], Marco Genovese[2], Milena D'Angelo[3], Ivano Ruo Berchera[2]; [1]*Politecnico di Torino, Italy;* [2]*INRIM, Italy;* [3]*Università degli Studi di Bari, Italy.* We propose a technique which exploits light correlations and light-field principles to recover the volumetric image of an object without acquiring axially resolved images and without knowing its position or longitudinal extent.

**QTu3A.28**
**The Minimum-Error Quantum Estimation Through Noisy Multi-Projector Measurement,** Martin Bielak[1], Dominik Koutný[1], Michal Neset[1], Miroslav Jezek[1]; [1]*Palacky Univ. Olomouc, Czechia.* Full quantum state characterization requires a tomographic procedure performed on a limited number of copies. Our experimental demonstration of one- and two-qubit overcomplete tomographic measurements (up to 400 separable projections) outperforms state-of-the-art approaches.

**QTu3A.29**
**Exact Quantum Sensing Limits for Bosonic Dephasing Channels,** Zixin Huang[1], Ludovico Lami[2], Mark M. Wilde[3]; [1]*Macquarie Univ., Australia;* [2]*Univ. of Amsterdam, Netherlands;* [3]*Cornell Univ., USA.* We computed the exact limits for quantum channel discrimination and parameter estimation of the bosonic dephasing channels. This is the first example of a non-Gaussian bosonic channel for which there are exact solutions for these tasks.

**QTu3A.30**
**Performing Joint Measurements of Light With Quantum Computers,** Spencer D. Dimitroff[1,2], Mohan Sarovar[2]; [1]*Center for Quantum Information and Control, Physics and Astronomy, Univ. of New Mexico, USA;* [2]*Quantum Algorithms and Applications Collaboratory, Sandia National Laboratories, USA.* We establish a model employing transduction of optical states to qubits in a quantum computer followed by quantum computation to ease the difficulty of performing joint measurements of optical quantum states.

**QTu3A.31**
**Directionally-Unbiased Linear Multiports: Quantum Interference and Registration of Multi-Dimensional Rotation,** David S. Simon[1,2], Christopher Schwarze[2], Alexander V. Sergienko[2,3]; *[1]Physics, Stonehill College, USA; [2]Electrical and Computer Engineering, Boston Univ., USA; [3]Physics, Boston Univ., USA.* We describe a quantum walk in which photons remain clustered together as they walk along a chain. This effect can be used to construct higher-dimensional quantum Sagnac interferometers that measure rotations about three axes simultaneously.

**QTu3A.32**
**Quantum Temporal Interferometers,** Moti Fridman[1], Eliahu Cohen[1]; *[1]Bar Ilan Univ., Israel.* Temporal optics revolutionize the field of ultrafast detection with its high temporal resolution. We adopt temporal devices to study quantum phenomena and develop quantum optical elements, where the optical elements are in a non-classical state.

**QTu3A.33**
**Nonlinear Quantum Optics at Your Fingertips: a Multipurpose Student-Lab Experiment on Sensing With Undetected Photons,** Marthe Zeja[1], Felix Mann[1], Emma Pearce[1], Sven Ramelow[1]; *[1]Institut für Physik, Humboldt-Universität zu Berlin, Germany.* We present a student-lab setup using a multipurpose nonlinear interferometer, enabling exploration of quantum interference and undetected photon sensing for mid-IR imaging and spectroscopy to facilitate hands-on understanding of modern quantum optics.

**QTu3A.34**
**Topology Optimization of High-Performance Optomechanical Resonator,** Yincheng Shi[1], Fengwen Wang[2], Dennis Høj[1], Ole Sigmund[2], Ulrik L. Andersen[1]; *[1]Center for Macroscopic Quantum States (bigQ), Department of Physics, Technical Univ. of Denmark, Denmark; [2]Department of Mechanical Engineering, Solid Mechanics, Technical Univ. of Denmark, Denmark.* The quality factor of resonator is described by a dilution factor defined as the ratio of tension to linear strain energies. We implement topology optimization of resonators with the dilution factor as an objective. The finite element model combines mesh refinement and a mixed formulation to accurately model the boundary effects in eigenmode.

**QTu3A.35**
Withdrawn.

**QTu3A.36**
**Hardware and Machine Learning Optimization of Diamond Quantum Sensors,** Peker Milas[1], Sheikh Mahtab[1,2], Tomas Sujeta[1], Michael Spencer[1], Birol Ozturk[1]; *[1]Morgan State Univ., USA; [2]Cornell Univ., USA.* Quantum sensing with nitrogen vacancy (NV) color center defects in diamond was optimized with hardware and machine learning approaches, which led to the development of small footprint quantum sensor devices.

**QTu3A.37**
**Enhanced Greenhouse Gas Sensors Exploiting Upconversion of Light,** Arthur Castro Cardoso[1], Ruaridh Smith[2], Imogen Moreland[2], Loyd McKnight[2], Corin Gawith[3], Andy Astill[3], Krish Pandiyan[3], Sara Carver[4], Andrew Weld[4], Xiao Ai[4], John Rarity[1]; *[1]Univ. of Bristol, UK;*

[2]*Fraunhofer Centre for Applied Photonics, UK;* [3]*Covesion Ltd, UK;* [4]*QLM Ltd, UK.* This paper proposes a new generation of greenhouse gas sensors exploiting upconversion of light. The method can outperform the state-of-the-art methane and carbon dioxide sensors by using silicon photon-counting technologies and high-efficiency upconversion waveguides.

**QTu3A.38**
Withdrawn

**QTu3A.39**
**All-Fiber Microendoscopic Polarization Sensing at Single-Photon Level Aided by Deep-Learning,** Martin Bielak[1], Dominik Vasinka[1], Miroslav Jezek[1]; [1]*Palacky Univ. Olomouc, Czechia.* We address the problem of precise polarization measurement in challenging conditions. To resolve this problem, we introduce a single-shot all-fiber method based on intermodal interaction aided by deep-learning, providing accuracy down to a single-photon level.

**QTu3A.40**
Withdrawn

**QTu3A.41**
***Graph States for Robust Quantum Magnetometry in Noisy Environments*****,** Phu Trong Nguyen[2], Trung Kien Le[3], Hung Q. Nguyen[4], Bin Ho Le[1]; [1]*Tohoku Univ., Japan;* [2]*Univ. of Science and Technology of Hanoi, Viet Nam;* [3]*Univ. of California, USA;* [4]*Vietnam National Univ., Viet Nam. This study examines how symmetric graph-state resources can improve quantum magnetometry under Markovian and non-Markovian noise. It shows significant improvements in estimating Larmor frequencies, indicating the potential for enhanced magnetic field measurements in noisy environments.*

**QTu3A.42**
**Enhancing Nitrogen Vacancy Center in Diamond Readout: Leveraging Photon Statistics for Analyzing Ionization Dynamics,** Ivan Panadero Munoz[1,2], Marta Arceiz[1], Hilario Espinos[2], Erik Torrontegui[2]; [1]*Arquimea Research Center, Spain;* [2]*Universidad Carlos III de Madrid, Spain.* We introduce a novel characterization formalism for a nitrogen vacancy center model, encompassing its charge transitions. This enables exploration of innovative readout methods aimed at enhancing its sensitivity.

**QTu3A.43**
**Approaching Maximal Precision of Hong-Ou-Mandel Interferometry With non-Perfect Visibility,** Othmane Meskine[1], Eloi Descamps[1], Arne Keller[1,2], Aristide Lemaître[3], Florent Baboux[1], Sara Ducci[1], Pérola Milman[1]; [1]*Laboratoire MPQ - Université Paris Cité, France;* [2]*Département de Physique, Université Paris-Saclay, France;* [3]*C2N - Université Paris-Saclay, France.* This work explores precision limits in two-photon Hong-Ou-Mandel interferometry under non-perfect visibility. A theoretical model is developed and experimentally validated. Results show a 0.97 ratio between experimental precision and the quantum limit, setting a new benchmark.

**QTu3A.44**
**Continuous Variable Distributed Quantum Sensing in Integrated Photonics,** Bethany H. Puzio[1,2], Giacomo Ferranti[1], Jonathan Matthews[1], Joel Tasker[1], Jonathan Frazer[1,2]; [1]*Quantum*

*Engineering Technology Labs, Univ. of Bristol, UK; [2]Quantum Engineering Centre for Doctoral Training, Univ. of Bristol, UK.* We present plans for performing continuous variable distributed quantum sensing on a silicon photonic chip. Linear functions of four integrated phase shifters will be measured with entanglement enhanced precision.

**QTu3A.45**
**Bidirectional Quantum Control,** Dominik Vasinka[1], Martin Bielak[1], Michal Neset[1], Miroslav Jezek[1]; *[1]Palacký Univ. Olomouc, Czechia.* We demonstrate a new method for optimal bidirectional control of complex physical systems. Employing a set of collaborative neural networks, our approach exhibits unprecedented accuracy, even at the single-photon level.

**QTu3A.46**
**Optimization of Entangled Two-Photon Absorption Experiments Based on Semi-Empirical Approach With Accessible Chemical Properties of Fluorescence Dyes,** Tobias B. Gäbler[1,2], Aleksa Krstić[2], Nitish Jain[1], Valerio Flavio Gili[1], Sina Saravi[2], Frank Setzpfandt[2,1], Markus Gräfe[3,1]; *[1]Fraunhofer Inst. for Applied Optics and Precision Engineering IOF, Germany; [2]Inst. of Applied Physics, Friedrich-Schiller Univ., Germany; [3]Inst. of Applied Physics, Technical Univ. of Darmstadt, Germany.* Studies on entangled two-photon absorption often do not show proof of fluorescence emission. Also, theoretical predictions for specific dyes are missing. We introduce a semi-empirical approach based on accessible chemical properties to optimize experimental investigations.

**QTu3A.47**
**Dual Pump Wavelength Frequency-Domain Optical Coherence Tomography With Undetected Mid-Infrared Photons,** Rajshree Swarnkar[1,2]; *[1]Technical Univ. of Darmstadt, Germany; [2]Department of Physics, Friderich Alexander Universität, Germany.* We implement a mid-infrared optical coherence tomography in a nonlinear optical interferometer using two different pump wavelengths for spontaneous parametric down conversion to enhance its axial resolution for the depth scans of highly scattering materials.

**QTu3A.48**
**Unbalanced Interferometer Beyond Coherence Length by Amplitude Measurement,** Yunxiao Zhang[1], Xuan Tang[2], Xueshi Guo[1], Cui Liang[1], Xiaoying Li[1], Z.Y. Ou[2]; *[1]TianJin Univ., China; [2]Department of Physics, City Univ. of Hong Kong, Hong Kong.* We report the recovery of interference in an interferometer with path imbalance well beyond coherence length of the input field. This is achieved by direct amplitude measurement via homodyne detection.

**QTu3A.49**
**Super-Resolution Imaging via Photon Enumeration (S-RIPE),** Ivan A. Burenkov[1,2], Alexandra Semionov[2], Sergey V Polyakov[2]; *[1]Joint Quantum Inst., USA; [2]NIST, USA.* We experimentally demonstrate super-resolution of up to 5 overlapping thermal optical modes using the passive supper-resolution technique. The experimental precision of source localization is more than ten times better than the diffraction limit.

**QTu3A.50**
**Optimal Control Pulse Design for Raman Light-Pulse Atom Interferometry,** Timothy Freegarde[1], Nikolaos Dedes[1], Jack C. Saywell[1,2], Max Carey[1,3], Ilya Kuprov[1]; *[1]Univ. of Southampton, UK; [2]Q-CTRL, Australia; [3]Aquark Technologies, UK.* We show how optimal

control 'beam-splitter' and 'mirror' pulses improve various aspects of the performance of light-pulse atom interferometers, in which different atoms see different laser intensities and experience different Doppler shifts.

**QTu3A.51**
**Qubit-Qutrit Correlations Under Modulated Interactions,** Atta U. Rahman[1], Cong-Feng QIao[1,2]; [1]*School of Physical Sciences, Univ. of Chinese Academy of Sciences, China;* [2]*Key Laboratory of Vacuum Physics, Univ. of Chinese Academy of Sciences, China.* We address the enhancement of quantum correlations by modulating the spin exchange and magnetic field by standing waves and Josephson junction in a mixed-spin model. The resultant dynamical maps reveal intricate dependencies between physical parameters, associated modulations, and quantum correlations.

**QTu3A.52**
**Quantum Secured-Imaging Using Decoy State Heralded Single Photon Source,** Siddhant A. Vernekar[1], Jolly Xavier[1]; [1]*Indian Inst. of Technology Delhi, India. Considering a low mean photon number regime, we make a comparative analysis investigating the superior performance of decoy state heralded single photon source, making it ideal choice for integrating QKD protocols for secure quantum imaging.*

**QTu3A.53**
**Continuous-Variable Nonclassicality Certification Under Coarse-Grained Measurement,** Chan Roh[1], Young-Do Yoon[1], Jiyong Park[2], Young-Sik Ra[1]; [1]*Department of Physics, Korea Advanced Inst. of Science and Technology, Korea (the Republic of);* [2]*School of Basic Sciences, Hanbat National Univ., Korea (the Republic of).* We experimentally certify the nonclassicality of continuous-variable quantum states under coarse-grained measurement. Furthermore, we show that the coarse-grained measurement generally outperforms the ideal fine-grained measurement in nonclassicality detection.

**QTu3A.54**
Withdrawn

**QTu3A.55**
Withdrawn

**QTu3A.56**
Withdrawn

### 16:00 -- 18:00
### Room: Rotterdam Hall 2
### QTu4A • Interconnects / Transduction

*Presider: Andreas Reiserer, Technische Universität Munchen, Germany*

**QTu4A.1 • 16:00 (Invited)**

**Entanglement and Readout of Superconducting Circuits With Light,** Johannes Fink[1]; *[1]Inst. of Science and Technology Austria (ISTA), Austria.* Using a resonant electro-optic interconnect we demonstrate ultra-low noise wavelength conversion, entanglement of microwave and optical fields, and an all-optical superconducting qubit readout that does not require cryogenic microwave components.

**QTu4A.2 • 16:30**

**Microwave-Optical Transduction Using High Overtone Bulk Acoustic Resonators on Silicon Nitride Photonics,** Terence A. Blesin[1], Wil Kao[1], Anat Siddharth[1], Rui Ning Wang[1], Alaina Attanasio[2], Hao Tian[2], Sunil Bhave[2], Tobias Kippenberg[1]; *[1]EPFL, Switzerland; [2]Purdue Univ., USA.* Integrating aluminum nitride piezoelectric actuators on silicon nitride photonic circuits realizes bidirectional conversion between microwave S- and optical C-bands. On-chip generation of microwave pulses through down-conversion suggests potential as photonic interconnect for cryogenic circuits.

**QTu4A.3 • 16:45**

**A two-Dimensional Optomechanical Crystal for Quantum Transduction,** Felix Mayor[1], Sultan Malik[1], André G. Primo[1,2], Samuel Gyger[1], Wentao Jiang[1], Thiago Alegre[2], Amir Safavi-Naeini[1]; *[1]Applied Physics and Ginzton Laboratory, Stanford Univ., USA; [2]Applied Physics, Universidade Estadual de Campinas, Brazil.* Optomechanical crystals are a promising platform for scalable quantum information processing. Current experiments for microwave-to-optical transduction remain limited by laser-induced heating. Here we present a qubit-compatible two-dimensional optomechanical crystal displaying improved thermal anchoring.

**QTu4A.4 • 17:00**

**A Microwave-to-Optical Transducer Based on a Two-Dimensional Optomechanical Crystal,** Felix Mayor[1], Sultan Malik[1], Andre Primo[1,2], Samuel Gyger[1], Oliver Hitchcock[1], Kevin Multani[1], Wentao Jiang[1], Thiago Alegre[2], Amir Safavi-Naeini[1]; *[1]Stanford Univ., USA; [2]Univ. of Campinas, Brazil.* Microwave-to-optical frequency converters have been plagued by added noise caused by heating from the pump laser. We present our efforts on mitigating this heating by implementing a piezo-optomechanical transducer based on a two-dimensional optomechanical crystal.

**QTu4A.5 • 17:15**

**Dual Approaches for the Development of Robust, Scalable, Ultra-low-Noise Quantum Frequency Converters for NV Center Qubits,** Florian Elsen[1,2], Bernd Jungbluth[1], Jan Fabian Geus[1], Hans Huber[1], Ludwig Hollstein[1], Constantin Häfner[1,2]; *[1]Fraunhofer ILT, Germany; [2]Chair for Laser Technology LLT, RWTH Aachen, Germany.* Quantum Frequency Converters (QFC) are key components for quantum networks, ensuring interconnectivity over large distances and in hybrid systems. We present two approaches for NV center QFC with highest-performance and the potential for commercialization.

**QTu4A.6 • 17:30 (Invited)**
Withdrawn.

**16:00 -- 18:00**
**Room: Mees I**
**QTu4B • Quantum Network II**
*Presider: Mikael Afzelius, Universite de Geneve, Switzerland*

**QTu4B.1 • 16:00**
**Uplink Simulation for Entanglement-Based Satellite Communication,** Alex Pickston[1], Thomas Jaeken[1], Faris Redza[1], Joseph Ho[1], Alessandro Fedrizzi[1]; *[1]Heriot-Watt Univ., UK.* We report on an entanglement-based uplink test, simulating the overpass of a satellite. We set up a far-non-degenerate entangled photon source, simultaneously distributing photons optimised for both satellite and fibre-based channels.

**QTu4B.2 • 16:15**
**Multipartite Remote Entanglement of Single Rare-Earth Ions,** Chun-Ju Wu[1], Andrei Ruskuc[1], Emanuel Green[1], Sophie Hermans[1], Joonhee Choi[2], Andrei Faraon[1]; *[1]Caltech, USA; [2]Stanford, USA.* We develop protocols that can entangle remote, optically distinguishable qubits in a way that's robust to optical spectral diffusion. We demonstrate bipartite and tripartite entanglement of single rare-earth ions distributed between two separate nanophotonic cavities.

**QTu4B.3 • 16:30**
**Remote Entanglement Between Solid-State Quantum Memories,** Jonathan Hänni[1], Alberto Rodriguez-Moldes Sebastian[1], Felicien Appas[1], Soeren Wengerowsky[1], Markus Teller[1], Samuele Grandi[1], Hugues de Riedmatten[1,2]; *[1]ICFO, Spain; [2]ICREA, Spain.* We report our progress towards the demonstration of telecom-heralded matter-matter entanglement between solid-state, on-demand and remote quantum memories based on rare-earth—doped crystals.

**QTu4B.4 • 16:45**
**Experiment for Entanglement Distribution Between Pr-Doped $Y_2SiO_5$ Crystals With an Optical Frequency Comb,** Koji Nagano[1], Tomoki Tsuno[1,2], Daisuke Yoshida[1,2], Riku Sasaki[2], Hiroki Tateishi[2], Daisuke Akamatsu[2], Feng-Lei Hong[2], Tomoyuki Horikiri[1,2]; *[1]LQUOM, Inc., Japan; [2]Department of Physics, Yokohama National Univ., Japan.* For long-distance quantum communication, low-loss photon transmission and remote frequency synchronization systems are required. We perform an entanglement distribution experiment with 1550-nm idler photons and an optical-frequency-comb-assisted frequency synchronization system.

**QTu4B.5 • 17:00**
**Distributed Blind Quantum Computing With a Two-Node Quantum Network,** Pieter-Jan C. Stas[2], Yan-Cheng Wei[2], Aziza Suleymanzade[2], Gefen Baranes[1], Can Knaut[2], Yan Qi Huan[2], Erik Knall[3], Kelly Werker-Smith[2], Francisco Machado[4], Madison Sutula[2], Daniel Assumpcao[3], Moritz Merz[2,5], Hongkun Park[6], Marko Loncar[3], Mikhail Lukin[2]; *[1]Department of Physics and Research Laboratory of Electronics, Massachusetts Inst. of Technology, USA; [2]Department of Physics, Harvard Univ., USA; [3]John A. Paulson School of Engineering and Applied Sciences, Harvard Univ., USA; [4]ITAMP, Harvard-Smithsonian Center for Astrophysics, USA; [5]Department of Physics, ETH, Switzerland; [6]Department of Chemistry and Chemical Biology, Harvard Univ.,*

*USA.* We show progress towards the experimental demonstration of distributed blind quantum computing using a two node quantum network of Silicon-Vacancy (SiV) centres in diamond nanocavities.

**QTu4B.6 • 17:15**
**Quantum Network Operations Over the Saarbrücken Telecom Fiber Link,** Christian Haen[1], Stephan Kucera[1], Elena Arenskötter[1], Jonas Meiers[1], Tobias Bauer[1], Christoph Becher[1], Jürgen Eschner[1]; *[1]Universität des Saarlandes, Germany.* We report on the implementation of quantum entanglement distribution and quantum teleportation over a 14km polarization-stabilized telecom fiber link in Saarbrücken, using an SCPD photon pair source and a single trapped $^{40}Ca^{+}$ ion.

**QTu4B.7 • 17:30**
**Towards a Long Distance Memory Assisted Quantum Repeater,** Chase Wallace[1], Tsering Lodhen[1], Leonardo Castillo-Veneros[1], Anthony Del Valle[1], Dounan Du[1], Samuel Woronick[2], Dimitrios Katramatos[2], Julian Martinez-Rincon[2], Sonali Gera[1], Eden Figueroa[1,2]; *[1]Department of Physics and Astronomy, Stony Brook Univ., USA; [2]Brookhaven National Laboratory, USA.* We report our progress towards performing memory-assisted entanglement swapping using deployed fiber in a five-node 259 km network testbed. Our quantum repeater testbed is envisioned to push beyond the PLOB boundary of repeaterless networks.

**16:00 -- 18:00**

**Room: Mees II**
**QTu4C • Quantum Imaging**
*Presider: Marco Barbieri, Universita degli Studi Roma Tre, Italy*

**QTu4C.1 • 16:00 (Invited)**
**Quantum Parameter Estimation Without Parameters,** Marco Barbieri[1]; [1]*Universita degli Studi Roma Tre, Italy.* Quantum parameter estimation relies on 'statistical models' assuming perfect knowledge of the channel. We discuss techniques relaxing this assumption and their optical implementation. This opens perspectives for secure quantum estimation.

**QTu4C.2 • 16:30**
**Quantum Imaging With Undetected Photons: Single-Frame Complex Image Reconstruction Using Off-Axis Holography,** Emma Pearce[2,1], Osian Wolley[2], Simon Mekhail[2], Thomas Gregory[2], Nathan Gemmell[1], Rupert Oulton[1], Alex Clark[3], Chris Phillips[1], Miles Padgett[2]; [1]*Blackett Laboratory, Department of Physics, Imperial College London, UK;* [2]*School of Physics and Astronomy, Univ. of Glasgow, UK;* [3]*Quantum Engineering Technology Labs, H. H. Wills Physics Laboratory and Department of Electrical and Electronic Engineering, Univ. of Bristol, UK.* We demonstrate single-frame reconstruction of infrared transmission and phase images using a silicon camera, by applying off-axis holography to quantum imaging with undetected photons. This enables single-frame, video-rate infrared imaging with visible detection.

**QTu4C.3 • 16:45**
**Optimized OCT With Undetected Photons Based on an Integrated Waveguide PDC Source,** Franz H. Roeder[1], René Pollmann[1], Michael Stefszky[1], Victor Quiring[1], Raimund Ricken[1], Christof Eigner[1], Benjamin Brecht[1], Christine Silberhorn[1]; [1]*Integrated Quantum Optics, Inst. for Photonic Quantum Systems (PhoQS), Paderborn Univ., Germany.* We present the experimental realization of an optical coherence tomography scheme with undetected photons using a nonlinear waveguide in an SU(1,1)-interferometer. A differential pumping scheme is investigated and incorporated to optimize the measured interferograms.

**QTu4C.4 • 17:00**
**Mid-IR Hyperspectral Imaging With Undetected Photons,** Marlon Placke[1], Chiara Lindner[2], Felix Mann[1], Inna Kviatkovsky[1], Helen M. Chrzanowski[3], Frank Kühnemann[2], Sven Ramelow[1]; [1]*Humboldt Universität zu Berlin, Germany;* [2]*Fraunhofer Inst. for Physical Measurement Techniques IPM, Germany;* [3]*Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR), Germany.* By combining a nonlinear interferometer in imaging-mode with Fourier-transform spectroscopy, we realize broadband mid-infrared hyperspectral acquisition with undetected photons. We demonstrate the novel imaging technique on polymer and bio-tissue samples using only near-infrared silicon-based cameras.

**QTu4C.5 • 17:15**
**Non-Interferometric Quantitative Phase Imaging Enhanced by Quantum Correlations,** Alberto Paniate[1,2], Giuseppe Ortolano[2], Pauline Boucher[2], Carmine Napoli[2], Sarika Soman[3], Silvania Pereira[3], Ivano Ruo Berchera[2], Marco Genovese[2]; [1]*Politecnico di Torino, Italy;* [2]*INRIM, Italy;* [3]*Delft Univ. of Technology, Netherlands.* We exploit quantum correlations to enhance

quantitative phase retrieval of an object in a non-interferometric setting, only measuring the propagated intensity pattern after interaction with the object.

**QTu4C.6 • 17:30**

**Simultaneous Quantum Imaging and Spectroscopy With Undetected Photons,** Vasile-Laurentiu Dosan[1,2], Adrià Sansa Perna[1], Marta Gilaberte Basset[3], Sebastian Töpfer[4], Oliver de Vries[1]; *[1]Quantum Optics Jena GmbH, Germany; [2]Abbe Center of Photonics, Friedrich Schiller Univ. Jena, Germany; [3]Fraunhofer Inst. for Applied Optics and Precision Engineering IOF, Germany; [4]Inst. of Applied Physics, Technical Univ. of Darmstadt, Germany.* We report a scheme for simultaneous quantum imaging and spectroscopy with undetected photons for low-cost IR sensing. Using curved mirrors and SPDC spatial filtering, we improve fiber-coupled visibility and minimize optical aberrations and system dimensions.

**QTu4C.7 • 17:45**

**Superconducting Single-Photon Camera for Quantum State Tomography,** Pierre J. Brosseau[1], Anton N. Vetlugin[1], Giorgio Adamo[1], Shuyu Dong[1], Cesare Soci[1]; *[1]Nanyang Technological Univ., Singapore.* We report our progress in designing and fabricating a quantum-state tomography camera operating at a single-photon level, based on superconducting nanowire metamaterials single-photon detectors with polarization selectivity.

## Wednesday, 26 June

### 08:30 -- 10:30
### Room: Rotterdam Hall 2
### QW1A • Keynote Session III

*Presider: Hugues de Riedmatten, ICFO - Institut de Ciencies Fotoniques, Spain*

**08:30 (Keynote)**

**Towards a Quantum Internet,** Stephanie Wehner[1]; *[1]Technische Universiteit Delft, Netherlands.* The Quantum Internet Alliance (QIA) is on a mission to realize a full stack prototype network that has the potential to become the first of its kind in the world. This talk will introduce QIA, including recent highlights. A specific focus will be the demonstration of a quantum network operating system that allows quantum networks to be programmed in high-level platform independent software.

### 10:30 -- 12:30
### Room: Rotterdam Hall 2
### QW2A • Down Conversion Sources

*Presider: Laura Padberg, Universität Paderborn, Germany*

**QW2A.1 • 10:30 (Invited)**

**Advanced Quantum Detectors via Advanced Quantum Trickery,** Paul Kwiat[1]; *[1]Univ of Illinois at Urbana-Champaign, USA.* One advantage of correlated photons from nonlinear processes is that they can have very wide spectra and very narrow time correlations. However, the value of these is lessened if not lost altogether because of detector limitations. Here we will describe our progress on some new ideas to improve detector performance. Well, newish.

**QW2A.2 • 11:00**

**Demonstration of a Squeezed Light Source on Thin-Film Lithium Niobate Without Periodic Poling,** Tummas Napoleon Arge[1], Seongmin Jo[2,3], Huy Nguyen[1], Francesco Lenzini[3], Jens Arnbak Holbøll Nielsen[1], Wolfram Pernice[2,3], Jonas Schou Neergaard-Nielsen[1], Tobias Gehring[1], Ulrik L. Andersen[1]; *[1]Technical Univ. of Denmark, Denmark; [2]Kirchoff-Inst. of Physics, Heidelberg Univ., Germany; [3]Inst. of Physics, Univ. of Münster, Germany.* Squeezed quantum states are the fundamental building block for continuous-variable quantum computing. We demonstrate a squeezed light source on an integrated LNOI platform with a shot noise reduction of 0.5 dB without periodic poling.

**QW2A.3 • 11:15**

**Hybrid III-v/Silicon Photonic Circuits Embedding Generation and Routing of Entangled Photon Pairs,** Lorenzo Lazzari[1,3], Jérémie Schuhmann[1,2], Aristide Lemaître[2], Maria I. Amanti[1], Frédéric Boeuf[3], Fabrice Raineri[4,2], Florent Baboux[1], Sara Ducci[1]; *[1]Laboratoire Matériaux et Phénomènes Quantiques, Université Paris Cité, France; [2]Centre de Nanosciences et Nanotechnologies, Université Paris-Saclay, France; [3]STMicroelectronics, Technology & Design Platform, France; [4]Institut de Physique de Nice, Université Côte d'Azur, France.* We demonstrate a hybrid AlGaAs/Silicon quantum photonic device combining the strong second-order nonlinearity and compliance with electrical pumping of the III-V semiconductor platform with the high maturity and CMOS compatibility of the silicon photonic circuitry.

**QW2A.4 • 11:30**

**Spectrally Separable Polarization Entanglement Source for Multiphoton Quantum Networking,** Michael B. Grayson[2], Shawn Meyer[4,2], Daniel Sorensen[4,2], Markus Allgaier[3,1], Nicholas Nardelli[2], Tara Fortier[2], Dileep Reddy[2,1], Martin Stevens[2], Michael Mazurek[1,2], Juliet T. Gopinath[1,4], Lynden K. Shalm[2,4]; *[1]Physics, Univ. of Colorado at Boulder, USA; [2]Applied Physics, National Inst. of Standards and Technology, USA; [3]Department of Physics and Astrophysics, Univ. of North Dakota, USA; [4]Electrical Computer and Energy Engineering, Univ. of Colorado, USA.* We present an SPDC-based photon pair source utilizing an apodized ppKTP crystal to achieve a near-ideal Schmidt number of 1.0032 ± 0.0005, indicating spectrally pure photon pairs, essential for multiphoton quantum communication systems.

**QW2A.5 • 11:45**

**A Highly Pure and Efficient Source of Telecom-Compatible Single Photons Based on Cavity-Enhanced SPDC,** Xavier Barcons Planas[1,2], Helen M. Chrzanowski[2], Leon Messner[2], Janik Wolters[2,3]; *[1]Humboldt-Universität zu Berlin, Germany; [2]German Aerospace Center, Germany; [3]Technische Universität Berlin, Germany.* Photonic quantum technologies require highly efficient sources of pure single photons. Utilizing pulsed spontaneous parametric down-conversion in a monolithic cavity, we demonstrate a source of pure single-photons with 85% heralding efficiency.

**QW2A.6 • 12:00**

**Automated Quantum State Tomography of Four Bell States Generated by Compact SPDC Source,** Sondos Elsehimy[1], Khaled Khallaf[1], Hussein Kotb[2], Salem Hegazy[3], Haitham A. Omran[1]; *[1]Laboratory of Micro Optics, German Univ. in Cairo, Egypt; [2]ECE, Faculty of Engineering, Ain Shams Univ., Egypt; [3]National Inst. of Laser Enhanced Sciences, Cairo Univ., Egypt.* The high fidelity of the four maximally entangled two-photon states, generated by a compact type-I SPDC source, is verified using automated quantum state tomography system.

**QW2A.7 • 12:15**

**Spatiotemporal Description of Non-Linear Interference Based on Cascaded Spontaneous Parametric Down-Conversion,** Carlos A. Sevilla[1], Fabian Steinlechner[1], Purujit Chauhan[1]; *[1]Fraunhofer Inst. for Applied Optics, Germany.* We study and experimentally demonstrate the full spatiospectral non-linear interference of cascaded SPDC sources using a spectrally dependent Laguerre-Gaussian basis and an arbitrary mode dependent transformation performed by the optical system.

**10:30 -- 12:30**
**Room: Mees I**
**QW2B • Quantum Networks III**
*Presider: Taofiq Paraiso, Toshiba Europe Ltd, UK*

**QW2B.1 • 10:30 (Invited)**

**Photonic Quantum Technologies: From Unravelling Quantum Foundations to Advancing Quantum Integration and Developing Applications in Quantum Networks and Computing,** Stefanie Barz[1,2]; *[1]Univ. of Stuttgart, Germany; [2]Center for Integrated Quantum Science and Technology, Germany.* I will explore various facets of photonic quantum systems and applications in quantum technologies: quantum interference, a key element in quantum technologies, photonic quantum computing, and both hardware aspects and applications of photonic quantum networks.

**QW2B.2 • 11:00**

**Photonic Quantum Networks Reveal the Nonlocal Nature of Bell-Local States,** Luis Villegas Aguilar[1], Emanuele Polino[1], Farzad Ghafari[1], Marco Túlio Quintino[2], Kiarn T. Laverick[1], Ian R. Berkman[3], Sven Rogge[3], Lynden K. Shalm[4], Nora Tischler[1], Eric G. Cavalcanti[1], Sergei Slussarenko[1], Geoff J. Pryde[1]; *[1]Griffith Univ., Australia; [2]Sorbonne Université, France; [3]Univ. of New South Wales, Australia; [4]National Inst. of Standards and Technology, USA.* Bell nonlocality, a fundamental resource for device-independent technologies like quantum key distribution, is highly susceptible to noise. We experimentally demonstrate that single copies of Bell-local states exhibit nonlocality when integrated into a photonic quantum network.

**QW2B.3 • 11:15**

**Fully Programmable Quantum Interference of Squeezed States via Frequency Conversion,** Patrick Folge[1], Abhinandan Bhattacharjee[1], Michael Stefszky[1], Sebastian Lengeling[1], Raimund Ricken[1], Benjamin Brecht[1], Christine Silberhorn[1]; *[1]Integrated Quantum Optics, Inst. for Photonic Quantum Systems (PhoQS), Paderborn Univ., Germany.* We experimentally demonstrate fully programmable interference of multiple squeezed states in a frequency bin network by utilizing a engineered frequency conversion process. This offers a scalable approach towards large multi-port quantum state interferometers.

**QW2B.4 • 11:30**

**Towards Efficient Detection of Multidimensional Single-Photon Time-bin Superpositions,** Adam Widomski[1], Maciej M. Ogrodnik[1], Michal Karpinski[1]; *[1]Uniwersytet Warszawski, Poland.* We show that multidimensional time-bin superpositions can be detected using a single time-resolved photon detector with the Talbot effect. The results will enable resource-efficient quantum communication.

**QW2B.5 • 11:45**

**Multi-Color Continuous Variables Unconditional Quantum Teleportation: From Near-Infrared to Telecommunications' L-Band,** Felipe L. Gewers[1,2], Gabriel Borba[1], Beatriz Moura[1], Tulio Brasil[6], Rayssa Bruzaca de Andrade[4], Renné L. Medeiros de Araújo[3], Igor Konieczniak[5], Paulo Nussenzveig[1], Marcelo Martinelli[1]; *[1]LMCAL - Inst. of Physics, Univ. of São Paulo, Brazil; [2]Nonlinear Quantum Optics - Department of Physics, Humboldt Univ. of Berlin, Germany; [3]Department of Physics, Federal Univ. of Santa Catarina, Brazil; [4]Center for Macroscopic Quantum States bigQ - Department of Physics, Technical Univ. of Denmark, Denmark; [5]Department of Physics, Federal Univ. of Paraná, Brazil; [6]Niels Bohr Inst., Univ. of Copenhagen, Denmark.* We demonstrate an unconditional quantum teleportation system between near-infrared (793nm) and telecommunications' L-band (1616nm). For a coherent input state, a fidelity of 56.2(5)% was achieved, violating the classical limit by more than twelve standard deviations.

**QW2B.6 • 12:00**

**Photon Quantum Interference for Quantum Position Verification With Four Detectors,** Kirsten Kanneworff[1], Petr Steindl[1], Mio Poortvliet[1], Wolfgang Löffler[1]; *[1]Leiden Univ.,*

*Netherlands.* We show a first proof of concept experiment of quantum position verification using single photons produced 1 µs apart in a quantum-dot cavity-QED system.

**QW2B.7 • 12:15**
**A Long-Distance Two-Node Quantum Network With Silicon Vacancies in Diamond Nanocavities,** Yan-Cheng Wei[1], Can Knaut[1], Aziza Suleymanzade[1], Daniel Assumpcao[2], Pieter-Jan C. Stas[1], Yan Qi Huan[1], Bartholomeus Machielse[3], Erik Knall[2], Madison Sutula[1], Gefen Baranes[4], Neil Sinclair[2], Chawina De-Eknamkul[3], David Levonian[3], Mihir Bhaskar[3], Hongkun Park[5], Marko Loncar[2], Mikhail Lukin[1]; *[1]Department of Physics, Harvard Univ., USA; [2]John A. Paulson School of Engineering and Applied Sciences, John A. Paulson School of Engineering and Applied Sciences, Harvard Univ., USA; [3]AWS Center for Quantum Networking, USA; [4]Massachusetts Inst. of Technology, USA; [5]Department of Chemistry and Chemical Biology, Harvard Univ., USA.* A key challenge in realizing long-distance quantum networks involves entanglement between memory nodes via existing fiber infrastructure. Here, we demonstrate a two-node quantum network based on Silicon Vacancy defect centers in diamond nanophotonic cavities integrated with a metropolitan telecommunication fiber network.

**10:30 -- 12:30**
**Room: Mees II**
**QW2C • Superconducting QC**
*Presider: Johannes Fink, California Institute of Technology, USA*

**QW2C.1 • 10:30 (Invited)**
**Next Generation Superconducting Qubits,** Vladimir Manucharyan[1]; *[1]Univ. of Maryland, USA.* Constructing large-scale qubit systems requires, among other things, improving individual qubits. In case of superconducting technology, most systems are based on transmon qubits. Here we review latest progress in improving gate fidelity in single (F > 0.9999) and two-qubit (F > 0.999) devices based on fluxonium qubits..

**QW2C.2 • 11:00**
**Optical Readout of a Superconducting Qubit Using a Scalable Piezo-Optomechanical Transducer,** Pim Duivestein[3], Thierry van Thiel[3], Matthew Weaver[3], Federico Berto[3], Mathilde Lemang[3], Kiki Schuurman[3], Martin Zemlicka[3], Frederick Hijazi[3], Alexandra Bernasconi[3], Ella Lachman[1], Mark Field[1], Yuvraj Mohan[1], Fokko de Vries[2], Niels Bultink[2], Jules van Oven[2], Josh Mutus[2], Robert Stockill[3], Simon Groeblacher[3]; *[1]Rigetti Computing, Inc., USA; [2]Qblox B.V., Netherlands; [3]Qphox B.V., Netherlands.* Cryogenic systems will soon limit the scalability of superconducting qubit processors. To alleviate this bottleneck different control and readout methods are required. We demonstrate optical readout of a transmon qubit using a piezo-optomechanical transducer.

**QW2C.3 • 11:15**
**Quasiparticle Dynamics in a Superconducting Qubit Irradiated by a Localized Infrared Source,** Rodrigo da Silva Benevides[1], Maxwell Drimmer[1], Giacomo Bisson[1], Francesco Adinolfi[1], Uwe von Lüpke[1], Hugo M. Doeleman[1], Gianluigi Catelani[2,3], Yiwen Chu[1]; *[1]ETH Zurich, Switzerland; [2]Forschungszentrum Jülich, Germany; [3]Technology Innovation Inst. Abu Dhabi, United Arab Emirates.* We systematically study the properties of a transmon qubit under illumination by focused infrared radiation with various powers, durations, and spatial locations.

Our observations agree with a model of low-energy quasiparticle dynamics dominated by trapping.

**QW2C.4 • 11:30**
**Full Quantum Approaches to a Dispersive Transmission Line Using Josephson Junctions,** Yongjie Yuan[1], Michael Haider[1], Özüm Emre Asirim[1], Christian Jirauschek[1]; [1]*Technical Univ. of Munich, Germany.* We present two promising approaches that provide a full quantum description for the dissipation and thermal fluctuations in a dissipative-dispersive Josephson traveling-wave parametric amplifier, and highlight the advantages of both approaches.

**QW2C.1 • 11:45 (Invited)**
**Bidirectional Microwave-optical Conversion with a Triply Resonant Barium Titanate Transducer,** Paul Seidler[1]; [1]*IBM Research GmbH, Switzerland.* We present a monolithically integrated, bidirectional, electro-optic transducer comprising barium titanate ridge waveguides and a superconducting microwave circuit. The triply resonant device achieves an on-chip efficiency of >10-8 and a conversion bandwidth of 15 MHz.

### 14:00 -- 16:00
### Exhibits- Poster Area
### QW3A • Poster Session II

**QW3A.1**
**Single Photon Detection With Multipixel Superconducting Nanowire Single Photon Detectors,** Val Zwiller[1,2]; [1]*Kungliga Tekniska Hogskolan Kista, Sweden;* [2]*Single Quantum, Netherlands.* We present results obtained with multipixel SNSPD arrays that enable various applications such as spectroscopy and quantum communication.

**QW3A.2**
**Non-Degenerate Correlated SPDC Photon Source for UV-a Illumination,** Preetisha Goswami[1,2], Marta Gilaberte Basset[1,2], Jorge Fuenzalida[3], Markus Gräfe[3], Valerio Flavio Gili[1]; [1]*Fraunhofer IOF, Germany;* [2]*Friedrich-Schiller-Univ. Jena, Germany;* [3]*Inst. of Applied Physics, Technical Univ. of Darmstadt, Germany.* We present a correlated photon source consisting of a BBO nonlinear crystal that generates ultraviolet UV-A and infrared light via SPDC. Quantum imaging and sensing techniques can benefit from the correlations between the down-converted beams.

**QW3A.3**
Withdrawn

**QW3A.4**
**Germania Glass-Based Optical Fibers for mid-Infrared Single-Photon Sources,** Shruti Jain[1], Deepak Jain[1]; [1]*Optics and Photonics Centre, IIT Delhi, India.* We propose novel Germania-glass fibers exploiting FWM to produce single-photons in 2 to 3 µm range. The phase matching conditions at different wavelengths can be fulfilled by employing different modes for pump, signal, and idler.

**QW3A.5**
Withdrawn.

**QW3A.6**
**Characterization of Thermal Degraded Optical cat States by non-Gaussianity,** Po Han Wang[1], Ray-Kuang Lee[1]; [1]*National Tsing Hua Univ., Taiwan.* We apply the non-Gaussianity measure to degraded optical states, based on the Hilbert-Schmidt distance to thermal squeezed states, and reveal a counter-intuitive increase of non-Gaussianity when the coupled thermal states at a low average photon number.

**QW3A.7**
**Using Quantum Cheshire Cats to Explore Contextuality and Quantum Coherence,** Jonte R. Hance[2,1], Ming Ji[1], Holger Hofmann[1]; [1]*Hiroshima Univ., Japan;* [2]*School of Computing, Newcastle Univ., UK.* We analyse the quantum Cheshire cat using contextuality theory. The results shed a surprising new light on the relation between quantum paradoxes, weak values, and contextuality, a key resource for quantum computing.

**QW3A.8**
**Aperiodic Devices for Quantum Photonic Applications,** Oliver Trojak[1], Sean Gorsky[2], Fabrizio Sgrignuoli[2], Felipe Pinheiro[3], Jin Dong Song[4], Luca Dal Negro[2], Luca Sapienza[1]; [1]*Univ. of Cambridge, UK;* [2]*Boston Univ., USA;* [3]*Universidade Federal do Rio de Janeiro, Brazil;* [4]*KIST, Korea (the Republic of).* We experimentally show that aperiodic photonic devices, composed of free-standing GaAs membranes embedding single InAs/GaAs quantum dots, allow controlling the spontaneous emission of single photons, with lifetime modifications up to a factor 10.

**QW3A.9**
**Ultrafast Low-Jitter Photodetection and Broad Spectral Response in High-Temperature Superconducting Nanowires,** Ankit Kumar[1], Dmitry Panna[1], Shlomi Bouscher[1], Avi Koriat[1], Yuval Nitzav[1], Ronen Jacovi[1], Amit Kanigel[1], Alex Hayat[1]; [1]*Technion, Israel.* We demonstrate ultrafast optical response in high-$T_c$ YBCO-based nanowires. Our research demonstrates ~100 ps jitter, with rise and fall times of ~850 and ~1250 ps. Nanowires respond from visible to infrared, important for quantum optics.

**QW3A.10**
**Controlling All Degrees of Freedom of the Optical Coupling in Hybrid Quantum Photonics,** Niklas Lettner[1,2], Lukas Antoniuk[1], Anna Ovvyan[3,4], Viatcheslav Agafonov[5], Wolfram Pernice[3,4], Alexander Kubanek[1]; [1]*Insitut for Quantum Optics, Universitat Ulm, Germany;* [2]*Center for Integrated Quantum Science and Technology, Germany;* [3]*Kirchhoff-Inst. for Physics, Heidelberg Univ., Germany;* [4]*Inst. of Physics and Center for Nanotechnology, Univ. of Münster, Germany;* [5]*Greman, Tours Univ., France.* Combining emitters in nanodiamonds with silicon nitrid photonic crystal cavities in a hybrid quantum phonics enables control over all degrees of freedom of the optical coupling.

**QW3A.11**
**Interference of Bi-Photon Joint Spectral Amplitudes,** Inbar Hurvitz[1], Anatoly Shukhin[2], Leonid Vidro[2], Hagai Eisenberg[2], Ady Arie[1]; [1]*Tel Aviv Univ., Israel;* [2]*The Hebrew Univ., Israel.* We introduce a novel experimental technique to study the interference of bi-photon joint spectral

amplitudes, exploring new possibilities in quantum photonics. Our approach uniquely uncovers the intricate phase-dependent phenomena in entangled photon spectra.

**QW3A.12**

**Mid-IR and Telecom Bands Interconnection Through Direct Generation of Quantum Correlated Photons: an Integrated Silicon Photonics Route,** Abhishek K. Pandey[1], Deepak Jain[1], Catherine Baskiotis[2]; *[1]Indian Inst. of Technology Delhi, India; [2]L@bISEN, ISEN Nantes, France.* We propose a Silicon-On-Insulator waveguide for Four-Wave Mixing conversion of two pump photons at 2260 nm into a correlated photon pair with signal wavelength in the mid-IR band and idler wavelength in the C-band.

**QW3A.13**

**Implementation of Cryogenic Amplifier by Using Superconducting Nanowire Single Photon Detector,** Behnoosh Babaghorbani[1]; *[1]TU delft, Netherlands.* Measuring superconducting materials near absolute zero Kelvin poses challenges due to low output voltage. This study presents a cryogenic amplifier for ultra-low temperatures, fabricable on the same chip as the material, replacing noisy room temperature setups.

**QW3A.14**

**Optimization of Inhibited-Coupling Hollow-Core Fibers for Quantum Entangled Photon Source Platforms,** Lorenzo Rosa[1], Walter Belardi[2], Federico Melli[1], Annamaria Cucinotta[2], Luca Vincetti[1]; *[1]Univ degli Studi Modena e Reggio Emilia, Italy; [2]DIA, Univ. of Parma, Italy.* We present developments on generation platforms for correlated entangled photon pairs in gases using hollow-core inhibited-coupling optical fibers. Non-linear simulation on tube lattice fibers can be accomplished through innovative techniques based on fast analytical optimization.

**QW3A.15**

**SiN/ GaAs Quantum Photonic Platform With Efficient Fiber-Coupling,** Jasper De Witte[1,2], Zhe Liu[3,4], Atefeh Shadmani[3], Tom Vanackere[1,2], Tom Vandekerckhove[1,2], Gunther Roelkens[1,2], Claus Pedersen[4], Leonardo Midolo[3], Dries Van Thourhout[1,2], Bart Kuyken[1,2]; *[1]Photonics Research Group, Ghent Univ.-imec, Belgium; [2]Center for Nano- and Biophotonics (NB-Photonics), Ghent Univ., Belgium; [3]Center for Hybrid Quantum Networks, Niels Bohr Inst., Univ. of Copenhagen, Denmark; [4]SparrowQuantumApS, Denmark.* High requirements on quantum photonic experiments requires full integration of its building blocks. We integrated GaAs nanobeams embedded with InP quantum dots on SiN as well as SU8 spot size convertors for efficient fiber coupling.

**QW3A.16**

**Cooperative Emission From Multiple Remote Indistinguishable Quantum Dots,** Sheena Shaji[1]; *[1]Heriot-Watt Univ., UK.* We implement the use of spatial light modulators as a novel way to study cooperative emission between multiple quantum dots to achieve a scalable source of indistinguishable single photons for programmable quantum circuits.

**QW3A.17**

**Electron-Photon Entanglement Without Recoil,** Madlene Haddad[1], Offek Tziperman[1], Ron Ruimy[1], Ido Kaminer[1]; *[1]Technion, Israel.* We present a novel entanglement type between free electrons and photons that requires no recoil, hidden within the multimode nature of electron radiation. This discovery opens new avenues for creating desired states of quantum light.

**QW3A.18**

**Quantum Light Emission From Individual Colloidal 0D and 2D Nanocrystals,** Tingting Yin[1]; [1]*Nanyang Technology Univ., Singapore.* Novel single photon emission has been obtained from individual colloidal perovskite 0D quantum dots and CdSe 2D nanoplatelets, which shows almost blinking free properties and high single photon purity, thus promising as robust single-photon sources.

**QW3A.19**

**Metallic Nano-Rings for Enhanced Quantum Light Emission,** Cori Haws[1], Edgar Perez[2], Marcelo Davanco[2], Jin Dong Song[3], Kartik Srinivasan[2], Luca Sapienza[1]; [1]*Univ. of Cambridge, UK;* [2]*NIST, USA;* [3]*KIST, Korea (the Republic of).* By depositing metallic nano-rings on the surface of GaAs chips containing single InAs quantum dots, we show that single-photon extraction is increased, reaching fluxes as high as 7M photons/s, in a broadband, scalable device.

**QW3A.20**

**Fast Simulation of Spontaneous Parametric Down-Conversion via Neural Operators,** Dor Hay Shacham[1], Nativ Maor[1], Ben Halperin[1], Eyal Rozenberg[1,2], Alex Bronstein[1], Daniel Freedman[2]; [1]*Computer Science, Technion Israel Inst. of Technology, Israel;* [2]*Verily Research, Israel.* We present a learning approach to simulating Spontaneous Parametric Down-Conversion. Based on Fourier Neural Operators, the method is both fast and resolution independent. The learned operator is able to generalize well, successfully predicting physical observables.

**QW3A.21**

Withdrawn

**QW3A.22**

**Optimization of AlGaAs-Based Bragg-Reflection Waveguides for Entangled Photon Sources in Telecom C-Band,** Thorsten Passow[1], Quankui Yang[1], Vivienne Leidel[1], Robert Keil[1], Silvia Giudicatti[1], Marina Preschle[1], Elke Diwo-Emmer[1], Patrick Waltereit[1], Marko Härtelt[1]; [1]*Fraunhofer IAF, Germany.* We realized AlGaAs-based waveguides with reduced effective refractive index difference of TE and TM polarized modes which are promising for generation of entangled photons with high concurrence at high rate.

**QW3A.23**

**Superconducting Nanowire Single-Photon Detectors in Etchless BIC Waveguides,** Filippo Martinelli[1], Shuyu Dong[1], Mariia Sidorova[1], Cesare Soci[1]; [1]*Nanyang Technological Univ., Singapore.* We propose a new strategy to integrate superconducting nanowire single-photon detectors in etchless photonic circuits based on bound-states-in-the-continuum. We demonstrate the feasibility of this approach at cryogenic temperatures and report integrated detector with saturated efficiency.

**QW3A.24**
**Quantum Detector Tomography of $MgB_2$ Nanowire,** Mariia Sidorova[2,1], Alexei Semenov[1], Sergey Cherednichenko[3], Ilya Charaev[4], Anton N. Vetlugin[2], Cesare Soci[2], Heinz-Wilhelm Huebers[1,5]; [1]*German Aerospace Center (DLR), Germany;* [2]*Nanyang Technological Univ., Singapore;* [3]*Department of Microtechnology and Nanoscience, Chalmers Univ. of Technology, Sweden;* [4]*Univ. of Zurich, Switzerland;* [5]*Humboldt Univ. of Berlin, Germany.* We perform quantum detector tomography of a novel, unknown detector – superconducting magnesium diboride nanowire, and show that reconstructed POVM elements provide insights into underlying detection mechanism and multiphoton detection efficiencies.

**QW3A.25**
**Laser Induced Relaxation Oscillations in Superconducting Nanobridge Single Photon Detectors,** Frederik B. Baalbergen[1], Iman E. Zadeh[2], Michiel de Dood[1]; [1]*Huygens-Kamerlingh Onnes Laboratory, Universiteit Leiden, Netherlands;* [2]*Department of Imaging Physics, Delft Univ. of Technology, Netherlands.* We present the first observations of laser synchronised relaxation oscillations in superconducting nanowire single photon detectors. Understanding the thermal feedback behind these oscillations aids the development of photon number resolving and higher count rate detectors.

**QW3A.26**
**Optimizing Single-Mode Projection Techniques for High-Order Complex Spatial Modes,** Annameng Ma[1], Suraj Goel[1], Natalia Herrera Valencia[1], Will McCutcheon[1], Mehul Malik[1]; [1]*IPaQS, Heriot Watt Univ., UK.* Comparing effective manipulation of transverse-spatial modes of light through single and two plane phase modulations using a re-programmable multi-plane light conversion scheme (MPLC).

**QW3A.27**
**Cooperative Emission From Multiple Remote Indistinguishable Quantum Dots,** Sheena Shaji[1]; [1]*Heriot-Watt Univ., UK.* We implement the use of spatial light modulators as a novel way to study cooperative emission between multiple quantum dots to achieve a scalable source of indistinguishable single photons for programmable quantum circuits.

**QW3A.28**
Withdrawn.

**QW3A.29**
**Photon-Pair Generation in Ordered and Disordered Arrays of Nonlinear Nanoparticles,** Sergey Krasikov[1], Maximilian Weissflog[1,2], Thomas Pertsch[1,3], Frank Setzpfandt[1,3], Sina Saravi[1]; [1]*Inst. of Applied Physics, Abbe Center of Photonics, Friedrich Schiller Univ. Jena, Germany;* [2]*Max Planck School of Photonics, Germany;* [3]*Fraunhofer Inst. for Applied Optics and Precision Engineering, Germany.* We theoretically investigate photon-pair generation in planar arrays of point-like nonlinear sources, with periodic and disordered patterns. We investigate the pattern-dependent evolution of emission directionalities, and discover a regime for pattern-independent generation of polarization-entangled states.

**QW3A.30**
**Universal Control of Symmetric States Using Spin Squeezing,** Nir Gutman[1], Alexey Gorlach[1], Offek Tziperman[1], Ron Ruimy[1], Ido Kaminer[1]; [1]*Technion, Israel.* We present protocols

relying on coherent rotations and squeezing for the creation of arbitrary symmetric states. The obtained states can be further transferred to traveling photonic states via spontaneous emission, enabling engineered quantum light states.

**QW3A.31**
**Joint Spectral Characterization of Photon Pairs Generated in (Al)GaAs-on-Insulator Waveguides,** Alexandre Leger[1], Emil Z. Ulsig[2], Eric J. Stanton[4,3], Dileep Reddy[3], Nicolas Volet[2], Lynden K. Shalm[3], Martin Stevens[3], Deny R. Hamel[1], Richard Mirin[3]; *[1]Université de Moncton, Canada; [2]Department of Electrical and Computer Engineering, Aarhus Univ., Denmark; [3]National Inst. of Standards and Technology, USA; [4]EMode Photonix, USA.* We demonstrate spontaneous parametric downconversion in straight GaAs and AlGaAs-on-insulator waveguides, which yield a maximum pair generation rate of $1.2 \times 10^{10}$ $s^{-1}$ $mW^{-1}$, normalized to the pump power. The joint spectral intensity is directly measured via time-of-flight spectroscopy.

**QW3A.32**
**Improving and Benchmarking Photon-Number-Resolving Capabilities of Superconducting Nanowire Detectors,** Gregor Sauer[2,1], Mirco Kolarczik[3], Oskar Kohout[2,1], Rodrigo Gómez[2,1], Johanna Conrad[2,1], Fabian Steinlechner[2,1]; *[1]Fraunhofer IOF, Germany; [2]Inst. of Applied Physics, Friedrich Schiller Univ. Jena, Germany; [3]Swabian Instruments GmbH, Germany.* We show how ultra-high-resolution timing measurements of the rising and falling edges of electrical pulses generated from conventional superconducting nanowire detectors enable to distinguish photon numbers of up to 9 in a single-shot measurement.

**QW3A.33**
**Heterogeneous Integration of GaAs Waveguides With Silicon Nitride Photonic Integrated Circuits,** Atefeh Shadmani[1], Arnulf J. S. Nielsen[1], Martijn Heck[2], Nicolas Volet[2], Sven Scholz[3], Arne Ludwig[3], Andreas Wieck[3], Leonardo Midolo[1]; *[1]Niels Bohr Inst., Denmark; [2]ECE, Aarhus University, Denmark; [3]Bochum Univ., Germany.* The heterogeneous integration of GaAs waveguides with embedded quantum dots on a silicon nitride chip is presented. Efficient optical light coupling between the two waveguide layers is realized by designing a taper-based spot-size converter.

**QW3A.34**
**Metasurface Mediated Single Photon Emission Into Highly Entangled States,** S Kumar[1], Xujing Liu[1], Yinhui Kan[1], Liudmilla Kulikova[2], Valery Davydov[2], Viatcheslav Agafonov[3], Changying Zhao[4], Fei Ding[1], Sergey Bozhevolnyi[1]; *[1]Univ. of Southern Denmark (SDU), Denmark; [2]Russian Academy of Sciences, Russian Federation; [3]Université de Tours, France; [4]Shanghai Jiao Tong Univ., China.* Entanglement between orbital angular momentum states and polarization states of single photons is demonstrated experimentally. This is achieved by utilizing metasurfaces for channeling photons from single quantum emitters into highly entangled states.

**QW3A.35**
**Non-Hermitian Coupled Laser Arrays With Periodic Boundary Conditions,** Stefan C. Badescu[1], Jongheon Lee[2], Mercedeh Khajavikhan[2]; *[1]Air Force Research Laboratory, USA; [2]Ming Hsieh Department of Electrical and Computer Engineering, Univ. of Southern California, USA.* We model a chain of lasers with complex, asymmetric couplings and periodic boundaries.

The unidirectional couplers enable phase locking and generation of light with orbital angular momentum. We discuss also a monolithic non-Hermitian topological sensor.

**QW3A.36**

**Towards Quantum Readout of Time-Domain Physical Unclonable Keys,** Daan de Ruiter[1], M.C. Velsink[1], D.P. Stellinga[1], L. van der Hoeven[1], S. Marzban[1], P.W.H. Pinkse[1]; *[1]Univ. of Twente, Netherlands.* We report on the development of Physical Unclonable Keys made by in integrated photonics. Quantum readout of these keys for authentication is expected to be possible via standard telecom networks.

**QW3A.37**

**Alignment Sensitivity of Optical Microcavities With Finite-Size and Non-Spherical Mirrors,** William J. Hughes[1], Thomas H. Doherty[2], Jacob A. Blackmore[2], Joseph F. Goodwin[2], Peter Horak[1]; *[1]Optoelectronics Research Centre, Univ. of Southampton, UK; [2]Department of Physics, Univ. of Oxford, UK.* We study the losses and eigenmodes of Fabry-Pérot cavities with finite-size or non-spherical mirrors under transverse misalignment. We find complex patterns of resonances of elevated/reduced loss depending on mirror separation, alignment, and shape.

**QW3A.38**

**FPGA-Based Time-to-Digital Converter for Quantum Key Distribution With Continuous Calibration,** Matías R. Bolaños Wagner[1], Daniele Vogrig[1], Paolo Villoresi[1,2], Giuseppe Vallone[1,2], Andrea Stanco[1,2]; *[1]Department of Information Engineering, Univ. of Padova, Italy; [2]Padua Quantum Technologies Research Center, Univ. of Padova, Italy.* In this work, we introduce a scalable, multichannel FPGA-based time-to-digital converter design for quantum key distribution. Our approach includes a non-disruptive calibration scheme, enabling continuous data acquisition and enhancing system performance.

**QW3A.39**

**Neural Adjoint, Inverse Design for Arbitrary Unitary Matrix Recreation in Coupled Waveguide Arrays Using Programmable Phase Change Materials,** Thomas Radford[1], Peter Wiecha[2], Alberto Politi[1], Otto Muskens[1]; *[1]Univ. of Southampton, UK; [2]Université de Toulouse, France.* We present a deep learning adjoint network, demonstrating its use for the inverse design of refractive index perturbation patterns required to map an arbitrary unitary matrix onto a waveguide array using programmable phase change materials.

**QW3A.40**

Withdrawn

**QW3A.41**

**Volume Bragg Gratings for Atomic and Quantum Applications,** Alexei L. Glebov[1], Oleksiy Mokhun[1], Ruslan Vasilyeu[1], Vadim Smirnov[1]; *[1]OptiGrate - IPG Photonics, USA.* We demonstrate application of reflecting Volume Bragg Gratings (VBGs) as ultra-narrow band filters for longitudinal mode selection/cleaning of quantum light sources and highly dispersive chirped VBGs for efficient conversion of phase to amplitude modulation.

**QW3A.42**

**Joint Spectral Characterization of SOI Integrated Directional Coupler Using Hong-Ou-Mandel Interference,** Yoel Olivier[1], Dan Cohen[1], Leonid Vidro[1], Hagai Eisenberg[1], Matan

Slook[2], Mirit Hen[2], Avinoam Zadok[2]; *[1]Hebrew Univ. of Jerusalem, Israel; [2]Faculty of Engineering and Inst. for Nanotechnology and Advanced Materials, Bar-Ilan Univ., Israel.* We characterize the spectral response of a silicon chip integrated non-perfect directional coupler by measuring the biphoton joint spectrum at the Hong-Ou-Mandel dip and show the resulting spectral coupling dependency.

**QW3A.43**
**Polarization-Entangled Photon-Pair Generation in Thin-Film Lithium Niobate Waveguides,** Pawan Kumar[1], Sina Saravi[1], Thomas Pertsch[1,2], Frank Setzpfandt[1,2]; *[1]Friedrich-Schiller Univ. of Jena, Germany; [2]Fraunhofer Inst. for Applied Optics and Precision Engineering IOF, Germany.* Polarization-entangled photon-pair states are useful for quantum applications. Here, we propose generation of these states with controlled spectral properties using doubly periodically poled and dispersion-engineered thin-film lithium niobate (TFLN) ridge waveguides.

**QW3A.44**
**Resonant Avalanche Photodiodes Fabricated in a Silicon-on-Insulator Foundry Platform for Red and NIR Photo Detection,** James A. Miklaucich[1], Krishna C. Balram[1]; *[1]Univ. of Bristol, UK.* Two narrowband ($\lambda$ = 637 nm, $\lambda$ = 800 nm) SOI foundry-fabricated APDs are reported. In a first for this platform, a Guided Mode Resonance grating is used to enhance the absorptance by 16x.

**QW3A.45**
**AC Stark Effect in an Exciton-Polariton Condensate,** Sarit Feldman[1], Dmitry Panna[1], Nadav Landau[1], Sebastian Brodbeck[2], Sebastian Klembt[2], Christian Schneider[2], Sven Hoefling[2], Alex Hayat[1]; *[1]Technion Israel Inst. of Technology, Israel; [2]Universität Würzburg, Germany.* We report the first observation of the ac Stark modulation of the energy an exciton-polariton condensate by differential reflectivity measurement and coherent oscillations. Our results enable new quantum technologies and fundamental condensed matter research.

**QW3A.46**
**Fabrication, Characterisation and Prospects of a High-Finesse Microcavity Created From Tapered Fused Silica Substrates,** Chloe So[1], Thomas H. Doherty[1], Mark IJspeert[1], Jan Ole Ernst[1], Axel Kuhn[1]; *[1]Department of Physics, Univ. of Oxford, UK.* A cavity-based quantum node is a promising and fundamental resource for realising hybrid quantum computing. Here, we present the creation, benchmarking and current progress on a high-finesse Fabry–Pérot microcavity formed from tapered UV-fused silica substrates.

**QW3A.47**
**Miniaturized Diode Laser Modules for Operation in Quantum Experiments in Microgravity,** Martin Gärtner[1], Marcel Bursy[1], Stephanie Gerken[1], Nora Goossen-Schmidt[1], Jonas Hamperl[1], Sriram Hariharan[1], Janpeter Hirsch[1], Simon Kubitza[1], Christian Kürbis[1], Mathis Müller[1], Norbert Müller[1], Tamukanashe Musengezi[1], Max Schiemangk[1], Marvin Schilling[1], Christoph Tyborski[1], Dian Zou[1], Andreas Wicht[1]; *[1]Ferdinand-Braun-Institut (FBH), Germany.* We present our latest hybrid micro-integrated fiber-coupled diode laser modules intended for use in an $^{87}$Rb atom interferometer in microgravity. The ECDL-MOPA concept allows high optical power emissions with a narrow linewidth.

**QW3A.48**

**Higher-Order Counter-Propagating SPDC and a Complete Analysis of the Noise Spectrum of a Bulk PpKTP Quantum Frequency Converter,** Felix Mann[1], Helen M. Chrzanowski[1], Felipe Gewers[2], Marlon Placke[1], Sven Ramelow[1,3]; *[1]Humboldt Univ. of Berlin, Germany; [2]Instituto de Física, Universidade de São Paulo, Brazil; [3]IRIS Adlershof, Germany.* Pump-induced noise remains a bottleneck to the applicability of quantum frequency conversion to real-world quantum networking scenarios. Here, we investigate and decipher the different physical origins of noise in a bulk ppKTP quantum frequency converter.

**QW3A.49**

**Soliton Collision Dynamics in Multiple Coupled Quantum Well Structure,** Kritika Halder[2], Manoj Mishra[1], Shwetanshumala S[3], Soumendu Jana[4], Swapan Konar[2]; *[1]SciSER, Somaiya Vidyavihar Univ., India; [2]Physics, BIT-Mesra, India; [3]Physics, Patiliputra Univ., India; [4]SPMS, TIET, India.* The article investigates the impact of the probe and control beam on the propagation and collision dynamics of optical solitons in an MCQW structure incorporating giant higher-order nonlinearities by simulating the complex cubic-quintic Ginzburg-Landau equation.

**QW3A.50**

**Impact of Response Function on Modulation Instability of Nonlocal Optical Soliton,** Divya Yadav[1], Manoj Mishra[2], Brajraj Singh[1], Soumendu Jana[3]; *[1]MUST, India; [2]SciSER, SKSC, Somaiya Vidyavihar Univ., Mumbai, India; [3]SPMS, TIET, India.* The article elucidates the effects of different response functions on the modulation instability of nonlocal optical soliton by employing a linear stability method on the Nonlinear Nonlocal Schrödinger Equation.

**QW3A.51**

**Investigation of Multi-Pass Cells for Field-Widened Time-bin Interferometers,** Ramy Tannous[2], Thomas Jennewein[1]; *[1]Department of Physics & Astronomy, Univ. of Waterloo, Canada; [2]National Research Council, Canada.* We present the work of investigating the use of multi-pass cells for field-widened time-bin interferometers of long time delays.

**QW3A.52**

Withdrawn

**QW3A.53**

Withdrawn

**QW3A.54**

**L00L Entanglement and the Twisted Quantum Eraser,** Dylan Danese[1], Sabine Wollmann[1], Saroch Leedumrongwatthanakun[2], Will McCutcheon[1], Manuel Erhard[3], William Plick[4], Mehul Malik[1]; *[1]Heriot-Watt, UK; [2]Division of Physical Science, Prince of Songkhla Univ., Thailand; [3]Quantum Technology Laboratories, Austria; [4]Xanadu, Canada.* Demonstration of two-photon entanglement in the transverse Laguerre-Gaussian basis by performing a “twisted” quantum eraser. The state is generated using linear optics and measured using full state tomography with a fidelity up to 95.31%

**16:00 -- 18:30**
**Room: Rotterdam Hall 2**
**QW4A • Photonic QC**
*Presider: Heike Riel, IBM, Zurich, Switzerland*

**QW4A.1 • 16:00**
**High-Fidelity Quantum Information Processing With Machine Learning-Characterized Photonic Circuits,** Andreas Fyrillas[1,2], Olivier Faure[1], Nicolas Maring[1], Jean Senellart[1], Nadia Belabas[2]; *[1]Quandela, France; [2]C2N, France.* Photonic integrated circuits (PICs) are attractive platforms for manipulating quantum light. Imperfections limit the fidelity of photonically integrated quantum information protocols. We use machine learning and a clear box approach to characterize large PICs and mitigate imperfections, achieving high-fidelity for scalable implementations.

**QW4A.2 • 16:15**
**Photonic Quantum Extreme Learning Machine,** Alessia Suprano[1], Danilo Zia[1], Luca Innocenti[2], Salvatore Lorenzo[2], Valeria Cimini[1], Taira Giordani[1], Ivan Palmisano[3], Emanuele Polino[1,4], Nicolo' Spagnolo[1], Fabio Sciarrino[1], Gioacchino Massimo Palma[2], Alessandro Ferraro[2,5], Mauro Paternostro[3]; *[1]Sapienza Univ. of Rome, Italy; [2]Università degli studi di Palermo, Italy; [3]Queen's Univ. Belfast, Ireland; [4]Griffith Univ., Australia; [5]Università degli Studi di Milano, Italy.* We experimentally implemented a quantum extreme learning machine to reconstruct the polarization state of single photons. Our approach offers a resource-efficient method that does not require a detailed apparatus calibration.

**QW4A.3 • 16:30**
**Experimental Photonic Quantum Computation With High-Dimensional Cluster States,** Ohad Lib[1], Yaron Bromberg[1]; *[1]The Hebrew Univ. of Jerusalem, Israel.* We experimentally generate large photonic cluster states at high rates through high-dimensional spatial encoding. We use a record-large 10-plane light converter to coherently control the quantum state and to realize time-efficient measurement-based quantum gates.

**QW4A.4 • 16:45**
**Higher-Order Process Matrix Tomography of a Passively-Stable Quantum Switch,** Michael Antesberger[1], Marco Túlio Quintino[1], Philip Walther[1], Lee Rozema[1]; *[1]Universitat Wien, Austria.* The quantum switch is a process with an indefinite causal order, going beyond the circuit model. We introduce and perform a tomography protocol for such processes, testing it on a novel implementation of the switch.

**QW4A.5 • 17:00**
**Experimental Generation of Three-Dimensional Cluster Entangled State,** Chan Roh[1], Geunhee Gwak[1], Young-Do Yoon[1], Young-Sik Ra[1]; *[1]Department of Physics, Korea Advanced Inst. of Science and Technology, Korea (the Republic of).* We deterministically generate three-dimensional cluster entangled state in time-frequency modes of ultrafast quantum light. Moreover, we verify the cluster state generation by nullifier measurements as well as full inseparability test.

**QW4A.6 • 17:15**

**Optimizing the Generation of Large Cluster States With Residual Visibility Measurements,** Leonid Vidro[1], Valentin Guichard[2], Dario Fioretto[2], Daniel Istrate[1], Nadia Belabas[2], Pascale Senellart[2], Hagai Eisenberg[1]; *[1]HUJI, Israel; [2]C2N, CNRS, France.* We demonstrate a 6-photon linear cluster state measurement using a resource-efficient quantum dot single photon source and linear optics setup. Shorter, high-rate, states created in the process give useful indications on the quality of alignment and interference for optimization.

**QW4A.7 • 17:30**

**Cluster States Generation in Photonic Time-Crystals,** Mark Lyubarov[1], Michael Birk[1], Ohad Segel[1], Alexey Gorlach[1], Liat Nemirovsky-Levy[1], Yonatan Plotnik[1], Mordechai Segev[1]; *[1]Technion, Israel.* We show that Photonic Time-Crystals generate two-mode squeezing for photonic modes with opposite momentum. Based on this property we propose a three-step algorithm for generation of cluster states for measurement-based quantum computing.

**QW4A.8 • 17:45**

**An Open Quantum System for Discrete Optimization,** Lac Nguyen[1], Wesley Dyk[1], Mohammad-Ali Miri[1], Milan Begliarbekov[1], R. Joseph Rupert[1], Sheng Wu[1], Nick Vrahoretis[1], Irwin Huang[1], Pranav Mahamuni[1], Cesar Martinez Delgado[1], David Haycraft[1], Yong Meng Sua[1], Yuping Huang[1]; *[1]Quantum Computing Inc, USA.* We propose a novel framework for photonic quantum computing specialized in solving discrete optimization problems by leveraging the quantum Zeno effect. We demonstrate the efficiency of this computing paradigm within a hybrid quantum optimization machine.

**QW4A.9 • 18:00**

**Multi-Client Blind Quantum Computing Over a Qline Architecture,** Beatrice Polacchi[1], Dominik Leichtle[2], Leonardo Limongi[1], Gonzalo Carvacho[1], Giorgio Milani[1], Nicolo' Spagnolo[1], Marc Kaplan[4], Fabio Sciarrino[1], Elham Kashefi[2,3]; *[1]Dipartimento di Fisica, Sapienza Università di Roma, Italy; [2]Laboratoire d'Informatique de Paris 6, CNRS, Sorbonne Université, France; [3]School of Informatics, Univ. of Edinburgh, UK; [4]VeriQloud, France.* Blind quantum computing (BQC) was only demonstrated in single-client scenarios. In this work, we designed a versatile multi-client BQC on a linear network and demonstrated it in a two-client setting on an adaptive photonic platform.

**QW4A.10 • 18:15**

**Extending Classical Boson Sampling Techniques,** Stefan van den Hoven[1], Edwin Kanis[1], Jelmer J. Renema[1]; *[1]Adaptive Quantum Optics, Netherlands.* We extend classical simulation techniques for noisy boson sampling twice. First, we extend the algorithm to include realistic, non-uniform, partially distinguishable photons. Second, we extend the simulation technique to a particular family of structured matrices.

**16:00 -- 18:15**
**Room: Mees I**
**QW4B • Quantum Memory**
*Presider: Janik Wolters, German Aerospace Center, Germany*

**QW4B.1 • 16:00 (Invited)**
**A Quantum Repeater Node Based on a Broadband and Multimode 171Yb:Y2SiO5 Quantum Memory,** Mikael Afzelius[1]; *[1]Univ. of Geneva, Switzerland.* I will present our latest results of remote distribution and storage of multimode quantum correlations based on a broadband 171Yb:Y2SiO5 quantum memory and a non-degenerate SPDC source interfaced with the memory.

**QW4B.2 • 16:30**
**Spectrally-Multiplexed Optical Readout and Coherent Control of Individual Erbium Spins,** Andreas Reiserer[1,2]; *[1]TU Munich, Germany; [2]MPI of Quantum Optics, Germany.* Frequency multiplexing allows for resolving and addressing many individual erbium dopants in an optical resonator as coherent single-photon emitters. Using large quality factor resonators, we further demonstrate the readout and coherent control of their spin.

**QW4B.3 • 16:45**
**Fast, Efficient and Lossless Measurement of Atom-Photon Entanglement,** Gianvito Chiarella[1], Tobias Frank[1], Pau Farrera[1,2], Gerhard Rempe[1]; *[1]Max Planck Inst. for Quantum Optics, Germany; [2]Munich Center for Quantum Science and Technology (MCQST), Germany.* We implement a quantum network node composed of a single 87Rb atom coupled to two crossed fiber-resonators, one mediating the efficient atom-photon entanglement generation, and the other collecting fluorescence photons for fast atomic state measurement.

**QW4B.4 • 17:00**
**Cavity-Enhanced on-Demand Spin-Wave Solid State Quantum Memory,** Leo Feldmann[1], Soeren Wengerowsky[1], Stefano Duranti[1], Hugues de Riedmatten[1,2]; *[1]ICFO-Institut de Ciencies Fotoniques, Spain; [2]ICREA-Institució Catalana de Recerca i Estudis Avançats, Spain.* We report the first cavity-enhanced on-demand atomic frequency comb spin-wave quantum memory. We used a $Pr^{3+}:Y_2 SiO_5$ crystal embedded in an impedance-matched cavity to achieve a device efficiency of 38% for weak coherent pulses.

**QW4B.5 • 17:15**
**Development of a 7x7 Grid of Absorptive Quantum Memories,** Siddharth Sehgal[1,2], Eden Figueroa[1], Julian Martinez-Rincon[2]; *[1]Stony Brook Univ., USA; [2]Brookhaven National Laboratory, USA.* The ability to effectively store multiple entangled modes is essential to build high repetition-rate long-distance quantum repeaters. We present a multiplexed room-temperature quantum memory system, where we can store up to 49 independent quantum modes.

**QW4B.6 • 17:30**
**Fluorescence Detected Photon Echoes in $Er^{3+}:Y_2SiO_5$,** Jayash Panigrahi[1], Felix Montjovet-Basset[1], Diana Serrano[1], Alexandre Tallaire[1], Patrice Bertet[2], Alexey Tiranov[1], Philippe Goldner[1]; *[1]Chimie Paristech, France; [2]Université Paris-Saclay, CEA, CNRS, SPEC, 91191 Gif-*

*sur-Yvette Cedex, France, France.* Understanding the dephasing dynamics of quantum materials with a low number of emitters is crucial for optimizing them for quantum nanophotonics. Here, we investigate the recovery of photon echoes from fluorescence emissions in rare-earth doped systems.

**QW4B.7 • 17:45**
**Entanglement Distribution Using Loop-Based Quantum Memories,** Todd B. Pittman[1], Carson J. Evans[1], Cory M. Nunn[1], Sandra W. Cheng[1], James D. Franson[1]; *[1]Physics, Univ. of Maryland Baltimore County, USA.* We describe experimental work on storing polarization-entangled photons in distant “loop-based” quantum memories. The inherently broadband nature of this memory platform offers advantages in various entanglement distribution and quantum networking applications.

**QW4B.8 • 18:00**
**Integration of Color Centers in Diamond Into Fabry-Perot Cavities,** Robert Berghaus[1], Gregor Bayer[1], Selene Sachero[1], Florian Feuchtmayr[1], Niklas Lettner[1], Viatcheslav Agafonov[2], Alexander Kubanek[1]; *[1]Univ. Ulm, Quantum optics, Germany; [2]Greman, UMR 7347 CNRS, INSA-CVL, France.* Color centers in diamond, including defects like silicon vacancy and germanium vacancy, offer optical accessibility and spin transition for quantum bits. Our investigation focuses on integrating diamond into optical microcavities to enhance the signal and enable fast quantum communication.

**QW4B.9 • 18:15**
**Resonance Fluorescence From a Diamond Nitrogen-Vacancy Center in a Cavity,** Yannik L. Fontana[1], Viktoria Yurgens[1], Andrea Corazza[1], Brendan Shield[1,2], Patrick Maletinsky[1], Richard J. Warburton[1]; *[1]Basel Univ., Switzerland; [2]Quantum Network Technologies, USA.* Efficiently coupling a narrow-linewidth nitrogen-vacancy center (NV) in diamond to an open optical microcavity, we observe for the first time NV resonance fluorescence without requiring any time-filtering, marking a breakthrough toward high-efficiency spin-photon entanglement sources.

**16:00 -- 18:00**
**Room: Mees II**
**QW4C • Tutorial: Ion Trap Quantum Computing**
*Presider: Robert Niffenegger, Univ. of Massachusetts, USA*

**QW4C.1 • 16:00 (Tutorial)**
**Trapped Ion Quantum Computing,** Robert Niffenegger; *[1]Univ. of Massachusetts, USA.* Trapped Ions are a leading technology for scalable quantum computing. We will review basic operation, qubit gates and calibrations, then compare architectures and prospects for scaling up trapped ion QPUs through integrated technologies.

## Thursday, 27 June

### 09:00 -- 10:00
### Room: Rotterdam Hall 2
### JTh1A • Keynote Session IV
*Presider: Ronald Holzwarth, Menlo Systems GmbH, Germany*

**QTh1A • 09:00 (Keynote)**
**Next-Generation Chip-Scale Atomic Clocks,** John Kitching[1]; *[1]National Inst. of Standards & Technology, USA.* We describe the development of next-generation chip-scale atomic clocks based on optical transitions and atomic beams. Such clocks may allow improved short- and long-term frequency stability while maintaining small size, low power consumption and high level of integration.

### 10:30 -- 12:30
### Room: Rotterdam Hall 2
### QTh2A • Atomic QC
*Presider: Norbert Linke, Duke University, USA*

**QTh2A.1 • 10:30 (Invited)**
**Photonic Interfaces for Neutral Atom Quantum Computers,** Mikhail Lukin[1], Brandon Grinkemeyer[1]; *[1]Harvard Univ., USA.* We introduce a platform that integrates atom arrays in optical tweezers with a fiber Fabry-Perot cavity, providing an efficient quantum optical interface for neutral atom quantum computers. Leveraging strong atom-cavity coupling, we demonstrate state readout with error detection and novel methods for cavity-mediated entanglement generation.

**QTh2A.2 • 11:00**
**A New Programmable Quantum Simulator With Strontium Rydberg Atoms in Optical Tweezer Arrays,** Vladislav Gavryusev[1,2], Luca Guariento[4,3], Veronica Giardini[2,3], Andrea Fantini[1,3], Shawn Storm[1,3], Jacopo Catani[3,2], Massimo Inguscio[5,2], Leonardo Fallani[1,2], Giacomo Cappellini[3,2]; *[1]Department of Physics and Astronomy, Univ. of Florence, Italy; [2]European Laboratory for Non-Linear Spectroscopy, Italy; [3]National Inst. of Optics (CNR-INO), National Research Council, Italy; [4]Department of Physics Ettore Pancini, Univ. of Napoli Federico II, Italy; [5]Univ. Campus Bio-Medico, Italy.* Ultra-cold interacting Rydberg Strontium atoms trapped in reconfigurable optical tweezers can simulate quantum magnetism and energy transport. I will present our setup and planned capabilities, including electric field control, 3D traps and single site addressing.

**QTh2A.3 • 11:15**
**Extending the Lifetime of Collective Rydberg Qubits,** Stanislaw Kurzyna[1], Bartosz Niewelt[1], Mateusz Mazelanik[1], Wojciech Wasilewski[1], Michal Parniak[1]; *[1]Univ. of Warsaw, Poland.* Collective Rydberg excitations stored in atomic ensembles possess many advantages, such as strong coupling to light and immunity to single-atom loss. We present a scheme that allows 10-fold lifetime extension of collective Rydberg excitations, fully mitigating motional decoherence.

**QTh2A.4 • 11:30**

**From an Optical Magnus Effect to a Novel Quantum Gate,** Robert J. Spreeuw[1,2], Zeger E. Ackerman[1], Louis P. Gallagher[1], Matteo Mazzanti[1], Arghavan Safavi-Naini[1,2], Rene Gerritsma[1,2]; *[1]Inst. of Physics, Universiteit van Amsterdam, Netherlands; [2]QuSoft, Netherlands.* We discuss the use of optical tweezers for two-qubit gates on trapped ions in a crystal. Qubit-state dependent forces arise from polarization gradients near the focus. We simulate gate infidelities of ~$10^{-3}$.

**QTh2A.5 • 11:45**
**Towards High-Fidelity Gates for the Nitrogen-Vacancy Center in Diamond,** Jiwon Yun[1,2], Hans P. Bartling[1,2], Kai-Niklas Schymik[1,2], Margriet van Riggelen[1,2], Luc A. Enthoven[1,3], Hendrik Benjamin van Ommen[1,2], Masoud Babaie[1,3], Fabio Sebastiano[1,3], Tim H. Taminiau[1,2]; *[1]QuTech, Delft Univ. of technology, Netherlands; [2]Kavli Inst. of Nanoscience Delft, Delft Univ. of Technology, Netherlands; [3]Department of quantum and computer engineering, Delft Univ. of technology, Netherlands.* We realize high-fidelity gates for the two-qubit system formed by NV center. Using gate set tomography, we report gate fidelities exceeding 99%, and analyze the origin of the errors.

**QTh2A.6 • 12:00**
**Er Sites in Si for Quantum Information Processing,** Alexey A. Lyasota[1], Ian Berkman[1], Gabriele de Boo[1], John Bartholomew[2,3], Shao Qi Lim[4], Brett Johnson[5], Jeffrey McCallum[4], Bin-Bin Xu[1], Shouyi Xie[1], Rose Ahlefeldt[6], Matthew Sellars[6], Chunming Yin[7,1], Sven Rogge[1]; *[1]Centre of Excellence for Quantum Computation and Communication Technology, School of Physics, Univ. of New South Wales, Australia; [2]Centre for Engineered Quantum Systems, School of Physics, The Univ. of Sydney, Australia; [3]The Univ. of Sydney Nano Inst., The Univ. of Sydney, Australia; [4]Centre of Excellence for Quantum Computation and Communication Technology, School of Physics, Univ. of Melbourne, Australia; [5]School of Science, RMIT Univ., Australia; [6]Centre of Excellence for Quantum Computation and Communication Technology, Research School of Physics, Australian National Univ., Australia; [7]Hefei National Laboratory for Physical Sciences at the Microscale, CAS Key Laboratory of Microscale Magnetic Resonance and School of Physical Sciences, Univ. of Science and Technology of China, China.* We report on Er sites in $^{28}$Si with millisecond spin coherence (extended to 40 ms using Alternating-Phase-CPMG sequence), homogeneous and inhomogeneous broadening below 100 kHz and 100 MHz. These results are promising for future quantum applications.

**QTh2A.7 • 12:15**
**Photonic Control of Atom-Like Qubits Using 2D Scanning Waveguide-on-Cantilever “ski-Jumps”,** Y. Henry Wen[1], Matthew Zimmermann[1], Matthew Saha[1], Kevin J. Palm[1], Andrew S. Greenspon[1,2], Mark Dong[1,2], Genevieve Clark[1,2], Alex Witte[1], Andrew J. Leenheer[3], Gerald Gilbert[4], Matt Eichenfield[3,5], Dirk R. Englund[2]; *[1]The MITRE Corporation, USA; [2]Research Laboratory of Electronics, Massachusetts Inst. of Technology, USA; [3]Sandia National Laboratories, USA; [4]The MITRE Corporation, USA; [5]College of Optical Sciences, Univ. of Arizona, USA.* We demonstrate 2D beam steering of a single-mode waveguide beam-spot with >10K resolution in a piezo-driven waveguide-on-cantilever scanner with broadband visible transmission and show local addressing of single color centers in diamond.

**10:30 -- 12:30**
**Room: Mees I**
**QTh2B • Entanglement Distribution**
*Presider: Stefanie Barz, Stuttgart University, Germany*

**QTh2B.1 • 10:30 (Invited)**
**Towards Room Temperature Quantum Repeating,** Mehdi Namazi[1], Yang Wang[1], Alexandder Craddock[1], Jaeda Mendoza[1], Mael Flament[1]; *[1]Qunnect Inc., USA.* Here we will discuss our experimental results from entangling telecom photons generated using a four-wave mixing entanglement source with a room-temperature quantum memory. This work paves the way towards building field-deployable quantum repeaters.

**QTh2B.2 • 11:00**
**Experimental Anonymous Quantum Conferencing,** Jonathan Webb[1], Joseph Ho[1], Federico Grasselli[2], Glaucia Murta[2], Alex Pickston[1], Andres Ulibarrena[1], Alessandro Fedrizzi[1]; *[1]Heriot-Watt Univ., UK; [2]Heinrich-Heine-Universitat Dusseldorf, Germany.* Using a six-photon maximally entangled state, we demonstrate anonymous key distribution protocols showing a substantial reduction in network resources when multi-partite entanglement is available over solely bi-partite entanglement, considered in the asymptotic- and finite-key regime.

**QTh2B.3 • 11:15**
**Multiplexed Quantum Secret Sharing via Subspace Encoding,** Meritxell Cabrejo[1], Christopher Spiess[1], Carlos Sevilla-Gutierrez[1], Fabian Steinlechner[1,2]; *[1]Fraunhofer IOF, Germany; [2]Abbe Center of Photonics, 2Friedrich Schiller Univ. Jena, Germany.* By manipulating the spectral phase of polarization-entangled photons, we show a subspace encoding method that enables Quantum Secret Sharing to be deployed in multiplexed and reconfigurable networks.

**QTh2B.4 • 11:30**
**100-km Entanglement Distribution With Co-Existing Quantum and Classical Signals in a Single Fiber,** Anouar Rahmouni[1,2], Paulina S. Kuo[1], Ya-Shian Li-Baboud[1], Ivan Iurenkov[1,2], Yicheng Shi[1], Jabir Marakkarakath Vadakkepurayil[1], Nijil Lal Cheriya Koyyottummal[1], Dileep Reddy[3], Mheni Merzouki[1], Lijun Ma[1], Abdella Battou[1], Sergey V Polyakov[1], Slattery Oliver T.[1], Gerrits Thomas[1]; *[1]NIST, USA; [2]Univ. of Maryland, USA; [3]NIST, USA.* We demonstrate metropolitan-scale polarization entanglement distribution with co-existing quantum and WR-PTP classical synchronization signals in the same single-core fiber. We achieved high-fidelity entanglement between nodes separated by 100 km of optical fiber.

**QTh2B.5 • 11:45**
**Distribution of Telecom Time-Bin Entangled Photons Through a 7.7 km Antiresonant Hollow-Core Fiber,** Michael Antesberger[1], Carla Richter[1], Francesco Poletti[2], Radan Slavík[2], Periklis Petropoulos[2], Hannes Hübel[3], Alessandro Trenti[3], Philip Walther[1], Lee Rozema[1]; *[1]Universitat Wien, Austria; [2]Univ. of Southampton, UK; [3]Austrian Inst. of Technology, Austria.* We show that hollow-core fibers have emerged for quantum technology by distributing entangled time-bin qubits over a 7.7 km fiber. We study this fiber's advantages in transmission speed and dispersion over a broad spectral range.

**QTh2B.6 • 12:00**

**A Multiplexed Programmable Quantum Photonic Network,** Natalia Herrera Valencia[1], Suraj Goel[1], Annameng Ma[1], Saroch Leedumrongwatthanakun[1,2], Francesco Graffitti[1], Alessandro Fedrizzi[1], Will McCutcheon[1], Mehul Malik[1]; *[1]Heriot-Watt Univ., UK; [2]Prince of Songkla Univ., UK.* We harness the large mode-mixing process inside a multi-mode fibre to implement a spatially multiplexed programmable network that distributes and swaps entanglement between 4 parties.

**QTh2B.7 • 12:15**

**Programmable High-Dimensional Quantum Circuits in Space and Time,** Mehul Malik[1], Suraj Goel[1], Saroch Leedumrongwatthanakun[1], Natalia Herrera Valencia[1], Vatshal Srivastav[1], Dylan Danese[1], Armin Tavakoli[2], Claudio Conti[3], Pepijn Pinkse[4], Will McCutcheon[1]; *[1]Heriot-Watt Univ., UK; [2]Lund Univ., Sweden; [3]Univ. of Rome, Italy; [4]Univ. of Twente, Netherlands.* We harness the complex mixing process inside a commercial multi-mode fibre to program high-dimensional linear optical circuits for photonic qudits encoded in transverse space and time-of-arrival, and demonstrate their use for high-dimensional entanglement certification.

**10:30 -- 12:30**
**Room: Mees II**
**QTh2C • Instrumentation**
*Presider: Matt Eichenfield, Univ of Arizona, Coll of Opt Sciences, USA*

**QTh2C.1 • 10:30 (Invited)**

**Scalability of Silicon Photonics for Quantum Technologies,** Michal Lipson[1]; *[1]Columbia Univ., USA.* Large and complex systems are putting a high demand on silicon photonics scalability. I will describe the challenges that silicon photonic faces  and focus on our recent works that addresses the scaling issue.

**QTh2C.2 • 11:00**

**Development of Mode-Hop Free Tunable Chip-Scale Laser at 780 nm for Nonlinear Quantum Photonics and Atomic Sensing,** Joshua E. Castro[1], Eber Nolazco-Martinez[1], Paolo Pintus[1], Zeyu Zhang[2], Boqiang Shen[2], Theodore Morin[1], Lillian Thiel[1], Trevor Steiner[1], Nicholas Lewis[1], Sahil Patel[1], John Bowers[1], David Weld[1], Galan Moody[1]; *[1]UCSB, USA; [2]Nexus Photonics, USA.* We present III-V-on-Si3N4 chip-scale lasers operating from 765-795 nm with < 5 kHz intrinsic linewidth and > 100 GHz mode-hop-free tuning. We demonstrate their application for nonlinear photonics with Si3N4 microring resonators, atomic spectroscopy, and locking to 87Rb.

**QTh2C.3 • 11:15**

**Microcavity Platform for Widely Tunable Optical Double Resonance,** Sigurd Flågan[2,1], Patrick Maletinsky[2], Richard J. Warburton[2], Daniel Riedel[2,3]; *[1]Univ. of Calgary, Canada; [2]Univ. of Basel, Switzerland; [3]AWS Center for Quantum Networking, USA.* We present *in situ* tuning of both the absolute and relative frequency spacing of resonant modes in an optical microcavity by incorporating a wedged diamond membrane. We demonstrate THz continuous tuning of doubly-resonant Raman scattering.

**QTh2C.4 • 11:30**
**Integrating a Fibre Cavity With an ion Trap for Scalable Quantum Computing,** Shaobo Gao[1], Ezra Kassa[1], Vishnu Kavungal[1], Shuma Oya[1], Daichi Okuno[2], Soon Teh[1], Hiroki Takahashi[1]; *[1]Okinawa Inst. of Science and Technology, Japan; [2]Univ. of Tokyo, Japan.* Integrating optical micro-cavity with ion traps is essential to achieve interconnection between ion traps, which is a promising approach for scalable quantum computing. Here we demonstrate some of the key technologies required for this purpose.

**QTh2C.5 • 11:45**
**Compact Vertical-Cavity Surface-Emitting Laser (VECSEL) Platform for Quantum Technology,** Jussi-Pekka Penttinen[1], Emmi Kantola[1], Topi Uusitalo[1], Sanna Ranta[1], Arttu Hietalahti[1], Roope Vuohenkunnas[1], Mircea D. Guina[1]; *[1]Vexlum Ltd, Finland.* A compact VECSEL-system (VXL™) exhibiting a unique combination of features addressing quantum technology applications is reported. Recent experiments demonstrating new capability for frequency locking, linewidth narrowing to sub-Hz level, and wavelength coverage are presented.

**QTh2C.6 • 12:00**
**Opto-Electronic Operation of an SNSPD With a Cryogenic Laser,** Frederik Thiele[1], Niklas Lamberty[1], Thomas Hummel[1], Tim J. Bartley[1]; *[1]Universität Paderborn, Germany.* We demonstrate an opto-electronic operation of an SNSPD at 1K, utilizing a photodiode bias and a cryogenic laser for signal-readout. The cryogenic photonic link reduces the heatload and maintains a high performance of the SNSPD.

**QTh2C.7 • 12:15**
**Quantum Paraelectric Parametric Amplifiers,** Anja I. Ulrich[3,2], Kamal Brahim[4,3], Andries Boelen[5,1], Bart Kuyken[2], Christian Haffner[3]; *[1]InterUniv. Microelectronics Center, Belgium; [2]Department of Information Technology (INTEC), Photonics Research Group, Ghent Univ., Belgium; [3]IMEC, Belgium; [4]Department of Electrical Engineering (ESAT), KU Leuven, Belgium; [5]Department of Materials Engineering, KU Leuven, Belgium.* A conceptual analysis of an RF parametric amplifier based on the quantum paraelectric strontium titanate. The analysis suggests a gain of 20dB, a bandwidth of several MHz and a dynamic range of -60dBm are feasible.

**14:00 -- 16:00**
**Exhibits- Poster Area**
**QTh3A • Poster Session III**

**QTh3A.1**
**Quantum Internet Enabling Technology – QuIET,** Robert Broberg[1], Haoqi Zhao[1], Yichi Zhang[1], Liang Feng[1], Johnathan Smith[1]; *[1]UPenn, USA.* The Quantum Internet promises advances in security, privacy and performance. Using standards defined interfaces as "interoperability layers", QuIET (Quantum Internet Enabling Technology) offers a non-disruptive path using Internet infrastructure for new quantum network applications.

**QTh3A.2**

**Engineering Spectral Purity of Telecom Wavelength Photons Generated via SPDC for Multi-Partite Quantum Communication,** Johanna Conrad[1,2], Rodrigo Gómez[1,2], Markus Leipe[1,2], Meritxell C. Ponce[1,2], Fabian Steinlechner[1,2]; *[1]Emerging Technologies, Fraunhofer IOF Jena, Germany; [2]Inst. of Applied Physics, Friedrich-Schiller Universität Jena, Germany.* We report on engineering spectrally pure photon pairs via SPDC and provide a comprehensive characterization of periodically and aperiodically poled KTP crystals as well as Hong-Ou-Mandel experiments between photons produced in distinct SPDC crystals.

**QTh3A.3**

**Analyzing Quantum Secure Direct Communication With Forward Error Correction,** Masab Iqbal[1], Michela S. Moreolo[1], Arturo Villegas[1], Laia Nadal[1]; *[1]Ctr Tecnològic de Telecom de Catalunya, Spain.* We implement a quantum equivalent to classical QPSK communication on IBMQ and NetSquid. Results show that forward error correction fails to provide error-free transmission using near-term devices. Error-free transmission is possible when qubit fidelity reaches 0.981.

**QTh3A.4**

**Precision Thermal Feedback Wavelength Stabilized Adiabatic Single-Photon Quantum Key Transmitter,** Shih-Chang Hsu[1], You-Cheng Lin[1], Gong-Ru Lin[1]; *[1]National Taiwan Univ., Taiwan.* Ultra-stable quantum-key transmitter with precision wavelength/phase control is approached using passively adiabatic package and actively thermal feedback controller to achieve decoding visibility of 99.4%, quantum bit-error-ratio of 3.06%, and secure-key-rate of more than 40 kbit/s.

**QTh3A.5**

**Integrated Preparation of Qubit States and Chip-Fibre Interface for Quantum Networks,** Jonas Zatsch[1,2], Tim Engling[1,2], Jeldrik Huster[1,2], Nico Hauser[1,2], Christian Schweikert[3], Stefanie Barz[1,2]; *[1]Inst. for Functional Matter and Quantum Technologies, Univ. of Stuttgart, Germany; [2]Center for Integrated Quantum Science and Technology (IQST), Germany; [3]Inst. of Electrical and Optical Communications Engineering, Univ. of Stuttgart, Germany.* We present an integrated photonic chip, which offers the on-chip control of a path-encoded qubit. It has the capability of converting the quantum state to polarization-encoding, enabling a chip-fibre interface for quantum network tasks.

**QTh3A.6**

**Reconstruction of Generic Light Pulses Stored via EIT Using the Coherent Atomic Transfer Function,** Billie V. DeLuca[1], Anil Patnaik[1]; *[1]Air Force Inst. of Technology, USA.* We use the Fourier-based coherent atomic transfer (CAT) function for EIT storage in a $\Lambda$ atomic system to reconstruct an arbitrary pulse shape given the retrieved output using numerical deconvolution algorithms.

**QTh3A.7**

**Classical Attack on Bell Inequalities,** Aishi Guha[1], Noah A. Davis[1], Brian R. La Cour[1]; *[1]The Univ. of Texas at Austin, USA.* Representing multi-mode squeezed light with a Gaussian random vector, our locally deterministic detection model challenges the CHSH game, achieving fidelities exceeding 96\%. Squeezing strength, detector threshold, and efficiency influence the security of the quantum bound.

**QTh3A.8**
**Mode Formation in Optical Microcavities,** Martin van Exter[1]; *[1]Universiteit Leiden, Netherlands.* We show how the resonant modes in optical microcavities differ from the well-known Gaussian modes, due to non-paraxial and mirror-shape effects. We discuss their resonance frequencies, (polarization-resolved) mode profiles, and attainable finesse.

**QTh3A.9**
**Selective Propagation of Transverse Modes of Light Through Few Mode Fibers,** Anindya Banerji[1], Shuin Jian Wu[1], Alexander Ling[1,2]; *[1]Centre for Quantum Technologies, Singapore; [2]Department of Physics, National Univ. of Singapore, Singapore.* We use mechanical perturbations controlled by a computational optimization algorithm to guide a single mode of light in a few mode fiber that supports multiple transverse modes. This technique can prove beneficial for free-space quantum communication protocols.

**QTh3A.10**
**MZI-Based Polarization Encoder for DS-BB84 QKD,** Giannis Giannoulis[1], Aristeidis Stathis[1], Argiris Ntnaos[1], Giannis Poulopoulos[1], Hercules Avramopoulos[1]; *[1]Electrical and Computer Engineering, National Technical Univ. of Athens, Greece.* An interferometric polarization encoding structure, envisioned as a PIC suitable for QKD, is proposed, examining the impact of non-ideal components on its functionality, and assessing its performance in terms of intrinsic QBER.

**QTh3A.12**
Withdrawn

**QTh3A.11**
**Integrated Quantum Photonics for Quantum Network,** Xiaosong Ma[1]; *[1]Nanjing Univ., China.* Quantum photonics provides a promising path for both delivering quantum-enhanced technologies and exploring fundamental physics. In this talk, I will present our recent endeavors in developing functional nodes for quantum information processing based on integrated optics architecture and their potential applications in a metropolitan fiber network.

**QTh3A.13**
**Continuous Polarization Correction for Long-Distance Quantum Key Distribution,** Uday Chandrashekara[1], Andrej Krzic[1], Rodrigo Gómez[1], Fabian Steinlechner[1]; *[1]Fraunhofer Inst. for Applied Optics, Germany.* We present a polarization correction module using a beacon laser. Using this device we stabilize the polarization drift of a 70km dark fiber link used for quantum communication.

**QTh3A.14**
**Enhancing Quantum Communications: Automated, Ultra-Bright Entangled Photon Generation,** Rana Sebak[1,2], Erik Beckert[1], Fabian Steinlechner[1,2]; *[1]Fraunhofer IOF, Germany; [2]Friedrich Schiller Univ., Germany.* An efficient, bright entangled photon source using time-reversed Hong-Ou-Mandel interference, with motorized alignment for robust space applications. This innovation promises to advance quantum communications by ensuring high-quality, accessible quantum technologies.

**QTh3A.15**

**Resource-Efficient and Loss-Aware Photonic Graph State Preparation Using an Array of Quantum Emitters, and Application to all-Photonic Quantum Repeaters,** Eneet Kaur[1,2], Ashlesha H. Patil[1], Saikat Guha[1]; *[1]The Univ. of Arizona, USA; [2]Cisco Quantum Lab, USA.* Our algorithm uses quantum emitters to generate photonic graph states deterministically. It trades between the number of emitters and emitter CNOTs used to produce a repeater graph state (RGS) with significantly fewer emitters compared to the linear-optics method, while achieving the same entanglement rate for all-photonic repeaters.

**QTh3A.16**

**Generation of Indistinguishable Single Photons With Nanosecond Laser Pulses,** Pascal Baumgart[1], Max Bergerhoff[1], Stephan Kucera[1,2], Jürgen Eschner[1]; *[1]Universität des Saarlandes, Germany; [2]Luxembourg Inst. of Science and Technology, Luxembourg.* We investigate the generation of single photons from a single trapped $^{40}Ca^{+}$ ion via nanosecond laser pulses, resulting in an increased photon indistinguishability for pulse lengths in the order of the excited state lifetime.

**QTh3A.17**

Withdrawn

**QTh3A.18**

**Network Quantum Steering Enables Randomness Certification Without Seed Randomness,** Shubhayan Sarkar[1]; *[1]Physics, Laboratoire d Information Quantique, Universite Libre De Bruxelles, Belgium.* We show that even two parties with two sources that might be classically correlated can witness a form of quantum nonlocality, in particular quantum steering, in networks without inputs if one of the parties is trusted. We term this effect as swap-steering. We utilise the proposed scenario for the certification of randomness without seed randomness.

**QTh3A.19**

**The Performance-Cost Trade-Off of Multipath Multipartite Entanglement Distribution,** Natasha Siow[1], Evan Sutcliffe[1], Alejandra Beghelli[1]; *[1]Univ. College London, UK.* High rates for multipath multipartite entanglement distribution require more repeaters than single-path. We show that prioritising high-usage repeaters enables multipath protocols to still significantly outperform single-path with just 2.8× repeaters instead of 6×.

**QTh3A.20**

**Entangling Quantum Memories at High Rate Using Gottesman-Kitaev-Preskill Qudits,** Prajit Dhara[1], Liang Jiang[2], Saikat Guha[1]; *[1]Wyant College of Optical Sciences, The Univ. of Arizona, USA; [2]Pritzker School of Molecular Engineering, The Univ. of Chicago, USA.* We propose an interface between solid-state quantum memories and Gottesman-Kitaev-Preskill encoded photonic qubits using cavity-assisted controlled phase gates. Our protocol yields capacity-approaching high rate of heralded entanglement among quantum memory registers in the low-loss regime.

**QTh3A.21**

Withdrawn.

**QTh3A.22**

**Combating Decoherence in Single Rare Earth Ion Quantum Network Nodes,** Emanuel Green[1], Sophie Hermans[1], Erin Liu[1], Andrei Ruskuc[1], Chun-Ju Wu[1], Andrei Faraon[1]; *[1]Caltech, USA.* We study the lifetime and coherence of single $^{171}Yb^{3+}$ qubits in $YVO_4$ in the context of Yb concentration, paramagnetic defects and nuclear spin interactions. Additionally, we works towards the control of an additional memory resource.

**QTh3A.23**

**Higher-Dimensional HOM Effect With Directionally Unbiased Linear-Optical Multiports Enables Entangled State Routing in Quantum Networks,** Alexander V. Sergienko[1], David Simon[3,1], Christopher Schwarze[1], Anthony Manni[1], Abdoulaye Ndao[2,1]; *[1]Boston Univ., USA; [2]UC San Diego, USA; [3]Stonehill College, USA.* A four-port beamsplitter only maps between two input and output modes. We introduce a more general four-port scatterer that supports a broader class of state transformations, enabling a higher-dimensional HOM effect and entangled state routing.

**QTh3A.24**

**Scaling Behaviour of Multinode Quantum Computers Connected With Imperfect Ebits,** John Stack[1], Alejandra Beghelli[1]; *[1]Optical Networks Group, Department of Electronic & Electrical Engineering, Univ. College London, UK.* We distributed random circuits across multinode quantum computers with 2 to 6 nodes connected by imperfect ebits and studied scaling behaviour via an upper bound. High computational accuracy is achieved for ebit infidelity below $10^{-3}$.

**QTh3A.25**

Withdrawn.

**QTh3A.26**

**Generation and Distribution of Entangled Time-bin Qubits,** Kiwon Moon[1], Jinwoo Kim[1], Guhwan Kim[1], Jiho Park[1], Tetiana Slusar[1], Hong-seok Kim[1], Jintae Kim[1], Jaegyu Park[1], Min-su Kim[1], Jung Jin Ju[1]; *[1]Electronics and Telecom Research Inst, Korea (the Republic of).* In this work, we present the generation and the distribution of controllable time-bin qubits over 100 km single-mode fiber. Moreover, we briefly show our entanglement source based on a nonlinear photonic integrated circuit platform.

**QTh3A.27**

**Quantum Key Distribution With Atom-Photon Entanglement Over an Urban Fiber Link,** Jonas Meiers[1], Christian Haen[1], Max Bergerhoff[1], Stephan Kucera[1,2], Jürgen Eschner[1]; *[1]Universität des Saarlandes, Germany; [2]Luxembourg Inst. of Science and Technology, Luxembourg.* We implement a protocol for quantum key distribution based on atom-photon-entanglement over a 14-km urban dark-fiber link, using single photons from a $^{40}Ca^{+}$-ion and active polarization correction.

**QTh3A.28**

Withdrawn

**QTh3A.29**
**Suppressing Polarization Mode Dispersion With the Quantum Zeno Effect,** Ian C. Nodurft[1,2], Alejandro Rodriguez Perez[2], Naveed Naimipour[2], Harry C. Shaw[2]; *[1]Peraton, USA; [2]NASA GSFC, USA.* The quantum Zeno effect protects circularly polarized photons from unwanted birefringence. This is accomplished by introducing absorbing material that is resonant with the polarization mode opposite to that of the passing photon.

**QTh3A.30**
**Optical Fractional Fourier Transform in the Time-Frequency Domain Based on a Quantum Memory,** Bartosz Niewelt[1,2], Marcin Jastrzebski[1,2], Stanislaw Kurzyna[1,2], Jan Nowosielski[1,2], Wojciech Wasilewski[1,2], Mateusz Mazelanik[1], Michal Parniak[1,2]; *[1]Centre for Quantum Optical Technologies, Poland; [2]Faculty of Physics, Univ. of Warsaw, Poland.* Operations in the time-frequency domain of light are widely used in communication. Transformations such as fractional Fourier transform are indispensable tools for noise reduction. We present a protocol for quantum memories to perform this operation.

**QTh3A.31**
**Halting Single Photon Dissipation by Zeno Effect,** Anton N. Vetlugin[1], Mariia Sidorova[1], Ruixiang Guo[1], Cesare Soci[1], Nikolay I. Zheludev[1,2]; *[1]Nanyang Technological Univ., Singapore; [2]Univ. of Southampton, UK.* We experimentally demonstrate that a single photon propagating through multiple absorbers in intricate optical networks can experience a significant reduction in dissipation rate as the number of absorbers increases.

**QTh3A.32**
**A Arduino-Based Quantum Key Distribution System From Off-the-Shelf Electroncis,** Fabian Klingmann[1], Mira Stephan[1], Alexander Noack[1], René Kirrbach[1]; *[1]Data Communication & Computing | Systems Group, Fraunhofer Inst. für Photonische Mikrosysteme (IPMS), Germany.* We propose a quantum key distribution system operated only by two Arduinos. We demonstrate the transmission of 7ns pulses using LEDs and detection with 55ps accuracy by the Arduinos. We estimate the photon detection rate.

**QTh3A.33**
**Towards Interacting Single Rare Earth Ions,** Eduardo Beattie[1], Lothaire Ulrich[1], Samuele Grandi[1], Diana Serrano[2], Alban Ferrier[2], Philippe Goldner[2], David Hunger[3], Hugues de Riedmatten[1]; *[1]ICFO The Inst. of Photonic Sciences, Spain; [2]Chimie ParisTech, France; [3]Karlsruhe Inst. for Technology, Germany.* Gates between multiple single rare earth ion qubits may be implemented via direct dipolar interactions. We outline our work towards the first detection of such interactions.

**QTh3A.34**
**Towards Interconnecting Cold-Atom Interfaces Using an Infrared Free-Space Quantum Link,** Samet Demircan[1], Rishikesh Gokhale[1], Guodong Cui[1], Justine Haupt[2], Ivy Huang[3], Paul Stankus[2], Dimitrios Katramatos[2], Eden Figueroa[1]; *[1]Stony Brook Univ., USA; [2]Brookhaven National Laboratory, USA; [3]Wesleyan Univ., USA.* We report on our progress towards establishing a 20 km free-space quantum communication link connecting two cold-atom quantum light-matter interfaces across the Stony Brook Univ. (SBU) and Brookhaven National Laboratory (BNL) campuses.

**QTh3A.35**

**Impact of Noise on Multipartite Entanglement Distribution in Quantum Networks,** Hahn Lon Lam[1], Evan Sutcliffe[1], Alejandra Beghelli[1]; [1]*Univ. College London, UK.* We examine non-ideal entanglement swapping and fusion operations in single-path and multipath routing for multipartite entanglement distribution. Results show the distance-invariant multipartite distribution rate of multipath routing is lost in the presence of noise.

**QTh3A.36**

Withdrawn.

**QTh3A.37**

**Two-Pumps-Based Entanglement Generation Source Enabling Entanglement-Assisted Communication Over Beyond Strong Atmospheric Turbulence Channels,** Ivan B. Djordjevic[1], Vijay Nafria[1]; [1]*Univ. of Arizona, USA.* Two S-/L-band pumps, satisfying PPLN quasi-phase-matching-condition, are used to generate bright entangled-photons providing flexibility in wavelength-selection over entire C-band. By performing phase-conjugation on idler photons, we demonstrate entanglement-assisted communication at 1Gb/s over 1.5km FSO link operated in beyond strong turbulence.

**QTh3A.38**

**QKD Secret Key Scaling With Ground Station Aperture Size and Satellite Overpass,** Ravinder Singh[1], Thomas Roger[1], Chithrabhanu Perumangatt[1], Mirko Sanzaro[1], Robert Woodward[1], Andrew Shields[1]; [1]*Toshiba Europe Limited Cambridge Research, UK.* The secret key generation results for different telescope sizes and maximum satellite elevation within an overpass are generated using a satellite-to-ground quantum key distribution emulator which can support cost-effective satellite-QKD network deployment.

**QTh3A.39**

**Optical and Spin Coherence of NV Centers in Isotopically Purified Diamond for Quantum Networks,** Hendrik B. van Ommen[1], Kai-Niklas Schymik[1], Takashi Yamamoto[1], Tim H. Taminiau[1]; [1]*Qutech and Kavli Inst. of Nanoscience, TU Delft, Netherlands.* We discuss measurements on single NV centers in isotopically purified diamond and show coherent optical transitions combined with enhanced electron and carbon spin coherence. These results open avenues for new quantum network applications.

**QTh3A.40**

**Towards Atomic Rydberg Ensembles as Quantum Network Nodes,** Lena K. Schumacher[1], Jan Lowinski[1], Felix Hoffet[1], Hugues de Riedmatten[1]; [1]*ICFO, Spain.* We present an experimental setup, in which we want to combine cavity-enhanced efficient single-photon generation with deterministic atom-photon entanglement generation to realize a quantum repeater protocol using atomic Rydberg ensembles.

**QTh3A.41**

**Towards Practical Squeezed Light Distribution With Digital Signal Processing,** Huy Q. Nguyen[1], Hou-Man Chin[1], Adnan Hajomer[1], Ulrik L. Andersen[1], Tobias Gehring[1]; [1]*Danmarks Tekniske Universitet, Denmark.* We propose and experimentally demonstrate a method for recovering squeezed light after detection with a free-running receiver station. We achieve approximately 1 dB of squeezing without the need for pre-aligning polarization or locking frequency and phase.

**QTh3A.42**
**Experimental High-Dimensional Quantum Key Distribution Using a Multi-Plane Light Converter,** Ohad Lib[1], Kfir Sulimany[1], Yaron Bromberg[1]; *[1]The Hebrew Univ. of Jerusalem, Israel.* We use multi-plane light conversion to realize up to 25-dimensional quantum key distribution with spatially entangled photons, and design measurement bases that reduce the experimental complexity and improve the error distribution.

**QTh3A.43**
**What is the Best Wavelength for Fibre Quantum Communication?,** Marcus J. Clark[1], Ruizhi Yang[1], Rui wang[1], Reza Nejabati[1], Dimitra Simeonidou[1], Siddarth Joshi[1]; *[1]Univ. of Bristol, UK.* We present a detailed simulation study to conclusively answer the wide spread debate in the quantum community about the benefits of using the telecommunications C-Band or O-Band for quantum communication.

**QTh3A.44**
Withdrawn

**QTh3A.45**
Withdrawn

**16:00 -- 18:00**
**Room: Rotterdam Hall 2**
**QTh4A • Quantum Sources**
*Presider: Daniel Higginbottom, Simon Fraser University, Canada*

**QTh4A.1 • 16:00**
**Spatially Ordered Spectrally Compliant on-Demand Scalable Quantum Emitter Large Arrays for Multi-Emitter Based Quantum Networks,** Qi Huang[1], Lucas Jordao[1], Siyuan Lu[2], Swarnabha Chattaraj[3], Jiefei Zhang[3], Anupam Madhukar[1]; *[1]Univ. of Southern California, USA; [2]Cruise Inc, USA; [3]Argonne National Laboratory, USA.* Unique spatially-ordered and spectrally-uniform solid-state quantum emitter arrays show figures-of-merit suitable for realizing multisource and multipartite quantum networks. Optical and structural characteristics of these quantum emitters in large (~100x100) arrays are statistically sampled and discussed.

**QTh4A.2 • 16:15**
**Engineering and Certification of Multimode Non Gaussian States of Light,** Niels Tripier-Mondancin[1], Nicolas Treps[1], Valentina Parigi[1], David Barral[1,2], Ganaël Roeland[1], Yann Bouchereau[1], Leonardo Rincón[1], Mattia Walschaers[1]; *[1]Laboratoire Kastler Brossel, France; [2]CESGA, Spain.* We use double homodyne detection to sample the Q-Husimi function of a photon-subtracted mutlimode squeezed vacuum state. Thereafter, we perform a fidelity estimation protocol to certify the Wigner negativity and stellar rank of the generated state.

**QTh4A.3 • 16:30**

**Mode Entanglement Created by Interacting Superradiant Emitters,** Chen Mechel[1], Offek Tziperman[1], Alexey Gorlach[1], Ido Kaminer[1]; *[1]Technion, Israel.* We show that interacting quantum emitters coupled to a waveguide or any bath of optical-modes emit mode-entangled light. Controlling this entanglement could create useful multi-mode pure states, although each mode has thermal statistics.

**QTh4A.4 • 16:45**
**Photon Number Filtering Using Dynamically Coupled Cavities,** Kamma Nørrelund Pedersen[1], Matias Bundgaard-Nielsen[1,2], Philip Trøst Kristensen[1,2], Mikkel Heuck[1,2]; *[1]Department of Electrical and Photonics Engineering, Technical Univ. of Denmark, Denmark; [2]NanoPhoton-Center for Nanophotonics, Technical Univ. of Denmark, Denmark.* We numerically investigate using dynamically coupled nonlinear cavities to modify the photon number of incident optical pulses. By optimizing the instantaneous coupling rate, we convert a coherent state to a single-photon with over 99% efficiency.

**QTh4A.5 • 17:00**
**Single-Pair Measurement of the Bell Parameter,** Ivo P. Degiovanni[1]; *[1]INRIM, Italy.* We present the first single-pair Bell inequality test, able to obtain a Bell parameter value for every entangled pair detected. After the measurements, each pair still presents a noteworthy amount of entanglement to be exploited for further quantum-protocols.

**QTh4A.6 • 17:15**
**Decreasing Critical Detection Efficiency via Parallelized Bell Tests,** Daniel Ricardo R. Sabogal Perez[1], Suraj Goel[1], Natalia Herrera Valencia[1], Adán Cabello[2,3], Mehul Malik[1]; *[1]Heriot-Watt Univ., UK; [2]Departamento de Física Aplicada II, Universidad de Sevilla, Spain; [3]Universidad de Sevilla, Instituto Carlos I de Física Teórica y Computacional, Spain.* We present the experimental implementation of three parallelized Bell tests encoded in an eight-dimensional entangled state that allows for the reduction of the critical detection efficiency relevant to loophole-free Bell experiments.

**QTh4A.7 • 17:30**
**Imperfections in Heralding Three-Photon GHZ States for Quantum Computing Applications,** Franciscus H. Somhorst[1], Jelmer J. Renema[1]; *[1]MESA+ Inst. for Nanotechnology, Univ. of Twente, Netherlands.* We compute the effect of imperfections, specifically partial photon indistinguishability, on a linear-optical scheme that heralds three-photon Greenberger-Horne-Zeilinger (GHZ) states for use in a recently demonstrated scheme for fusion-based quantum computation.

**QTh4A.8 • 17:45**
**Enhanced Light Collection From Solid-State Qubits in Silicon Carbide Through Grayscale Hard-Mask Lithography,** Christiaan Bekker[1], Alexander Jones[1], Xingrui Cheng[2], Patrick Salter[2], Jason Smith[2], Muhammad J. Arshad[1], Pasquale Cilibrizzi[1], Peter Lomax[3], Graham S. Wood[3], Rebecca Cheung[3], Wolfgang Knolle[4], Neil Ross[1], Brian Gerardot[1], Cristian Bonato[1]; *[1]School of Engineering and Physical Sciences, Heriot-Watt Univ., UK; [2]Department of Engineering Science, Univ. of Oxford, UK; [3]Scottish Microelectronics Centre, Univ. of Edinburgh, UK; [4]Leibniz Inst. of Surface Engineering (IOM), Germany.* A scalable, shape-

controllable method for nanofabrication of high-aspect-ratio microlenses in silicon carbide is presented. Light collection from these lenses is investigated, and an enhancement in collection efficiency of a factor 4.4+/-1.0 is demonstrated.

**16:00 -- 18:00**
**Room: Mees I**
**ATh4B • Quantum Key Distribution**
*Presider: Paul Kwiat, Univ of Illinois at Urbana-Champaign, USA*

**ATh4B.1 • 16:00 (Invited)**
**Quantum-Secure Networks in Europe,** Valerio Pruneri[1], Luis Trigo Vidarte[1]; *[1]ICFO -Institut de Ciencies Fotoniques, Spain.* We describe the use of quantum technologies in practical quantum-secure networks to guarantee security, while maintaining flexibility. We show recent progress on quantum devices and systems for such networks and their deployment in the field.

**ATh4B.2 • 16:30**
**Quantum Cryptography Network Testbed Connecting Smart Power Grid Nodes,** Dimitrios Katramatos[1], Leonardo Castillo-Veneros[2], Guodong Cui[2], Dounan Du[2], Samuel Woronick[1], Julian Martinez-Rincon[1], Eden Figueroa[2,1]; *[1]Brookhaven National Laboratory, USA; [2]Stony Brook Univ., USA.* We present the deployment of a prototype hybrid quantum/classical network generating encryption keys with MDI-QKD and use it to secure a smart power grid encompassing a power plant and a solar array.

**ATh4B.3 • 16:45**
**Environmental Testing of the Dual Wavelength QKD Payload for a CubeSatellite,** Peide Zhang[1], Jaya Sagar[1,2], Hobbs Willett[1,2], Siddarth Joshi[1], John Rarity[1]; *[1]Quantum Engineering Technology Labs, Univ. of Bristol, UK; [2]Quantum Engineering Centre for Doctoral Training, Univ. of Bristol, UK.* Cube-satellites promise a flexible platform for global scale QKD but limited SWaP leads to design challenges. We present a payload engineering module for the UK SPOQC mission highlighting low volume and high key rate.

**ATh4B.4 • 17:00**
**QOSST: a Highly Modular Open Source Platform for Continuous Variable Quantum Key Distribution Applications,** Yoann Piétri[1], Matteo Schiavon[1], Valentina Marulanda Acosta[1,2], Baptiste Gouraud[3], Luis Trigo Vidarte[4], Philippe Grangier[5], Amine Rhouni[1], Eleni Diamanti[1]; *[1]LIP6 - CNRS - Sorbonne Université, France; [2]DOTA, ONERA, Université Paris Saclay, France; [3]Exail, France; [4]ICFO - Institut de Ciènces Fotòniques, The Barcelona Inst. of Science and Technology, Spain; [5]Université Paris-Saclay, Institut d'Optique Graduate School, CNRS, Laboratoire Charles Fabry, France.* We present a highly modular Open Source Software to perform CV-QKD experiments. The software is hardware agnostic and was benchmarked on bulk and integrated receivers, reaching state of the art secret key rates.

**ATh4B.5 • 17:15**
**Noise Characterization in co-Propagation of Classical and CV-QKD Signals Over Fiber and Free-Space Link,** João R. Frazão[1], Vincent v. Vliet[1], Kadir Gumus[1], Menno van den Hout[1], Sjoerd v. Heide[1], Aaron A. Mejia[1], Boris Skoric[1], Chigo Okonkwo[1]; *[1]Eindhoven Univ. of Technology, Netherlands.* Real-time CV-QKD receiver achieves peak 2.9 Mbit/s secret-key-

rates over 12.8 km of fiber, while co-propagating 15 classical channels, separated 1 nm from the quantum signal. Performance degrades at higher launch powers due to crosstalk.

**ATh4B.6 • 17:30**

**MacZac: Ultra low QBER Time-bin Qubit and Qudit Generator,** Davide Scalcon[1], Elisa Bazzani[1], Giuseppe Vallone[1], Paolo Villoresi[1], Marco Avesani[1]; *[1]Universita degli Studi di Padova, Italy.* The qubit encoding with low quantum-bit-error-rate (QBER) is crucial in effective quantum communications as it directly influence the final key-rate. We here introduce Mac-Zac scheme leveraging on intrinsically-stable interferometer reaching parts in 10^5 of base contrast.

**ATh4B.7 • 17:45**

**Experimental Demonstration of a Hybrid Authenticated Key Exchange Integrating QKD and PQC in a Single Protocol,** Lydia Garms[1], Taofiq Paraiso[2], Neil Hanley[3], Ayesha Khalid[3], Ciara Rafferty[3], Andrew Shields[2], Carlos Cid[4,5], Maire O'Neill[3]; *[1]Royal Holloway Univ. London, UK; [2]Toshiba Europe Ltd, UK; [3]Centre for Secure Information Technologies, Queen's Univ. Belfast, UK; [4]Okinawa Inst. of Science and Technology Graduate Univ., Japan; [5]Simula UiB, Norway.* We present a quantum secure hybrid authenticated key exchange protocol that combines classical, post-quantum and quantum cryptography. The protocol is modular and enables information theoretic security for both authentication and encryption key exchange.

**16:00 -- 18:00**
**Room: Mees II**
**QTh4C • Quantum Sensing**
*Presider: To be announced*

**QTh4C.1 • 16:00 (Invited)**

**Quantum Sensing of Weak Forces at Short Distances,** Franck Pereira dos Santos[1,2], Yann Balland[1], Luc Absil[1]; *[1]SYRTE, Observatoire de Paris, France; [2]CNRS, France.* I will report on short range forces measurements with a quantum sensor based on a trapped atom interferometer, for atom surface separations in the micrometer range and with unprecedented force stabilities in the quectonewton range.

**QTh4C.2 • 16:30**

**Differential Quantum Gravimeters for Field Measurements,** Camille Janvier[1,2], Peter Rosenbusch[1], Cédric Majek[1], Bruno Desruelle[3]; *[1]Quantum Systems, exail, France; [2]Laboratoire Photonique Numérique et Nanosciences, France; [3]exail, France.* Our Differential Quantum Gravimeter (DQG) measures simultaneously the mean gravitational acceleration and its vertical gradient to $<5$ nm/s$^2$ and 0.1 E = $10^{-10}$ s$^{-2}$, respectively. This is state-of-the-art. We give recent results including surveying.

**QTh4C.3 • 16:45**

**Large-Scale Fiber Interferometry to Measure the Gravitationally Induced Phase Shift on Entangled Photons,** Eleonora Polini[1], Dorotea Macri[1], Xinghui Yin[1], Eric Oelker[1], Piotr

Chrusciel[2], Georgi Dvali[3], Christopher Hilweg[2,4], Mario Hudelist[2], Dorilian Lopez Mago[2], Thomas Mieling[2], Thomas Morling[2], Marius Oancea[2], Raffaele Silvestri[2], Florian Steininger[2], Haocun Yu[2], Philip Walther[2], Nergis Mavalvala[1]; *[1]Laser Interferometer Gravitational Wave Observatory (LIGO), Massachusetts Inst. of Technology, USA; [2]Faculty of Physics, Univ. of Vienna, Austria; [3]Arnold Sommerfeld Center, Ludwig-Maximilians-Universität, Germany; [4]Inst. for Quantum Optics and Quantum Information (IQOQI Vienna) of the Austrian Academy of Sciences, Austria.* Gravitational time dilation, a prediction of General Relativity, lacks confirmation alongside quantum mechanics. Our experiment aims to measure gravitationally induced phase shift of path-entangled photons between two vertically displaced arms of a fiber interferometer.

**QTh4C.4 • 17:00**
**Experimental Quantum Noise Sensing via Quantum Zeno/Anti-Zeno Effect,** Salvatore Virzì[1], Laura Knoll[2], Fabrizio Piacentini[1], Alessio Avella[1], Stefano Gherardini[3], Tomas Opatrny[4], Abraham Kofman[5], Gershon Kurizki[5], Marco Gramegna[1], Filippo Caruso[6,7], Ivo P. Degiovanni[1,8], Marco Genovese[1,8]; *[1]INRiM, Italy; [2]DEILAP-UNIDEF, CITEDEF-CONICET, Argentina; [3]CNR-INO, Italy; [4]Palacky Univ., Czechia; [5]Weizmann Inst. of Science, Israel; [6]Univ. of Florence, Italy; [7]LENS, Italy; [8]INFN, Italy.* We introduce and experimentally demonstrate two techniques allowing to extract information on the noise affecting single-photon probes propagating in a quantum channel, by exploiting quantum Zeno and anti-Zeno effects.

**QTh4C.5 • 17:15**
**Quantum Enhanced Precision Metrology for Quantum Networks,** Jabir M. V.[1], Riley Dawkins[2,1], J. Sabines-Chesterking[3], Dileep V. Reddy[4,5], A. E. Lita[5], Abdella Battou[1], Gerrits Thomas[1]; *[1]National Inst. of Standards and Technology, USA; [2]Department of Physics and Astronomy, Louisiana State Univ., USA; [3]Xanadu Quantum Technologies, Canada; [4]Department of Physics, Univ. of Colorado Boulder, USA; [5]National Inst. of Standards and Technology, USA.* We construct a source generating two-mode squeezed vacuum states for precise transmission estimation. Experimentally, we demonstrate that measurements using TMSV states offer greater quantum advantage compared to coherent states.

**QTh4C.6 • 17:30**
**Quantum Sensing With Arrays of NV Centers for High Energy Physics,** Cyrus Dreyer[2], Gabriel López-Morales[4], Steven Linden[1], Patrick Salter[3], Joanna Zajac[1,3]; *[1]Instrumentation Division, Brookhaven National Laboratory, USA; [2]Physics and Astronomy, Stony Brook Univ., USA; [3]Department of Engineering Science, Oxford Univ., UK; [4]Department of Physics, CUNY-City College of New York, USA.* We propose, model theoretically, build and test a dark matter detector facilitating an array of laser written NV centers in diamond. Theoretical simulation and experiments using confocal microscopy allow us to demonstrate proof-of-principle device operation.

**QTh4C.7 • 17:45**
**Detection of Organic Gases in Ambient Air via Quantum Fourier-Transform Mid-Infrared Spectroscopy,** Simon Neves[1], Adimulya Kartiyasa[1], Shayantani Ghosh[1], Geoffrey Gaulier[1], Luca La Volpe[1], Jean-Pierre Wolf[1]; *[1]GAP - Biophotonics, Univ. of Geneva, Switzerland.* A Quantum FTIR spectrometer was used to detect, discriminate and track organic gases in ambient air with unprecedented sensitivity, leveraging spectral entanglement, induced coherence, long-path absorption, and specific analysis techniques such as DOAS.