Wednesday, January 19

12:30-1:00pm Registration

Opening Session

1:00 – 1:30pm Welcome and Opening Remarks by John Dennis, Optics Valley Chair with special guests Carol Stewart, Associate Vice President, Tech Parks Arizona and Karla Morales, Vice-President, Southern Arizona Regional Office , Arizona Technology Council

Quantum Information Science Session chaired by Stephen Fleming, Center for Quantum Networks, University of Arizona

1:30 - 2:00pm **Keynote: The Quantum Internet — Why Should We Care?**

Presenter: Saikat Guha, PhD, Director and Principal Investigator, Center for Quantum Networks (CQN) and Professor of Optical Sciences, University of Arizona

2:00 - 2:30pm **Decoding of Quantum Low-Density Parity Check (QLDPC) Codes**

Author and Presenter: Bane Vasić, PhD, Professor of Electrical and Computer Engineering and Mathematics at the University of Arizona and a director of the Error Correction Laboratory

Authors: Bane Vasić, Nithin Raveendran and Narayanan Rengaswamy

Abstract: Quantum error correction (QEC) codes are vital for protecting fragile qubits from decoherence. It has been widely recognized that they are indispensable for practical realizations of quantum computers, secure communications systems and

networks. Designing good QEC codes together with low-complexity, high-performance decoders is an important theoretical and engineering challenge facing scalable practical realizations of these systems. Decoders for QEC codes need to be powerful enough to correct the quantum errors, but also have low complexity and low latency to fight against the qubit decoherence. Achieving high qubit reliability with stringent latency constraints is extremely challenging, and is not possible by existing solutions. This talk introduces an advanced QEC scheme based on quantum low-density parity-check (QLDPC) codes. QLDPC codes are attractive because they support low-complexity iterative decoding algorithms such as Belief Propagation, however, iterative decoders are impacted by detrimental graphical configurations known as trapping sets present in a code graph as well as symmetric degeneracy of errors. These configurations significantly degrade the decoder decoding probability performance, and cause so-called error floor. We show that the knowledge of trapping set can be used to design better QLDPC codes and decoders. Decoding probability improvements of two orders of magnitude in the error floor regime are demonstrated for some practical finite-length QLDPC codes without requiring any post-processing.

2:30 - 3:00pm	Company Pitches: Finetech, Optilab

3:00 - 3:30pm	*Networking & Coffee Break hosted by Control Vision*
3:30 - 4:00pm	**Advances in Photonic Quantum Information Processing** **Presenter:** Matt Eichenfield, Distinguished Member of Technical Staff and Group Leader for MEMS-Enabled Quantum Photonics, Sandia National Laboratories
4:00 - 4:30pm	**Entanglement Routing in a Quantum Network and its Applications** **Authors and Presenters:** Emily Van Milligen, PhD student, CQN, College of Optical Sciences, University of Arizona and Ashlesha Patil, PhD student, CQN, College of Optical Sciences, University of Arizona **Abstract:** Shared entanglement generation is a key resource for a multitude of applications such as Quantum Communications and Secret Key Generation. In this talk, we first discuss the building blocks of quantum networks and give some protocols to generate and route entanglement in the network. We show the benefits of multi-path routing when a quantum network is only equipped to make Bell State measurements, although the rate of entanglement spread still decays exponentially with distance. One way around this is to allow for GHZ measurements, which can result in a distance independent rate given certain network conditions. Time Multiplexing is another tool we introduce that can further improve these protocols, although its effectiveness is determined by average rate of decoherence in

	the network. We finish the talk by discussing how to apply all these tools to distributive sensing in order to more precisely measure some given scene parameter. Lastly, we mention some future directions for our work.
4:30 - 5:00pm	Company Pitches: Quantum Technology

Welcome Reception hosted by Edmund Optics

5:00 - 6:30pm	Welcome Reception

Thursday, January 20

7:30-8:00am	Registration & Coffee hosted by Control Vision

Opening Session

8:00 - 8:30am	Welcome and Opening Remarks by Robert Walker, Vice President, Sales and Marketing, Leonardo Electronics US with special guests Thomas Koch, PhD, Dean of the Wyant College of Optical Sciences and Eric Miller, Principal, PADT and Chairman of the Board, Arizona Technology Council

Biomedical Technology Session chaired by Edward Dotherow, DrPH, Mel and Enid Zuckerman College of Public Health, University of Arizona

8:30 - 9:00am	**Keynote: Advanced Photonics for Miniature Endoscopes** **Author and Presenter:** Jennifer Kehlet Barton, PhD, Director BIO5 Institute, University of Arizona **Abstract:** Recent years have brought a revolution in miniature, high performance optics and photonics. Combined with new materials and advanced manufacturing techniques, it is now possible to create sub-mm to few-mm endoscopes that can gain new insight into the health of the human body in a minimally-invasive manner. I will discuss

work performed in my lab and others, to create small stand-alone or babyscopes incorporating reflectance, fluorescence, optical coherence tomography, and multiphoton microscopy imaging, including images of fallopian tube in vivo.

9:00 - 9:30am

Unique Cloud-based Medical Laser Platform for Phototherapy and Treatment Monitoring Glioblastoma

Author and Presenter: Jari Ovaskainen, Business Development Director, Modulight Corp.

Abstract: Personalized medicine is one of the main directions in the current cancer care. Patients can be pre-screened for different treatments based on a genetic profiling and the treatments can be adjusted to each patient accordingly. In photoimmunotherapy the treatment monitoring can be done optically in real-time and adjusting the treatment based on the retrieved data for each patient. To answer this need, Modulight has implemented a minimally invasive real-time optical treatment monitoring unit into medical laser platform ML7710. It has been designed to illuminate and retrieve spectral data from the tumor tissue simultaneously from up to eight different locations. The device can be tailored for several different multi-wavelength illumination and measurement configurations. Any number of the eight channels can measure the spectra from tissue and/or drug simultaneously while all other channels are delivering treatment illumination.

	Alternatively, one or more channels can be used at a time to produce spatial data about treatment progress. The laser with this optical monitoring feature is currently being tested in glioblastoma trials in Germany where patients receive photoimmunotherapy and treatment is tailored through spectral monitoring of the drug photobleaching. The medical laser is cloud-connected, and all diagnostic data is downloaded real-time into the analytics server. This enables machine learning and AI-based data analytics to process recorded data, which aims to help clinicians to make more informed treatment decisions and deliver the best treatment outcome to patients in future.
9:30 - 9:45am	**CREOL Presentation** by David Hagan, PhD, Dean and Director of the College of Optics and Photonics, University of Florida
9:45 – 10:00am	Company Pitches: Lightel
10:00 - 10:30am	*Networking & Coffee Break hosted by Control Vision*
10:30 - 11:00am	**Author and Presenter:** Curtis Thorne, PhD, Assistant Professor, BIO5 Institute and Assistant Professor, Cellular and Molecular Medicine, University of Arizona
11:00 - 11:30am	**Imaging Through Hair-Thin Optical Fibers Using Nanostructured Metasurfaces** **Author and Presenter:** George S. D. Gordon, PhD, Associate Professor and UKRI Future Leaders Fellow, Faculty of Engineering University of Nottingham
11:30 - 12:00am	Company Pitches: Company Pitches: Park Innovaare, AEMtec

12:00 - 12:30pm	**Industry Organization Presentations** by APOMA, GPA, Optica and SPIE
12:30 - 1:30pm	*Lunch & Networking hosted by Tech Launch Arizona*

Laser Technology Session chaired by Lukas Gruber, PhD, Business Development, Leonardo Electronics US

1:30 - 2:00pm

Keynote: Multi-Joule Diode-Pumped Tm: YLF Laser

Author and Presenter: Issa Tamer, PhD, Advanced Photon Technologies, NIF and Photon Science, Lawrence Livermore National Laboratory

Authors: Issa Tamer, Brendan A. Reagan, Thomas Galvin, Justin Galbraith, Emily Sistrunk, Andrew Church, Glenn Huete, Hansel Neurath, Drew Willard, and Thomas Spinka

Abstract: We present the first demonstration of a multi-joule diode-pumped Tm:YLF laser. The compact demonstrator setup, consisting of a Tm:YLF-based oscillator producing ~20mJ, 20ns pulses at 1880nm wavelength that seeds a diode-pumped four-pass Tm:YLF power amplifier, generated pulse energies up to 3.9J with a maximum net gain exceeding 200. No saturation effects were observed within this amplifier, as the output pulse energies increased exponentially with the input pump power. When the amplifier was seeded with the free-running oscillator, with pulse durations still significantly shorter than the 15ms radiative lifetime of Tm:YLF, energies of up to 38J were achieved. To the best of our knowledge, this represents over a 100-fold improvement in the

	highest reported pulse energy from a Tm:YLF amplifier, and nearly an order of magnitude higher energy than any laser operating near 2µm. These results show that Tm:YLF, when operated in an efficient high repetition rate extraction regime and combined with a high-capacity heat removal technique, has the potential to enable a new class of efficient, high peak and average power laser systems to meet the demands of next generation scientific and industrial applications.
2:00 - 2:30pm	**Single Frequency Fiber Lasers with Several Millijoules Energy and Tens Kilowatts Peak Power** **Author and Presenter:** Dr. Shibin Jiang, President and CEO, AdValue Photonics Inc. **Abstract:** Pulsed single frequency fiber lasers at 1micron, 1.55micron and 2micron wavelength using AdValue Photonics' proprietary fiber technology will be presented. Pulse energy of several millijoules and peak power of tens kilowatts are successfully demonstrated, which represent the best fiber laser performance in the world to the best of our knowledge. Their applications of such pulsed single frequency fiber lasers from Lidar to glass drilling will be discussed. Innovative glass and ceramic laser machining system will be presented.
2:30 - 3:00pm	Company Pitches: Photonics Automation Specialties, Ferdinand Braun Institute
3:00 - 3:30pm	*Networking & Coffee Break hosted by Control Vision*

3:30 - 4:00pm

Compact High Power Fiber Laser Systems

Author and Presenter: Jenna Bergevin, Sr. Project Engineer–Fiber Systems, Leonardo Electronics US Inc.

Authors: Jenna Bergevin, Bo Liu, Michael Oswald, Connor Magness, Christian Hemala, Xochitl Cooper, Mark Crowley, Clifford Headley, Prabhu Thiagarajan

Abstract: The industrial usage of fiber laser systems is ubiquitous with an emerging application in defense for directed energy systems. Desired attributes in these systems include: small size and weight, high efficiency and high-power output. Results from a multi-kilowatt fiber amplifier are presented, and system tradeoffs in reaching the desired metrics are discussed.

4:00 - 4:30pm

Fiber Laser Pump Modules: Review and Outlook

Author and Presenter: Dr. Hans-Georg Treusch, Owner, GTSolution

Abstract: Fiber lasers have shown the highest growth rate in power, efficiency and volume for the last two decades not only in industrial but also in all other fields of applications. Advantages in beam quality and electro-optical efficiency over competing lasers as well as the reduced complexity are building the pillars for this success. None of this would be possible without the main building block of the pump diodes and their progress during the same time period. The presentation will review the progress of these pump diodes focusing on some

	technical aspects, how power was increased from a few to several hundred Watt and cost was driven down by volume and automation. In conclusion some scenario to reduced size at the highest power level will be discussed.
4:30 - 5:00pm	Company Pitches: Arizona Thin Films, TANDA photonics, MJS Design

Supply Chain Industry Panel and Reception hosted by University of Arizona Wyant College of Optical Sciences

5:00 - 6:30pm	Supply Chain Industry Panel followed by reception. Panel moderated by Patrick Marcus, President, Marcus Engineering with panelists Victor Cruz, VP Operations, Leonardo Electronics US; Virginia Figueroa, Operations Manager, Edmund Optics – Tucson Design Center; and Brad Mora, Purchasing Manager, Ruda-Cardinal

Friday, January 21

7:30-8:00am	Registration & Coffee hosted by Control Vision

Opening Session

8:00 - 8:30am	Photonics Cluster Presentations moderated by Jack Schumann, Optics Valley Co-Chair with Anke Siegmeier, OptoNet; Frank Lerch, Optec BB; and John Dennis, Optics Valley

Sensing and Metrology Session chaired by Shelby Ament, PhD, Arizona Optical Metrology

8:30 - 9:00am	**Keynote: Silicon Photonics as a Mainstream Technology: Time to Get Real** **Author and Presenter:** Scott Jordan, Head of Photonics; Sr. Director, NanoAutomation; PI Fellow, PI (Physik Instrumente) LP

Abstract: Silicon Photonics emerged within the last decade and found its first home as the foundation for high-speed networking, especially in the data centers. Recently, opportunities have blossomed across exciting new fields, and we witness SiPh enabling applications as diverse and chip-scale LIDAR for smart cars, wearable health sensors, quantum computing, and high-speed peripheral connectivity for business and consumer interconnects. All these are expected to ramp to volume production within the next five years. And that's the problem: Whereas the top SiPh suppliers of data-center transceivers have proudly achieved run rates of 2 million devices per year, these new applications are projected to see volumes two to three orders of magnitude higher. The time has come for Silicon Photonics to mature, and to address longstanding bottlenecks in production processes. Most of these bottlenecks boil down to the lengthy timescales required to achieve the precise optical alignments required by many industrial test and assembly steps. A key example is how recent advancements in intelligent micro-positioning can now reduce the cost of complex alignment process steps by a factor of 100 or more. We review these and other innovations and discuss their foundational import for production economics as Silicon Photonics enters a demanding and consequential new phase.

9:00 - 9:30am

Microfabrication and Dielectric Characterization of DLaTGS Based Pyroelectric Infrared Detectors

Author and Presenter: Motasim Alomari, PhD, Senior Scientist, Laser Components Detector Group

Abstract: A simple and cost-effective industrial microfabrication process based on polishing and lapping theory has been applied experimentally on the water-soluble deuterated L-alanine-doped triglycine sulfate (DLaTGS) material. The microfabrication technique has been successfully scaled down the DLaTGS wafer to the micrometer scale without leaving undesired physical defects or cracks. Optical profilometry analysis shows that the surface roughness of selected microfilms is within one micron. The micro DLaTGS chips were used to make IR detectors after a series of processes which include mechanical and chemical treatments, metal electrode deposition and several cleaning and inspections steps. The results and analysis of DLaTGS detector at 1 kHz using dielectric and IR pyroelectric test stations show a specific detectivity (D*) between (2.61-3.44) ×108 (cmHz1/2/W) with relatively low signal-to-noise ratio (NEP) between (3.35 - 4.42) ×10-10 W/√Hz. The promising measurements of the dielectric and IR detection properties of the DLaTGS detectors indicate promising applications in the sensing and metrology field, including, but not limited to: Fourier transform infrared (FTIR) spectrometer detectors, air quality monitoring, alcohol

	detection, anesthesiology monitoring, IR-flame detection, atmospheric and space measurements, biomedical imaging, border patrol systems, earth resource detection, engine analysis, gas analyzers, human sensors, IR detection and spectrometers, and laser detection.
9:30 – 10:00am	Company Pitches: VIAVI Solutions, Darling Geomatics, Arizona Optical Metrology
10:00 - 10:30am	*Networking & Coffee Break hosted by Control Vision*
10:30 - 11:00am	**Manufacturing Metrology for Alternative-reality Optical Displays** **Author and Presenter:** Peter de Groot, PhD, Chief Scientist, Zygo Corporation **Abstract:** One of the most exciting developments in applied optics and photonics today is innovative wearable display systems for augmented-, virtual- and mixed-reality. Successful AR|VR|MR devices address a variety of challenges beyond the state of the art in conventional imaging systems, driven by ergonomics, size, weight, and the essential goal of a compelling immersive experience. The challenges of Immersive displays has accelerated the development of new optical components and subsystems, including freeform optics, planar waveguides, diffractive films, volume holograms, micro displays, 3D sensors, and even metamaterials. All of these components and associated assemblies require metrology for surface form, relational measurements, surface

texture analysis, and imaging quality. This presentation describes some of the unique components of alternative-reality optical displays, and addresses ways in which interferometric metrology is playing a role in the development, optimization and ultimately, production quality control of these products.

11:00 - 11:30am

Instrumentation of Laser Linewidth and Relative Intensity Noise Measurement

Author and Presenter: Emily Rodriguez, Photonics Engineer, Optilab LLC

Authors: Emily Rodriguez, Ke Huang and Leijun Yin

Abstract: Recently the rise of coherent optical communication and sensing sets the vast demand of narrow linewidth and low noise lasers. In such applications the required laser linewidth is typically below 1 MHz and can be as low as only a few Hz, below the resolution of the widely used optical spectrum analyzer (OSA). The relative intensity noise (RIN) of these lasers can also be approaching to the short noise level, making it difficult to measure. While these lasers can be characterized in a lab environment by photonics professionals using laboratory grade instruments and setup, a cost-effective measurement instrument is missing for use in mass production industrial environment by technicians with less photonics training. To address the market need, Optilab developed the laser linewidth analyzer (LLA) in a standalone 3U rackmount form for convenient

	laser linewidth measurement. Thanks to the broad photonics components portfolio that Optilab carries, the vertical integration of Optilab's existing photonics components based on the delayed self-heterodyne configuration enables the standalone and affordable instrumentation for laser linewidth and RIN measurement.
11:30 – 11:45am	Company Pitches: LLA Instruments/Fraunhofer IPMS
11:45- 12:00pm	**Arizona Technology Council Impact and Success** presented by Steven Zylstra, President and CEO, Arizona Technology Council
12:00 - 12:30pm	**SBIR Opportunities** presented by the Arizona Commerce Authority
12:30 - 1:30pm	*Lunch & Networking hosted by Leonardo*

Astronomy Session chaired by Richard Green, PhD, Steward Observatory, University of Arizona

1:30 - 2:00pm	**Aspera: The Far-ultraviolet SmallSat Mission to Unveil the Missing Universe** **Author and Presenter:** Dr. Carlos J. Vargas, Aspera Mission Principal Investigator, Assistant Professor & Assistant Astronomer, University of Arizona **Abstract:** For over half a century, observational astrophysics has been eager to detect and map the most massive baryonic component of galaxies: warm-hot phase coronal gas extending into the circumgalactic medium (CGM). This phase of gas is entirely unmapped in the nearby universe. The evolution of galaxies relies heavily on the properties of gaseous halos, indicating an urgent need to map these

understudied regions. In the last decade, high-efficiency reflective coatings for UV optics have experienced improvements in reflectivity per bounce and overall coating stability in the far UV (FUV). Detector technology sensitive to FUV wavelengths has seen steady development of Microchannel Plate (MCP) detector technology. In parallel with these advances, SmallSat missions with serious science objectives—which did not exist a decade ago—have emerged as a promising platform for high-impact science investigations. In this talk, I present Aspera (PI C. Vargas): a FUV SmallSat mission to detect and map warm-hot phase gas emission in nearby galaxies for the first time. The Aspera mission is designed to target the O VI emission line doublet from highly ionized oxygen, located at 1032, 1038 Å rest frame. Aspera combines a simple spectroscopic optical design using advances in highly-reflective FUV-coated optics with advanced UV MCP detectors to optimize throughput and sensitivity. Aspera will build multiple days of exposure time on each target to ensure spectroscopic detection and mapping of O VI emission. The Aspera concept was recently selected for funding in the inaugural 2020 NASA Astrophysics Pioneers Program ($20M) in January of 2021.

2:00 - 2:30pm

High Spectral Resolution Over a Wide Field of View: The Hyperion FUV Spectrograph

Author and Presenter: Dr. Erika Hamden, Hyperion Mission Principal investigator, Assistant

	Professor, Department of Astronomy, & Assistant Astronomer, Steward Observatory, University of Arizona
2:30 - 3:00pm	Company Pitches: Infrared Laboratories, Leibniz Institute for Astrophysics Potsdam, Salvo Technologies
3:00 - 3:30pm	*Networking & Coffee Break hosted by Control Vision*
3:30 - 4:00pm	**Imaging Exoplanets and Searching for Life with the Giant Magellan Telescope** **Author and Presenter:** Dr. Jared Males, Assistant Astronomer, Steward Observatory, University Arizona
4:00 - 4:30pm	**The NEID Spectrometer: A Revolution in Radial Velocity Precision to Enable the Search for Earth-Twin Exoplanets** **Author and Presenter:** Dr. Chad Bender, Associate Astronomer, Steward Observatory, University of Arizona
4:30 - 5:00pm	Company Pitches: TBA

Closing Session

5:00 - 6:00pm	Closing Remarks by Robert Walker, Vice President, Sales and Marketing, Leonardo Electronics US

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