Q 29: Poster – Quantum Technologies I

Networks, Repeaters, and QKD; Detectors and Photon Sources; Sensing; Solid State Systems; QuanTour

Time: Tuesday 17:00–19:00 Location: Philo 2. OG

Q 29.1 Tue 17:00 Philo 2. OG

Coupling light from an airplane to a single ion — •Hans Dang[1,2], Sebastian Luff[1,2], Martin Fischer[1], Sheng-Hsuan Huang[1,2], Thomas Dirmeier[1,2], Markus Sondermann[1,2], Christoph Marquardt[1,2], and Gerd Leuchs[1,2] — [1]Max Planck Institute for the Science of Light, Erlangen, Germany — [2]Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU), Erlangen, German

Trapped ions are promising candidates for establishing long-distance quantum networks. Their ability to reliably retain quantum information as quantum memories makes them ideal building blocks to create such networks [1]. However, the operation of a quantum network necessitates the exchange of information stored in quantum memories over long distances. An aerial link between ground stations is thus considered as a means to effectively transfer information. As a first step towards establishing long-distance communication, 935 nm photons originating from either a laser or a whispering gallery mode resonator on an airplane have been successfully coupled to a single $^{174}Yb^+$ ion trapped in a parabolic mirror on the ground. Adaptive optics and fibers are used to collect and guide light from the airplane to the ion. The parabolic mirror then focuses the infrared light onto the ion from nearly full solid angle, increasing the efficiency of coupling photons to the ion [2]. This flight experiment is part of the larger German QuNET initiative and aims to develop the technology needed to interface light from a moving source with a single trapped ion.

[1] N. Sangouard et al., Rev. Mod. Phys. 83, 33 (2011)
[2] L. Alber et al., J. Eur. Opt. Soc.-Rapid Publ. 13, 14 (2017)

Q 29.2 Tue 17:00 Philo 2. OG

Towards Quantum Frequency Conversion of Single Photons from Germanium-Vacancy Centers in Diamond — •Jannis Sode, David Lindler, Marlon Schäfer, Tobias Bauer, Felix Rohe, and Christoph Becher — Universität des Saarlandes, Fachrichtung Physik, Campus E2 6, 66123 Saarbrücken

The germanium-vacancy (GeV) center in diamond is a promising candidate for a quantum memory in quantum communication networks due to its large Debye-Waller factor of up to 0.7 and long spin coherence times of more than 20 ms [1]. To facilitate the distribution of entanglement via preexisting optical fiber infrastructure, it is necessary to convert the single photons emitted by the GeV center from the visible spectrum into the low-loss telecom bands.

Here, we present our work towards low-noise, two-stage quantum frequency conversion of single photons resonant to germanium vacancy centers in diamond. The conversion scheme utilizes difference frequency generation in periodically poled lithium niobate waveguides to convert 602 nm photons to 867 nm, followed by a subsequent conversion to 1550 nm. Such a two-stage conversion scheme has been shown to achieve low conversion-induced noise for the conversion of silicon-vacancy centers [2]. We show first results on the conversion efficiency, as well as spectral noise distribution.

[1] K. Senkalla et al. Phys. Rev. Lett. 132, 026901, 2024
[2] M. Schäfer et al. Adv Quantum Technol. 2025, 8, 2300228

Q 29.3 Tue 17:00 Philo 2. OG

Coherent Photon Number State Superpositions in Frequency Converted Photons from SnV Color Centers — •Tobias Bauer, Dennis Herrmann, Marlon Schäfer, David Lindler, Robert Morsch, and Christoph Becher — Universität des Saarlandes, FR Physik, Campus E2.6, 66123 Saarbrücken

Photon-number coherence (PNC) represents both a powerful resource and a potential security concern for optical quantum technologies: it enables encoding and manipulation of information in the photon-number degree of freedom [1], while deviations from ideal one-photon states can compromise the security of quantum communication protocols [2]. Recent advances with semiconductor quantum dots have shown that coherent driving can generate photon-number superpositions on demand with high purity [3], providing deterministic access to vacuum-one-photon states and opening new possibilities for advanced quantum information processing.

We extend these concepts to color centers in diamond by generating coherent photon-number state superpositions from a SnV-center using resonant excitation with varying pulse powers. We further demonstrate that these states are preserved after frequency conversion of the SnV-resonant photons to the telecom C band.

[1] Polacchi, B., Hoch, F., Rodari, G. et al., npj Nanophoton. 1, 45 (2024). [2] Karli, Y., Vajner, D.A., Kappe, F. et al., npj Quantum Inf 10, 17 (2024). [3] Loredo, J.C., Antón, C., Reznychenko, B. et al., Nat. Photonics 13, 803*808 (2019).

Q 29.4 Tue 17:00 Philo 2. OG

Polarization-entanglement distribution over a 28 km urban fiber link at telecom wavelength — •Akriti Raj[1], Tobias Bauer[1], Christian Haen[1], David Lindler[1], Quankui Yang[2], Thorsten Passow[2], Marko Härtelt[2], Jürgen Eschner[1], and Christoph Becher[1] — [1]Universität des Saarlandes, FR Physik, Campus E2.6, 66123 Saarbrücken — [2]Fraunhofer-Institut für Angewandte Festkörperphysik IAF, Tullastr. 72, 79108 Freiburg

Entangled photon pair sources are essential resources for quantum technological applications. AlGaAs Bragg reflection waveguides are promising platform for such sources due to their high nonlinear coefficient, room temperature operation, and non-birefringent nature [1]. By using a type-II SPDC process, the down-converted photons are orthogonally polarized, and the generated photon pairs are inherently polarization entangled. Here, we present the generation and distribution of polarization-entangled photons over a 28 km dark fiber link [2]. The link consists of commercial fiber, deployed both underground and overhead, includes several patching points, resulting in a transmission loss of $\approx$ 19 dB. The source produces a state with 95.7 % fidelity and 92.4 % purity w.r.t. the $|\psi^+\rangle$ Bell state. After transmission over the actively stabilized [2] fiber link, the fidelity reduces to 87.9 % due to residual uncompensated polarization rotation whereas the purity remains unchanged (92 %). In summary, we demonstrate a room-temperature entangled photon pair source at telecom wavelength, suitable for real world quantum applications.

[1] F. Appas et al., J. Light. Technol. 40 (2022).
[2] S. Kucera et al., npj Quantum Inf. 10, 88 (2024).

Q 29.5 Tue 17:00 Philo 2. OG

Narrow-band bi-chromatic photon-pair source for quantum repeaters — •Henning Mollenhauer[1,2], Alexander Erl[1], Morten Kallevik Straume[1,2], Leon Messner[2], Helen M. Chrzanowski[3], and Janik Wolters[1,2] — [1]DLR, Institute of Space Research, Berlin — [2]TUB, Institute of Physics and Astronomy, Berlin — [3]HUB, Department of Physics, Berlin

Distribution of singe photons and their storage in quantum memories are essential building blocks for quantum networks. Many previous implementations of single photon creation, photon distribution, and storage in quantum memories relied on frequency conversion and/or the need for cryogenic environments. Here we report on a photon-pair source, tunable to a quantum memory, compatible with telecommunication wavelengths, and operating at room temperature. The source utilizes spontaneous parametric down-conversion for emission of photon pairs at cesium D1 and telecom C-band wavelengths. A monolithic resonator [1] funnels photon emission into spatially and spectrally well-defined, narrow-band modes with a bandwidth 23 MHz. We present performance metrics of the source and our progress on achieving single-photon storage in a quantum memory. Expanding source and memory to realize entangled state storage will determine the system*s performance for future quantum repeater schemes. [1] Mottola et al. (2020)

Q 29.6 Tue 17:00 Philo 2. OG

Towards storage of c-band heralded photons in a room temperature quantum memory — •Morten Kallevik Straume[1,2], Alexander Erl[1,2], Henning Mollenhauer[1,2], and Janik Wolters[1,2] — [1]DLR, Institute of Space Research, Berlin — [2]TUB, Institute of Physics and Astronomy, Berlin

One of the limiting factors of current global quantum networks is the lack of efficient light-matter interfaces required for quantum repeaters. In recent years, considerable progress has been made in the development of room-temperature quantum memories and compatible narrow-band single-photon sources based on spontaneous parametric down-conversion (SPDC) [1]. Room-temperature quantum repeater platforms are particularly attractive because they avoid the need for cryogenic cooling, operate with significantly lower power consumption, and offer the most favorable scaling potential compared with other state-of-the-art approaches. Here we present our efforts to interface an optical quantum memory [2], utilizing a Λ-scheme implemented in the Cs D_1-line, with a matching telecom -c-band heralded bichromatic photon-pair source.

[1] R. Mottola et al. Opt. Express 28, 3159-3170 (2020) [2] L. Esguerra et. al. PRA 107, 042607 (2023)

Q 29.7 Tue 17:00 Philo 2. OG

Towards consumer-level quantum-secure cryptography using entanglement-based short-range quantum-key-distribution — •Marco Arnds, Luca Graf, Vincent Reissmann, and Ralf Riedinger — Institute for Quantum Physics, Hamburg, Germany

Quantum key distribution (QKD), which generates a cryptographic key via a quantum channel, has paved the way for physically secure communication. Over the last decades, most efforts in developing QKD focused on long-distance implementations, which are costly and challenging due to exponential losses of photons in quantum channels. An alternative approach is hybrid cryptography, where key distribution occurs over short distances, followed by quantum-secure classical encryption over long distances. Initially, an information-theoretically secure Root-of-Trust is exchanged via a quantum channel, which is stored on two end modules. Afterwards, this Root-of-Trust can be employed to generate encryption keys through a classical rekeying algorithm. In this approach, it is possible to spatially separate the end modules and communicate over existing classical infrastructure, since no quantum channel is required after initialisation. We present a compact source for entangled photon pairs that enables short-range QKD. In future work, we aim to implement low-cost end modules based on semiconductor electronics for the detection scheme of the experimental setup.

Q 29.8 Tue 17:00 Philo 2. OG

Towards telecom-to-visible fiber-integrated quantum frequency conversion — •Felix Rohe, Marlon Schäfer, Tobias Bauer, David Lindler, Jannis Sode, and Christoph Becher — Universität des Saarlandes, Fachrichtung Physik, Campus E2.6, 66123 Saarbrücken

Telecom quantum light sources such as quantum dots, as well as weak coherent laser pulses have recently been gaining importance for quantum repeater applications, by entangling the photons with quantum memory nodes, possessing long spin coherence times [1]. However, since most of the quantum memories exhibit an optical interface in the visible or near-infrared, telecom-to-visible quantum frequency conversion is crucial for long-distance quantum entanglement distribution. Here, we present a two-stage conversion scheme to tune single telecom photons to resonance with the tin-vacancy (SnV) center in diamond in a fiber-integrated design using a solid-core photonic crystal fiber (PCF) coupled to a periodically-poled lithium niobate (PPLN) waveguide. The signal photons at 1550 nm are converted to 619 nm in a two-step sum-frequency generation process using a strong pump field at 2062 nm. This fiber-integrated design offers increased robustness against fluctuations of ambient conditions, paving the way for operation outside of a controlled lab environment. We show first results on coupling and conversion efficiencies, as well as noise rates.

[1] Knaut, C.M. et al., Nature 629, 573-578

Q 29.9 Tue 17:00 Philo 2. OG

Towards low noise and high efficient quantum frequency converters in TFLN — •Jonas Babai-Hemati, Ernst-Lukas Kuhlmann, Silia Babel, Laura Bollmers, Laura Padberg, Harald Herrmann, and Christine Silberhorn — Paderborn University, Integrated Quantum Optics, Institute for Photonic Quantum Systems (PhoQS), Warburger Str. 100, 33098 Paderborn, Germany

Quantum memories, such as tin-vacancy centers in diamond, play an essential role in realizing quantum protocols. To link the wavelengths of these memories to the telecom wavelength, compatible quantum frequency converters (QFCs) with high efficiency and low noise are needed. The thin-film lithium niobate (TFLN) platform exhibits outstanding potential in supporting such processes highly confined in waveguides. However, current TFLN structures still suffer from fabrication inhomogeneities, which decrease efficiency and spectrally broaden frequency conversion processes. A spectral broadening of unwanted noise processes can cause a spectral overlap of noise with a wanted process. We simulate a single-stage difference-frequency generation (DFG) in TFLN. This process converts tin-vacancy emission at 619 nm, pumped at 1030 nm, to the telecom C-band (1550 nm). We simulate the efficiency decrease from fabrication tolerances in critical parameters such as the periodic poling structure and waveguide geometry. We also investigate the spectral broadening of noise processes to identify which parameters most strongly contribute to noise in the simulated single-stage DFG System.

Q 29.10 Tue 17:00 Philo 2. OG

Integrated Photonic Chips for Quantum Network Applications — •Tim Engling[1,2], Jonas C. J. Zatsch[1,2], Jeldrik Huster[1,2], Louis L. Hohmann[1,2], Shreya Kumar[1,2], and Stefanie Barz[1,2] — [1]Institute for Functional Matter and Quantum Technologies, University of Stuttgart, 70569 Stuttgart, Germany — [2]Center for Integrated Quantum Science and Technology (IQST), 70569 Stuttgart

Realizing quantum networks requires generating, manipulating, and measuring photonic qubits at network nodes. Additionally, quantum channels connecting different network nodes and an interface between quantum channel and network node are required.

Integrated photonics based on a silicon-on-insulator offers a versatile and robust platform for networked quantum applications because of efficient qubit state manipulation and photon generation via four-wave mixing. Between nodes low-loss quantum channels can be realized using single-mode fibers.

Here, we present our advances in generating single photons and preparing entangled states directly on a chip. Additionally, we present methods for interfacing qubit states between the node and the channel. With our approach, we can transmit maximally entangled qubits with high fidelity between two integrated photonic chips. This is an important step in implementing quantum network protocols.

Q 29.11 Tue 17:00 Philo 2. OG

Towards entanglement swapping between two WGMRs — •Sheng-Hsuan Huang[1,2], Yen-Ju Chen[1,2], Thomas Dirmeier[1,2], Kaisa Laiho[3], Dmitry Strekalov[1], Gerd Leuchs[1,2], and Christoph Marquardt[2,1] — [1]Chair of Optical Quantum Technologies, Friedrich-Alexander-Universität Erlangen-Nürnberg, Staudtstrasse 7/A3, 91058, Erlangen, Germany — [2]Max Planck Institute for the Science of Light, Staudtstrasse 2, 91058 Erlangen, Germany — [3]German Aerospace Center (DLR e.V.), Institute of Quantum Technologies, Wihelm-Runge-Str. 10, 89081, Ulm, Germany

Entanglement swapping is a key ingredient in building advanced quantum networks. To realize entanglement swapping, two sources capable of generating entanglement and producing indistinguishable quantum states are required. Optical whispering-gallery-mode resonators (WGMRs) have been shown to generate polarization entanglement and to produce indistinguishable photons [1,2]. Together, these features make WGMRs a promising platform for realizing entanglement swapping. In this poster, we will discuss our first results and the progress of entanglement swapping between two WGMRs.

[1] Huang SH., et.al., npj Quantum Information 10 (2024), 85
[2] Huang SH., et.al., APL Photonics 10 (2025), 056111

Q 29.12 Tue 17:00 Philo 2. OG

Towards a multi-qubit register based on the GeV color center in diamond for a quantum repeater node — •Simon Gregor Walliser, Katharina Senkalla, and Fedor Jelezko — Institute for Quantum Optics, Ulm University, Albert-Einstein-Allee 11, 89081 Ulm, Germany

The realization of quantum networks will enable secure end-to-end communication and offers a path to overcoming current limitations of quantum devices in terms of scalability.

In a quantum network, quantum repeaters are used to distribute quantum information over long distances. Quantum repeaters based on color centers in diamond are a promising candidate for quantum network nodes.

Group-IV color centers, such as the germanium-vacancy (GeV) center, exhibit long coherence times at millikelvin temperatures and a high Debye-Waller factor.

Additionally, the use of dynamical decoupling (DD) on the electron spin of the GeV center enables coherent control of surrounding ^{13}C nuclear spins.

In more complex quantum-repeater protocols, a higher number of coherently controllable spins is necessary.

In this work, we present our progress on the detection and coherent control of a weakly coupled ^{13}C nuclear spin in the presence of a strongly coupled ^{13}C nuclear spin by using the XY8 and other DD sequences.

Q 29.13 Tue 17:00 Philo 2. OG

Towards Practical Quantum Networks: Atom-Photon entanglement over a metropolitan fiber link — •Maya Büki[1], Pooja Malik[2], Tobias Frank[1], Marvin Scholz[1], Florian Fertig[2], Gianvito Chiarella[1], Yiru Zhou[2], Emanuele Distante[4], Pau Farrera[1,3], Harald Weinfurter[1,2], and Gerhard Rempe[1] — [1]Max Planck Institute of Quantum Optics, Garching, Germany — [2]Ludwig-Maximilians-University, Munich, Germany — [3]Munich Center for Quantum Science and Technology (MCQST), Munich, Germany — [4]University of Florence, Florence, Italy

Entanglement generation and distribution are key capabilities in order to build scalable quantum networks. While long-distance communication requires photons in the telecommunication band, interfacing with existing quantum infrastructure such as atomic quantum processors demands near-visible photons. Here, we demonstrate robust atom-photon entanglement over a distance of 23 km of fiber within the Munich metropolitan area. A single rubidium atom is entangled with a photon at 780 nm, which is converted to the telecom S-band and, after propagation over the long fiber, back-converted to its original wavelength. By using two tailor-made low-noise quantum frequency converters and mitigating polarization drifts and noise we achieve an end-to-end entanglement fidelity above 85%. This experiment demonstrates the integration of atomic quantum nodes with existing fiber networks and thus lays the foundation for practical long-distance quantum communication and information processing.

Q 29.14 Tue 17:00 Philo 2. OG

Atom-Photon Quantum Gate using an Atomic Clock Qubit — •Leart Zuka[1], Tobias Frank[1], Gianvito Chiarella[1], Pau Farrera[1,2], and Gerhard Rempe[1] — [1]Max-Planck-Institut für Quantenoptik, Hans-Kopfermann-Straße 1, 85748 Garching, Germany — [2]Munich Center for Quantum Science and Technology (MCQST), Schellingstr. 4, D-80799 München, Germany

Single atoms coupled to optical cavities provide a powerful platform for photonic quantum information processing. Minimizing the influence of external factors like magnetic field fluctuations is a key goal in this endeavor. In this work, we investigate a novel gate protocol that employs a single Rb^{87} atom prepared in a magnetic-field-insensitive clock qubit and coupled to a high-finesse birefringent Fabry-Perot cavity. The cavity's high birefringence creates two well-separated polarization eigenmodes, enabling polarization-selective reflectivity that depends on the atomic qubit state. This allows us to implement a CPHASE gate between the atomic clock states and our photonic qubits. We present simulations based on input-output theory and master-equation modeling that quantify the conditional reflection amplitudes, gate truth table, and resulting fidelities under realistic experimental imperfections such as finite mode matching, cavity loss channels, and multiphoton contributions. We further report on ongoing experimental progress towards implementing the protocol. Our results indicate that atom-state-dependent phase shifts on the photonic qubit are achievable in the current system, providing a viable path toward a robust, high-fidelity, cavity-assisted atom-photon quantum gate.

Q 29.15 Tue 17:00 Philo 2. OG

Interfacing a rack-mounted narrow-band photon pair-source with a quantum memory — •Leon Messner[1,2], Anne Rohwäder[1,3], Mathilde Kakuschke[1,3], Helen Chrzanowski[4], and Janik Wolters[2,3,1] — [1]Advanced Quantum Light Sources UG, Berlin, Germany — [2]German Aerospace Center (DLR), Institute of Space Research, Berlin, Germany — [3]Technical University Berlin, Institut of Physics and Astronomy, Berlin, Germany — [4]Institute of Physics, Humboldt-Universität zu Berlin, Berlin, Germany

We present initial findings on interfacing a rack-mountable photon-pair source with a ladder-type quantum memory in warm Cesium vapor.

The monolithic cavity source generates heralded single photons with bandwidth and frequency consistent with the used memory transition at the D1 line. Using compact, off-the-shelve components, we achieve 45% heralding efficiency and a rate of approximately 50 kcts/(s mW).

Leveraging the noise-free and high-bandwidth photon storage capabilities of our memory [2], we explore applications for heterogeneous quantum networking and synchronization tasks.

[2] Maaß, B. et al., Phys. Rev. Applied **22**, 044050 (2024)

Q 29.16 Tue 17:00 Philo 2. OG

Improving the response of SNSPDs in high brightness environments — •Paul Vatter[1], Niklas Lamberty[1,2], Timon Schapeler[1,2], and Tim Bartley[1,2] — [1]Department of Physics, Paderborn University, Warburger Str. 100, Paderborn, 33098, Germany — [2]Institute for Photonic Quantum Systems (PhoQS), Paderborn University, Warburger Str. 100, Paderborn, 33098, Germany

Superconducting nanowire single-photon detectors (SNSPDs) offer great value as highly efficient single-photon counters and possess a high signal-to-noise ratio even in low-light environments. We investigate possible improvements in the optical response of SNSPDs by varying their efficiency. A lookup table was created, mapping the count rate of an SNSPD to the incoming light intensity and its efficiency, enabling the calculations of signal-to-noise ratios. This data set reveals how the count rate of SNSPDs transitions into plateau and saturation regions at high incoming light intensity. By characterizing the signal-to-noise ratio behaviour across different operating regimes, we quantify how SNSPDs perform at high incoming light intensity when reducing their detection efficiency. These results pave the way for deploying SNSPDs in a broader range of applications, including those involving high brightness environments.

Q 29.17 Tue 17:00 Philo 2. OG

Electric Field Control of Optical Properties of Carbon Based Quantum Emitters in Hexagonal Boron Nitride — •Niklas Pichel, Mohammad Nasimuzzaman Mishuk, Julien Chénedé, and Tobias Vogl — Department of Computer Engineering, School of Computation, Information and Technology, Technical University of Munich, 80333 Munich, Germany

Color centers in two-dimensional hexagonal boron nitride (hBN) are a compelling platform for realizing stable single photon sources at room temperature. The possibility for on-chip integration of these quantum emitters into e.g. waveguides/photonic integrated circuits is especially appealing for realizing compact and scalable photonic quantum technologies. For these applications, the precise control of the spectral and polarization properties of the photons generated from these color centers plays a crucial role to achieve optimal performance of quantum communication systems or to generate indistinguishable photons required for quantum computing. In this work, we investigate the tunability of the emission wavelength and polarization axis as well as spectral linewidth of single photons emitted from quantum emitters in hBN by applying an external electric field in arbitrary directions. We furthermore perform time-dependent measurements to reveal how the polarization dynamics change under the influence of an applied electric field.

Q 29.18 Tue 17:00 Philo 2. OG

Electrical modelling of superconducting nanowire single photon detectors and challenges for detecting single photons — •Thushara Suraweera Arachchilage[1], Philipp Karl[1], Sandra Mennle[1], Michael Zimmer[2], and Harald Giessen[1] — [1]4th Physics Institute, Research Center SCoPE, and IQST, University of Stuttgart, Pfaffenwaldring 57, 70569 Stuttgart, Germany — [2]IHFG, University of Stuttgart, Allmandring 3, 70569 Stuttgart, Germany

Applications of superconducting devices have become a rapidly evolving research field, and superconducting nanowire single photon detectors (SNSPDs) play a key role in this area. Although some studies have reported improved signal-to-noise ratios (SNR), reproducing these published results has proven difficult. Analyzing these detectors using equivalent electrical-circuit models lead to improvements, and could be deployed for single-photon detection with high accuracy.

This study primarily focuses on the electrical behavior of SNSPDs. As an initial step, contact resistances were investigated, since these contribute significantly to the total impedance of a detector. The obtained contact resistances ranged from tens of ohms to a few hundred ohms, which can pose a major problem for impedance matching with measurement instruments when detecting faint signals.

These observations also highlight the need to study additional variables, such as substrate selection, contact-pad materials, and their oxidation properties, that may influence the SNR of SNSPDs. Identifying these critical problems is the first step toward solving them, and thus enables an improvement in existing SNSPDs.

Q 29.19 Tue 17:00 Philo 2. OG

Single-Shot Fingerprinting of Solid-State Quantum Emitters

— •Sonya Kukulina, Julien Chénedé, and Tobias Vogl — Department of Computer Engineering, School of Computation, Information and Technology, Technical University of Munich, 80333 Munich, Germany

Single-photon emitters in hexagonal boron nitride are promising building blocks for scalable quantum technologies, particularly quantum communication, due to their room-temperature stability, bright emission, and compatibility with nanophotonic integration. Realizing robust, integrated quantum devices requires a clear understanding and consistent classification of these defect centers, motivating the development of an efficient, integrated characterization framework.

This work presents an optical measurement platform designed for single-shot fingerprinting of individual quantum emitters. The system integrates confocal scanning photoluminescence imaging, fluorescence lifetime mapping, second-order correlation measurements, spectral analysis, and polarization control over both excitation and emission within a unified, software-automated architecture. Dual excitation channels provide through-objective and side-fiber excitation, while three detection outputs in reflection, transmission, and side channels provide comprehensive readout of optical characteristics. This parallel acquisition scheme enables simultaneous mapping of multiple emitter properties within a single apparatus, supporting systematic identification and yielding consistent benchmarking for the development of solid-state quantum communication systems.

Q 29.20 Tue 17:00 Philo 2. OG

Optimising time multiplexed multi-loop heralded single photon sources — •Zora Kutz[1,2,3], Xavier Barcons Planas[1,2,3], Lasse Wendland[1], Jasmin Meinecke[1], and Janik Wolters[1,2,3] — [1]Technische Universität Berlin — [2]Deutsches Zentrum für Luft und Raumfahrt — [3]Physikalisch-Technische Bundesanstalt

To achieve quasi-deterministic heralded single-photon sources, the probabilistic nature of spontaneous parametric down conversion can be mitigated with time-multiplexing. At the event of a photon-pair generation, the signal photon is stored in a switchable fibre delay line of single [1] or multiple loops [2] until release. Photons can be spaced at regular intervals for later use in computing applications. Implementing storage loops of different lengths reduces the amount of necessary round trips and thus also overall losses. A setup applicable for single or multi-loop usage was realised. For further optimisation, the effect of tip/tilt degree of freedom of a collimator lens on a single mode gaussian beam was investigated in its regard to mode matching.

[1] T. B. Pittman, B. C. Jacobs, und J. D. Franson,Phys. Rev. A, Bd. 66, Nr. 4, S. 042303, Okt. 2002

[2] E. Lee, S. M. Lee, und H. S. Park, Opt. Express, Bd. 27, Nr. 17, S. 24545, Aug. 20192

Q 29.21 Tue 17:00 Philo 2. OG

Characterization of the swelling behavior of hydrogels using a laser-written Mach-Zehnder interferometer — •Johannes Schnegas[1], Karoline Becker[2], Alexander Szameit[2], and Udo Kragl[1,3] — [1]Institute of Chemistry, University of Rostock, Germany — [2]Institute of Physics, University of Rostock, Germany — [3]Department Life, Light & Matter, Faculty for Interdisciplinary Research, University of Rostock, Germany

Hydrogels are 3D polymer networks that can absorb water depending on the surrounding media, such as salt concentration or pH. This allows the use of hydrogels as sensor materials. Swelling directly affects the refractive index of the hydrogel. An integrated optical interferometer, such as the Mach-Zehnder interferometer, is an appropriate sensor for investigating swelling-induced refractive index changes. Its chemical sensing capability has been demonstrated in the literature. In this study, a fs-laser-written MZI fabricated in fused silica was used, which is composed of two waveguides combined by evanescent field couplers. One part of each interferometer arm runs close to the glass surface. A sensor area was created by exposing one of these via mechanical polishing, whereas the other interferometer arm served as a reference. A liquid sample applied to the sensor area results in a shifted phase to which the interferometer responds with a change in the output intensity. This study examines the capability of a laser-written Mach-Zehnder interferometer to characterise the swelling behaviour of hydrogels in different surrounding media.

Q 29.22 Tue 17:00 Philo 2. OG

Fiber fluorescence spectra and their impact on NV-based sensors — •Stefan Johansson, Alexander Bukschat, Jonas Gutsche, Dennis Lönard, Alena Erlenbach, and Artur Widera — RPTU University Kaiserslautern-Landau, Physics Department and State Research Center OPTIMAS, Kaiserslautern, Germany

Optical fibers are widely used as light-guiding components in sensing applications, including quantum sensors based on nitrogen-vacancy (NV) centers in diamond. For such miniaturized, fiber-integrated NV magnetometers, background fluorescence generated within the fiber, arising from scattering processes and intrinsic photoactive impurities, can spectrally overlap with the NV centers' fluorescence. This autofluorescence reduces the signal-to-noise ratio and ultimately limits the achievable magnetic-field sensitivity, particularly when the number of active spins is small. We systematically analyze the optical emission spectra of commonly used optical fibers under excitation at wavelengths relevant for NV centers. We investigate the influence of the materials used in the fabrication process and fiber type, and we study how the generated background light scales with excitation power. Based on these measurements, we identify characteristic spectral features and evaluate which fibers introduce the lowest fluorescence background in the NV centers' detection band.

Our results provide practical guidelines for selecting optimal optical fibers for NV-based quantum sensors and offer insights applicable to a broader field of fiber-coupled fluorescence-based sensors.

Q 29.23 Tue 17:00 Philo 2. OG

Nanoscale Temperature Sensing with Nitrogen-Vacancy Centers in Diamond — •Anja Jovicevic, Wanrong Li, and Oliver Benson — Humboldt-Universität zu Berlin, Germany

Negatively charged nitrogen-vacancy (NV) centers in nanodiamond offer powerful quantum sensing capabilities, particularly for nanoscale thermometry. We exploit the temperature-sensitivity of the ground-state zero-field splitting (ZFS) in NV centers in nanodiamonds: as the diamond lattice expands thermally, the ZFS shifts, and we track the shift using optically detected magnetic resonance (ODMR) under controlled thermal conditions. Excitation is performed with a green laser, while microwave radiation drives the spin transitions; we monitor the resulting fluorescence in the red to near-infrared wavelength regime. We establish a temperature calibration based on the frequency shift of the ODMR resonance. Our measurements for the resonance frequency shift per Kelvin are in agreement with previously reported values of about -77kHz/K. We will introduce gold nanospheres as local heat sources and observe the induced temperature rise in nearby NV centers. This hybrid configuration is intended to form the basis for applications in biological environments: by combining quantum thermometry with localized heating, one could map and control temperature gradients inside living cells with nanometer precision.

Q 29.24 Tue 17:00 Philo 2. OG

Sparse Optimization of Quantum Fourier Transform Spectroscopy — •Chinmay Sangavadekar[1], Zhengjun Wang[1,2], and Frank Schlawin[1,2,3] — [1]University of Hamburg, Luruper Chaussee 149, Hamburg, Germany — [2]Max Planck Institute for the Structure and Dynamics of Matter, Hamburg, Germany — [3]The Hamburg Centre for Ultrafast Imaging, Hamburg, Germany

Nonlinear interferometers are of fundamental importance for quantum-enhanced photonic sensing. They are able to perform measurements in the infrared regime while relying only on the detection of visible photons and their interactions [1]. Here we present a theoretical framework for quantum Fourier transform infrared spectroscopy using a cw source where a full analytic expression for the quantum interferogram based on signal photon count rate is derived and the complex transmittance is extracted via Fourier transformation. We further explore how sparse optimization may reduce the necessary number of measurements and thereby speed up data acquisition.

[1] G. Barreto Lemos, M. Lahiri, S. Ramelow, R. Lapkiewicz, and W. Plick, "Quantum imaging and metrology with undetected photons: tutorial," J. Opt. Soc. Am. B 39, 2200-2228 (2022).

Q 29.25 Tue 17:00 Philo 2. OG

An all-optical magnetic field quantum sensor based on an ensemble of Tin-vacancy color centers in diamond — •Anna Fuchs, Fabian Voltz, and Christoph Becher — Universität des Saarlandes, Saarbrücken 66123, Germany

Quantum sensing promises new opportunities in applied physics and life sciences due to high sensitivity, precision, and high spatial resolution. A possible implementation of a quantum sensor that became well known in recent years is based on NV centers in diamond. Whereas NV center based quantum sensors are based on microwave manipulation

of their spin states, the negatively charged group IV-vacancy centers in diamond offer the option of an all-optical, microwave-free coherent control of their spin states. This allows for applications where the use of microwave fields is detrimental or technically challenging.
We here investigate an ensemble of negatively charged Tin-vacancy (SnV^-) centers for its suitability for quantum sensing. To this end we use an experimental implementation based on coherent population trapping where two spin states are coupled to an excited state via two laser fields. To detect small magnetic changes we fix the laser frequency to the steepest slope of the dark-state resonance and detect the Zeeman shift by a change in the absorption signal. We report first experimental results on characterising our sample for achievable sensitivities.

Q 29.26 Tue 17:00 Philo 2. OG

Design and optimisation of microantenna for quantum sensor — •Anish Thomas, Alena Erlenbach, Stefan Johansson, Dennis Lönard, Jonas Gutsche, and Artur Widera — RPTU University Kaiserslautern Landau

Nitrogen-Vacancy(NV) centers in diamond are defects with spin characteristics that serve as highly sensitive magnetometers. This makes them suitable for quantum sensing applications, such as magnetic imaging of biological specimens and study of other quantities such as electric fields, temperature and pressure. Initializing these spin state of these centers requires a strong, homogenous magnetic field, emitted by a micro antenna structure on the tip of an endoscopic fiber at the microwave near-field range. This study reports on simulations conducted of the antenna structure with different geometries to analyze the magnetic field within the NV diamond volume with varying parameters. With this, one can calculate, map out and optimize measurable Rabi oscillations with appropriate impedance matched conditions.

Q 29.27 Tue 17:00 Philo 2. OG

Hybrid photonic circuits for fundamental quantum physics — •Yigit Erarslan[1], Alessandro Palermo[2], Zoya Polschykova[2], Akhil Gupta[3], Josef Hloušek[1], Gregor Weihs[1], Rachel Grange[2], Robert Chapman[2], Tobias Vogl[3], and Robert Keil[1] — [1]Universität Innsbruck, Innsbruck, Austria — [2]ETH Zurich, Zurich, Switzerland — [3]Technical University of Munich, Munich, Germany.

Quantum mechanics accurately describes microscopic and many mesoscopic phenomena, yet it relies on postulates that must ultimately be tested experimentally.

We are developing an experimental platform to test two such foundations: the Born rule and the complex-valued nature of quantum amplitudes. Using single-photon multi-path interferometers, we aim to improve the accuracy of these tests by about one order of magnitude compared to the current state of the art, thereby narrowing the parameter space of generalised quantum theories.

The platform is a hybrid quantum system combining room-temperature single-photon emitters based on hexagonal boron nitride, quantum frequency conversion from visible wavelengths to the telecom C-band, and waveguide interferometers on a single lithium-niobate-on-insulator photonic chip. The contribution will present the experimental concept, the planned hybrid photonic circuit, the required steps for its fabrication and characterisation, as well as the targeted sensitivities for these precision tests.

Q 29.28 Tue 17:00 Philo 2. OG

Quantum Emission in Monolayer WSe2 Transferred onto InP Nanowire Waveguides — •Jasleen Kaur Jagde[1], Palwinder Singh[1,2], Megha Jain[2,3], Edith Yeung[2,4], David Northeast[2], Simona Moisa[2], Seid Mohammed[2], Jean Lapointe[2], Una Rajnis[1], Annika Keinast[1], Philip Poole[2], Dan Dalacu[2,3,4], and Kimberley Hall[1] — [1]Department of Physics and Atmospheric Science, Dalhousie University, Halifax, Nova Scotia B3H 4R2, Canada — [2]National Research Council Canada, Ottawa, Ontario K1A 0R6, Canada — [3]Centre for Nanophotonics, Department of Physics, Engineering Physics, and Astronomy, Queen's University, Kingston, Ontario, K7L 3N6, Canada — [4]University of Ottawa, Ottawa, Ontario, K1N 6N5, Canada

Two-dimensional materials like Transition Metal Dichalcogenides (TMDs) have shown exceptional promise for on-demand solid state single-photon emitters in which strain enables site-selective, localized quantum emitter formation. It is viable to integrate these within photonic structures such as waveguides using pick-and-place methods. In our study, we demonstrate quantum emission in monolayer WSe2 deposited onto horizontally aligned InP nanowire waveguides (NWs). The faceted nature of NWs renders control in tailoring the strain-induced QE locations relative to the traditional rectangular waveguide geometries by the potential orientation of QEs on the top surface for efficient coupling. Multiple bright and narrow emission peaks are observed in the 715-785 nm spectral range, along with g(2)(0) as low as 0.049, indicative of high purity single photon generation.

Q 29.29 Tue 17:00 Philo 2. OG

Cavity-Enhanced Molecular Qubits Based on Ground-State Triplet Carbene Molecules — •Nico Striegler[1], Simon Roggors[1], Thomas Unden[1], Alon Salhov[1], Oleksiy Khavryuchenko[1], Jochen Scharpf[1], Gregor Bayer[1], Nick Lester Jobbit[2], David Hunger[2], Martin B. Plenio[1], Alex Retzker[1], Fedor Jelezko[1], Matthias Pfender[1], Philipp Neumann[1], Tim R. Eichhorn[1], and Ilai Schwartz[1] — [1]NVision Imaging Technologies GmbH — [2]Karlsruhe Institute of Technology (KIT)

Molecular qubits have emerged as chemically tunable alternatives to point defects in solid-state systems. In this work, we present a molecular spin photon interface based on ground-state triplet carbene molecules embedded in a molecular matrix. These organic qubits feature two unpaired electrons that allow for optical initialization and readout with a fluorescence contrast exceeding 40%. Using photoactivation, we achieve precise control over qubit density and spatial distribution, resulting in long spin coherence times ($T_2 = 157(4)$ μs at 5 K). To enhance the spin-photon interaction, we integrate molecular crystals containing carbene molecules into optical microcavities and perform low-temperature characterization measurements.

Q 29.30 Tue 17:00 Philo 2. OG

Role of time delay in two-color excitation protocols — •Zahra Noorinejad, Thomas Bracht, Doris Reiter, and Moritz Cygorek — Condensed Matter Theory, Department of Physics, TU Dortmund, Dortmund 44221, Germany

Fast excitation of a quantum dot (QD) on the order ofpicoseconds is one of the most important ingredients in quantum optics and quantum photonics. It has been suggested to use two-color excitation to achieve population inversion, for example in Nature Physics, volume 15, 941*946 (2019) by Y. He et al., and in Phys. Rev. Lett. 126, 047403 (2021) by Z. X. Koong et al. We resolve the apparent contradiction between these two papers and attribute it to the role of the time delay between the pulses. By several examples, we show that by controlling the time delay, one can tune the resonant Rabi oscillation and thereby obtain complete population inversion. Finally, we calculate the effect of phonons on our results.

Q 29.31 Tue 17:00 Philo 2. OG

Laboratory management software: Plesty: Python Library for Experimental Science and Technology — •Maximilian Heller, Frederik Benthin, Christopher Borchers, Nico Eggeling, Tom Fandrich, Dolores Garcia de Viedma, Joscha Hanel, Martin Hesse, Marcel Pölking, Tom Rakow, Pavel Sterin, Fei Ding, Jens Hübner, and Michael Zopf — Leibniz Universität Hannover, Institut für Festkörperphysik, Appelstraße 2, 30167 Hannover

Optical measurements often involve complex protocols requiring the coordination of many different devices. Laboratory management software such as DynExp, MAHOS, NOMAD-CAMELS and Qudi assist in performing these tasks and can *inter alia* provide a unique framework for configuration and concertation of a fully equipped laboratory via, e.g., standalone graphical user interfaces (GUI) for device control.

Here we present Python Library for Experimental Science and Technology (Plesty), which is a highly modular, standards based Python framework for advanced laboratory control. Among the main design goals are automatic metadata recording, distributed device coordination, modular and flexible but standardized code organization as well as independent and common GUIs. Analyzer GUIs perform common analyses specific to, e.g. photoluminescence spectroscopy and time-correlated single-photon counting of quantum dot single-photon sources.

Q 29.32 Tue 17:00 Philo 2. OG

Characteristics of hBN emitters in different conditions — •Raphael Neubacher, Adam Lafferty, Helmut Hörner, Malaika Waheed, Ambika Shorny, Fritz Steiner, Alex Götz, Adarsh Prasad, Stefan Walser, and Sarah M. Skoff — Atominstitut, TU Wien, Stadionallee 2, 1020 Vienna, Austria

Many quantum technologies rely on the development of stable single photon emitters that work under ambient conditions. Hexagonal Boron Nitride (hBN) is a 2D wide bandgap semiconductor which hosts various atomic scale defects that act as optically active centres. Some of these defect states result in bright, stable and spectrally distinct emission of single photons under ambient conditions. The type of the obtained defects is influenced by several factors, such as manufacturing technique, annealing in different gases or suspension in different liquids. Here, we investigate the characteristics of different hBN emitters in different sample types and under different conditions and aim to narrow down the origin of the most common defect types that emit single photons in the visible range.

Q 29.33 Tue 17:00 Philo 2. OG

Coupling single molecules to high-frequency acoustic vibrations — •Mojtaba Aghakasiri[1], Mohammad Musavinezhad[1], Jan Renger[1], Tobias Utikal[1], Felix Mayor[2], Sultan Malik[2], Kaveh Pezeshki[2], Amir Safavi-Naeini[2], Vahid Sandoghdar[1], and Alexey Shkarin[1] — [1]Max Planck Institute for the Science of Light, Erlangen, Germany — [2]Department of Applied Physics, Stanford University, Stanford, USA

Single organic dye molecules are promising building block for solid-state photonic quantum technologies. At cryogenic temperatures they demonstrate strong light-matter interaction, negligible dephasing, and high spectral stability. However, they confront the challenge of nanosecond-scale coherence time limited by the optical excited state lifetime. One way to circumvent this restriction, is to couple molecules to localized acoustic modes in their environment, which could be engineered to have millisecond-scale lifetime.

Here we report on such a hybrid nanophotonic-nanomechanical platform that combines wavelength-scale acoustic waveguides with printed organic host nanocrystals containing single quantum emitters. By exciting guided acoustic modes, we induce a controlled strain field that drives the localized acoustic modes of the nanocrystal and dynamically modulates the molecular resonance frequency. This platform allows for systematic exploration of geometry-dependent coupling strength and mechanical mode lifetime, establishing a route towards engineering systems combining optical access of single quantum emitters and high coherence and versatility of mechanical systems.

Q 29.34 Tue 17:00 Philo 2. OG

Long optical and spin coherence of europium-based organic molecular qubits for quantum information applications — •Preethika Thiraviam[1], Vishnu Unni C.[1], Evgenij Vasilenko[1], Nicholas Jobbitt[1], Barbora Brachnakova[1], Senthil Kuppusamy[1], Timo Neumann[2], Mario Ruben[1], Michael Seitz[2], and David Hunger[1] — [1]Karlsruher Institut für Technologie, Karlsruhe, Germany — [2]University of Tübingen, Tübingen, Germany

Rare-earth doped solid-state materials offer long spin coherence and high-resolution optical transitions, positioning them as building blocks for scalable quantum technologies. Recent success in cavity integration highlights the growing viability in this approach [1]. Building on the results of [2], we investigate different molecular complexes to optimize optical and spin properties toward realizing an optically addressable spin qubit [3]. The increased branching ratio observed in our characterized complexes provide design guidelines for ligand-field engineering. Moreover, we demonstrate ion-ion interactions in both mono- and bi-nuclear complexes, opening a route to deterministic two-qubit quantum gates. Finally, we report first steps toward integrating molecular crystals in a fiber-based microcavity to enhance light-matter interactions [4] aiming to address single ions to implement high fidelity single and two-qubit gates.

[1] Ulanowski et al., PRX Quantum 6, (2025) [2] Serrano et al., Nature, 603, 241-246 (2022) [3] Vasilenko et al., arXiv:2509.01467 (2025) [4] Eichhorn et al., Nanophotonics,14, 1817 (2025)

Q 29.35 Tue 17:00 Philo 2. OG

Theory of Quantum Dot Photon Properties: Influence of Hot States and Phonons — •Jana Schlücking[1], Maximilian Aigner[2], Thomas Bracht[1], Eva Schöll[2], Armando Rastelli[2], and Doris Reiter[1] — [1]TU Dortmund University, 44221 Dortmund, Germany — [2]JKU Linz, Altenberger Straße 69, 4040 Linz, Austria

Semiconductor quantum dots are promising single-photon sources for quantum communication technologies. The generation of indistinguishable photons is essential for these applications, yet it is strongly affected by various decoherence mechanisms. In this work, we investigate how the interaction of a quantum dot and its solid-state environment affects photon indistinguishability as a function of temperature.

We start to model the quantum dot as a two-level system and account for its coupling to a non-Markovian phonon environment. The model is then extendend to include higher excited, so called hot states, which are connected to the excited state through temperature-dependent transitions. At low temperatures, the loss of coherence is mainly caused by pure dephasing processes, while at higher temperatures the decrease of the indistinguishability is dominated by the hot states dynamics.

Our results show excellent agreement between measurement and simulation, which demonstrates that the inclusion of such hot states is crucial to explain the temperature dependence of photon indistinguishability. These insights help to clarify the limitations of often assumed two-level system dynamics and offer guidance for optimizing quantum dots as applicable single photon sources.

Q 29.36 Tue 17:00 Philo 2. OG

Investigation on quantum emitters found in hBN — •Tuna Özdür[1] and Ozan Ari[2] — [1]METU, Ankara, Turkey — [2]Hacettepe University, Ankara Turkey

This work focuses on developing a low-cost, accessible platform to fabricate and characterize bright, room-temperature single-photon emitters (SPEs) in hexagonal boron nitride (hBN) nanoflakes. Using a simple drop-casting method combined with a photoluminescence microscopy, we aim to systematically identify and quantify SPEs suitable for integration into quantum photonic devices.

Q 29.37 Tue 17:00 Philo 2. OG

Deterministic preparation and retrieval of a dark state population in a semiconductor quantum dot for generating time-bin entangled photon states. — •René Schwarz[1], Florian Kappe[1], Yusuf Karli[1,2], Thomas Bracht[3], Saimon Corve da Silva[4], Armando Rastelli[4], Vikas Remesh[1], Doris Reiter[3], and Gregor Weihs[1] — [1]Institute of Experimental Physics, University of Innsbruck, Innsbruck, Austria — [2]Cavendish Laboratory, University of Cambridge, Cambridge, United Kingdom. — [3]Condensed Matter Theory, Department of Physics, TU Dortmund, Dortmund, Germany — [4]Institute of Semiconductor and Solid State Physics, Johannes Kepler University Linz, Linz, Austria

Semiconductor quantum dots are a highly versatile and promising solid-state platform for generating non-classical states of light. While state-of-the-art optical excitation methods target bright excitons or biexcitons, quantum dots can also accommodate optically dark excitons, which cannot be accessed directly via optical excitation methods. Dark exciton states exhibit significantly slower decay rates than their bright counterparts, making them ideal for the deterministic generation of time-bin entangled states [1]. In this work, we perform a full magneto-optical characterization (in-plane magnetic field) of the dark exciton state in a single GaAs/AlGaAs quantum dot emitting at ~800 nm. By combining the magnetic field mixing and chirped laser pulses, we demonstrate the deterministic preparation the dark exciton and a controlled retrieval of its population [2]. [1] Phys. Rev. Lett. 94, 030502 (2005). [2] Sci. Adv. 11.28, eadu4261 (2025)

Q 29.38 Tue 17:00 Philo 2. OG

Tunnelling-assisted excitation of two quantum dots in a nanowire — •Akaash Srikanth[1], Rohan Radhakrishnan[1], Rodion Reznik[3], Gilles Patriarche[2], George Cirlin[3], and Nika Akopian[1] — [1]DTU Electro, Technical University of Denmark, 2800 Kgs. Lyngby, Denmark — [2]C2N, Université Paris-Saclay, CNRS, 91120 Palaiseau, France — [3]St. Petersburg, Russia

Multi-quantum-dot systems provide a robust platform for realizing quantum registers and multi-photon resources such as 2D cluster states. Here, we introduce a tunneling-based excitation scheme in a system of two quantum dots. We first create a spatially indirect exciton delocalized across two dots. Subsequently, electron tunneling converts it into a spatially direct exciton, enabling a localized radiative recombination pathway and hence direct emission. To quantify how inter-dot separation shapes these dynamics, we grow a series of samples comprising two InGaAs quantum dots (growth times 2 s and 5 s) with varying spacings, embedded in AlGaAs nanowires. Finally, we assess whether this platform–scheme combination can outperform established excitation approaches, particularly (a) resonant excitation, which can lead to fluorescence loss, and (b) the SUPER scheme, which typically demands higher excitation powers.

Q 29.39 Tue 17:00 Philo 2. OG

Towards achieving Stirling Cooler operable Single Photon Sources — •Maximilian Aigner[1], Christian Weidinger[1], Eva Schöll[1], Armando Rastelli[1], Jana Schlücking[2], and Doris Reiter[2] — [1]JKU Linz, Austria — [2]TU Dortmund, Germany

For photonic quantum technology applications, a photon indistinguishability close to unity is essential, and even more desirable at elevated temperatures reachable by Stirling cryocoolers. Here, we present temperature-dependent two-photon-interference measurements of the negative trion in a GaAs quantum dot, in excellent agreement with theoretical predictions accounting for electron-phonon interaction and coupling to higher excited (hot) states. We find that the Hong-Ou-Mandel visibility VHOM drops from near unity indistinguishablity with VHOM = 0.966(6) at 4.5 K to VHOM = 0.048(37) at 55 K. We show that this loss can be primarily attributed to the interaction with energetically closely spaced excited trion states. Our results outline pathways toward maintaining high photon indistinguishability at elevated temperatures by employing Purcell enhancement of the emission rate and increasing the energy separation of the excited states.