2026 SPRC Annual Symposium:

Symposium handbook

Organized by Stanford Photonics Research Center and NTT-Research Inc.

Held at The James H. Clark Center, Stanford

Sept 14-16, 2026

Sept 14: Computing, data centers, and copackaged optics

8:30am	Doors open	
9:00am	Keynote & Welcome	
	The role of AI in meeting the challenges of getting to net-zero GHG emissions	Steven Chu
	Welcome and Monday overview	Armand Niederberger
10:00am	Coffee discussion	
10:30am	Session 1: Future of computing	Timothy McKenna
	Progress towards large-scale fault-tolerant quantum computing with photons	Pete Shadbolt
	Beyond photonic acceleration: Computing with gain-driven dynamics	Hiroki Takesue
	Revisiting prospects of photonic computing in the AI era	Sunil Pai
	AI-Assisted Discovery for Hardware–Software Co-Design Across the Computational Stack	Timothée Leleu
12:00pm	Lunch at Greenfish@NeXus	
1:30pm	Session 2: Datacenter communication	Krishna Muralidharan
	Optics for AI infrastructure	Andreas Bechtolsheim
	Near-Ideal Coherent Detection Without a Local Oscillator	Joseph M. Kahn
	Reliability-first Optical Links for AI Clusters	LK Bhupathi
	May the Fiber Be With (and Without) You! – An Industry Perspective on Assembly & Testing for Co-Packaged Optics	Gaurang Choksi
2:45pm	Coffee discussion	
3:15pm	Session 3: Copackaged optics	Bob Gardner
	The Next Beachfront Might be Optical	Phil Winterbottom
	An Opto-Electronic Heterogeneous Integration Platform to address AI Hardware Challenges	Ameet Bhansali
	Heat Assisted Magnetic Recording (HAMR) Journey	Zoran Jandric
	Materials and Design for Next-Generation Photonics	Giovanni Scuri

Sept 15: Materials, systems, and entrepreneurship

8:30am	Doors open	
9:00am	Keynote & Welcome	
	Lasers for Co-packaged Optics	Haisheng Rong
	Welcome and Tuesday overview	Armand Niederberger
10:00am	Coffee discussion	
10:30am	Session 1: Materials	Elham Fadaly
	Glass for Photonics	Matthew J. Dejneka
	Metasurface-based optoelectronics devices	Mark Brongersma
	AI for the Future of Electronics at the Quantum Limit	Matthias F. Kling
	Radiative Cooling	Shanhui Fan
12:00pm	Lunch at Greenfish@NeXus	
1:30pm	Session 2: Systems	DP Prakash
	A brief history of photolithography and the longevity of Moore’s Law	Ronald Goossens
	Meta-Refractives: Curved and Freeform Metaoptics by Inverse Design	Jonathan Fan
	3D Programmable Photonic Integrated Circuits	Bijoy Krishna Das
	Fusing Photonics and AI for the Maritime Domain	John Wood
2:45pm	Coffee discussion	
3:15pm	Open Session: Entrepreneurship & innovation	Homan Yuen
	VC Panel: Funding breakthroughs	Jorn Smeets, Roozbeh Parsa, Hidenobu Nagata
	Startup pitches	
4:30pm	Poster session	
6:00pm	Conference dinner	Kazu Gomi
	Ginzton Labs in 1990s: Photonics at Stanford	Jungsang Kim

Sept 16: Life science, sensing, and the future of photonics

8:30am	Doors open	
9:00am	Keynote & Welcome	
	The Breakthrough Is Just the Beginning: Lessons from Taking Photonics from Lab to Market	Yasaman Soudagar
	Welcome and Wednesday overview	Armand Niederberger
10:00am	Coffee discussion	
10:30am	Session 1: Life Sciences	María Belén Pérez-Ramírez
	Leveraging single molecule tracking for drug discovery	Camille Pataki
	Label-free live-cell imaging: Interferometric Image Scanning Microscopy provides 120 nm lateral resolution inside live cells	Michelle Kueppers
	Metasurface-Enhanced Raman Spectroscopy for Molecular Sequencing and Single-Cell Phenotyping	Jen Dionne
	Prosthetic vision with a photovoltaic substitute for the lost photoreceptors	Daniel Palanker
12:00pm	Lunch at Greenfish@NeXus	
1:30pm	Session 2: Sensing	Maxwell Drimmer
	How Advances in Photonics Can Enable Us to Find Life Beyond the Solar System	Ruslan Belikov
	Development of a Scanning Interferometer for Imaging Stars	Charles Santori
	Nonclassical Light on a Chip: New Tools for Sensing, and Knowing When Quantum Helps	Amir H. Safavi-Naeini
	Quantum sensing with atoms and atom-like systems	Joonhee Choi
2:45pm	Coffee discussion	
3:15pm	Session 3: Future of Photonics	Stefan Steiner
	Wide & Slow Optical Interconnects for Optical Scale-Up	Dominik Schulten
	Free-space Reconfigurable Optical Interconnects	Olav Solgaard
	GDSFactory: Python-Driven Design Automation for Photonic and Analog Chips	Joaquin Matres
	The Photonics Tera Era: A 30-Year Journey from Terabits to the Peta Society	Waguih S. Ishak
4:30pm	Wrap-up and close	

Sponsors

SPRC would like to thank our 2026 Symposium co-organizer:

NTT Research

As well as our sponsors, partners, and affiliate members:

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Contents

1 – Welcome to SPRC

1.1 Directors' welcome

Dear Colleagues, Partners, and Friends,

It is our great pleasure to welcome you to the 2026 SPRC Symposium. All of us at the Stanford Photonics Research Center (SPRC) are honored to have you with us for this three-day gathering of scientists, innovators, and industry leaders. Whether this is your first time attending or you are a long-standing friend of the center, we are thrilled to share these days of discussion, discovery, and collaboration with you.

Strengthening the fabric of the photonics community has been our long-standing motto. We work to connect experts from adjacent fields, to make collaboration and cooperation easy, and to provide the fertile ground in which innovation blossoms. Few breakthroughs come from a group working on its own; they come when people who rarely share a room compare notes, borrow a method from a neighboring discipline, and recognize a problem worth solving together.

Our program this year reflects that. We are glad to welcome participants from across the United States and from Canada, Europe and Asia, including colleagues from Germany, the Netherlands, Japan and India. More than 200 researchers, industry leaders, government representatives, founders, and investors are with us at Stanford, working in life sciences, computing, communications, quantum technologies, and much else besides.

Our three keynotes show how wide this field has become. On Monday, **Professor Steven Chu**, Nobel laureate in Physics and former U.S. Secretary of Energy, considers what artificial intelligence can contribute to reaching net-zero greenhouse gas emissions, and what its rising appetite for energy will cost in return. On Tuesday, **Haisheng Rong**, Senior Fellow for Photonics Technology at AMD, takes up the light source for co-packaged optics, the piece most people assume is settled and which is in fact the hardest to scale. On Wednesday, the third keynote comes from **Yasaman Soudagar**, who founded the neurophotonics company Neurescence and led it from first prototype to acquisition; she asks how to tell whether a problem solved in the laboratory can become a product, and what the attempt demands of the people who try it. Each talk opens its day and frames the sessions that follow.

Around those talks you will find sessions on photonic and quantum computing, datacenter interconnects and co-packaged optics, photonic materials, sensing, life-science instrumentation, and the work of turning research into a business. They are built for conversation as much as for content: between academia and industry, between young companies and established ones, and between the students, faculty, and practitioners who have traveled here to take part.

Collaboration has always been the point of this symposium. Researchers get to test their assumptions against people working one field over. Companies get an early look at the science, at the talent coming through, and at partnerships that shorten the road from result to product. What each of us carries home is worth more than what we brought.

The international turnout this year is especially welcome. Photonics is a global undertaking, and the distances colleagues have traveled to be here are a reminder of how far the consequences of this work reach, and of the responsibility that comes with it.

Finally, our thanks to the organizations whose support makes this symposium possible. We are grateful to NTT Research, our co-organizer and partner. We thank our affiliate members Corning, Hamamatsu, and Seagate for their continued commitment to the photonics community, and our sponsors Catalight, Credo, Jenoptik, PhotonDelta, Keymaker, imec.ventures, DP2Ventures, GDSFactory, EE Times, and eyeKick. We also acknowledge the startups taking part in the showcase and the elevator pitches: Besxar, Lucintis, Matter42, Sinovia Technologies, Amplify Computing, Ely SensorTech, Optaric, and Pumpkinseed, together with DP2Ventures and GDSFactory. Our thanks go as well to our colleagues at Ginzton Lab, GLAM, SystemX, Q-FARM, PULSE, Bio-X, the Gordian Knot Center, and the Stanford Optical Society.

On behalf of the entire SPRC team, welcome to the 2026 SPRC Symposium. We hope you find these three days inspiring, productive, and filled with new opportunities to collaborate. Let's strengthen the fabric of our community, learn from each other, identify and collaborate on key strategic challenges, and together push the boundaries of what photonics can achieve.

Thank you for being here.

Warm regards,

Armand Niederberger, Olav Solgaard, Jen Dionne, Mark Brongersma, Tom Baer

Directors, Stanford Photonics Research Center (SPRC)
Email: `photonics@stanford.edu`

1.2 SPRC Leadership

The Stanford Photonics Research Center (SPRC) is led by Executive Director Dr. Armand Niederberger, alongside its faculty co-directors, with the support of SPRC's administrative team and staff. The leadership team is comprised of the following people:

Armand C. R. Niederberger

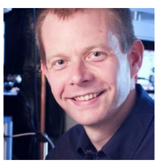
SPRC Executive Director

Expertise: Quantum optics, artificial intelligence, numerical optimization, algorithm development

Olav Solgaard

SPRC Faculty Co-director, Ginzton Lab Director, Professor

Expertise: Design and fabrication of nano-photonics and micro-optical systems



Mark L. Brongersma

SPRC Faculty Co-director, Professor

Expertise: Plasmonics, nano photonics, metasurfaces

Jennifer A. Dionne

SPRC Faculty Co-director, Professor

Expertise: Nanophotonics, plasmonics

Thomas M. Baer

SPRC Faculty Co-director, Adjunct Professor

Expertise: Entrepreneurship, frequency stabilized lasers and molecular spectroscopy, developmental biology, neuroscience

1.3 Mission and Membership

Mission

The Stanford Photonics Research Center (SPRC) fosters strategic partnerships between the Stanford photonics research community and industry, as well as with leading global photonics institutions.

Background

As one of the largest photonics programs in the United States, SPRC encompasses over 40 core faculty members and more than 200 scientists (including faculty, research scientists, postdoctoral scholars, and graduate students) from the Schools of Engineering, Humanities & Sciences, and Medicine. The research conducted at Stanford is inherently interdisciplinary, spanning areas such as lasers, optics, microscopy, quantum information and cryptography, neuroscience, solar cells, ophthalmology, and telecommunications, among others.

A significant portion of Stanford's photonics research is carried out in the Ginzton Laboratory, an independent research facility not confined to a single department. Ginzton Lab provides an open environment where researchers and students from diverse fields such as physics, applied physics, electrical engineering, mechanical engineering, and related disciplines collaborate on a wide array of photonics research. This includes work on lasers and ultrafast light pulses, quantum computing, and the development of photonic nanostructures.

Membership

Membership in the Stanford Photonics Research Center is available to companies interested in establishing collaborative relationships with the Stanford photonics community.

SPRC facilitates engagement between member companies and Stanford faculty, students, and researchers through a variety of avenues, including faculty-led working groups, SPRC workshops and symposia, collaborative research projects, and visiting researcher programs. Membership is governed by Stanford's Industrial Affiliates Program, which provides a framework for multi-faculty and multi-company interactions on pre-competitive research topics. Membership fees contribute directly to supporting photonics research and education at Stanford, and members benefit from enhanced access to students, faculty, and cutting-edge research. Key membership benefits include:

- Colloquia and symposia
- Special sessions
- Focused workshops

- Student recruitment opportunities
- Company focus days
- Visiting scientist programs

SPRC offers different membership tiers[1], each providing a distinct level of engagement:

- **Observer Status**: This introductory membership level is designed for companies and organizations seeking to familiarize themselves with Stanford's photonics research activities before determining specific faculty or Working Groups to support.
- **Standard Membership**: Standard Members may participate in one SPRC Working Group. Additionally, they have the option to allocate a portion of their membership fees toward research funding for a specific Stanford photonics faculty member or researcher, in alignment with SPRC Advisory Board and University policies.
- **Senior Membership**: In addition to the benefits offered to Standard Members, Senior Members are entitled to participate in multiple SPRC Working Groups and may also send one visiting scholar to collaborate with their chosen Stanford photonics faculty host.
- **Partner Membership**: Partner Members enjoy all the benefits of the other membership levels and they join the SPRC Advisory Board, giving them direct input into the center's strategic direction.

Contact

Companies and institutions interested in joining SPRC are cordially invited to contact any member of the leadership team, or to reach us via:

Address	**Stanford Photonics Research Center** 348 Via Pueblo Mall Suite 107 Stanford, CA 94305
Email	photonics@stanford.edu
URL	https://photonics.stanford.edu

[1] Membership tiers, fees, and benefits are subject to change without notice.

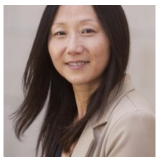
1.4 SPRC Faculty

SPRC is proud of the breadth of knowledge in photonics that its faculty brings to the table, listed in alphabetical order:

Eric Appel

Associate Professor

Expertise: Polymer Science, Biomaterials, Chemistry



Zhenan Bao

Professor

Expertise: Chemistry, Chemical engineering, wearable electronics

Stacey Bent

Professor

Expertise: Surface chemistry, interfaces, semiconductor processing, nanoscience, molecular probes, chemical engineering

Steven Block

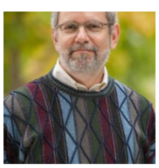
Professor, Emeritus

Expertise: Optical tweezers, single molecule biophysics, bimolecular motors

Mark Brongersma

Professor

Expertise: Plasmonics, nano photonics, metasurfaces



Philip Bucksbaum

Professor

Expertise: ARPES, strong-field laser-atom physics, ultrafast lasers, X-rays, free-electron laser

Robert Byer

Professor, Emeritus

Expertise: Lasers, nonlinear optics, Q-switched lasers, parametric oscillators, CARS spectroscopy

Thomas Clandinin

Professor

Expertise: Cellular neurobiology, visual computation, neurodegeneration, fly vision

Bruce Clemens

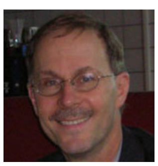
Professor

Expertise: Thin films, nanomaterials, phase transition, hydrogen storage, catalysis, advanced materials

Karl Deisseroth

Professor

Expertise: Optogenetics, hydrogels, neural adaption, neurostimulation, affective disorders, autism-spectrum disease



Michel Digonnet

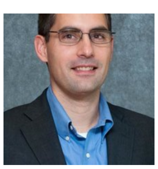
Professor

Expertise: Fiber optic sensors & gyroscopes, doped fiber lasers and amplifiers, anti-Stokes fluorescence, advanced metrology

Jennifer Dionne

Professor

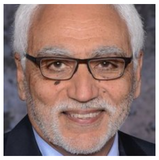
Expertise: Nanophotonics, plasmonics



Alfredo Dubra

Professor

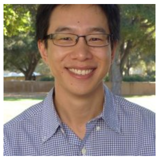
Expertise: Ophthalmology, vision loss, medical instrumentation



Abbas El Gamal

Professor

Expertise: Network information theory, FPGAs, digital imaging devices



Jonathan Fan

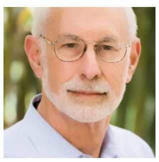
Associate Professor

Expertise: Nanophotonics, optical design, optical materials

Shanhui Fan

Professor

Expertise: Nanophotonics, photonic crystals, metamaterials



Michael Fayer

Professor

Expertise: ultrafast infrared and nonlinear UV/VIS characterization, mesoscopic chemistry, 2D IR spectroscopy, molecular chemistry

Robert Feigelson

Professor, Emeritus

Expertise: Crystal growth, thin films

Martin Fejer

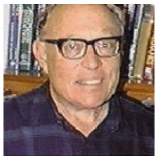
Professor

Expertise: Nonlinear and guided wave-optics, ferroelectrics, precision optical measurements, signal processing, quantum optics

Ronald Hanson

Professor

Expertise: laser-based diagnostics, shock tube methods, propulsion, combustion



Stephen Harris

Professor, Emeritus

Expertise: Lasers, quantum electronics, atomic physics, nonlinear optics

Lambertus Hesselink

Professor

Expertise: nano-photonics, ultra high density optical data storage, nonlinear optics, optical super-resolution, materials science, 3D image processing

Leo Hollberg

Professor

Expertise: quantum physics, atoms, lasers

Roger Howe

Professor, Emeritus

Expertise: sensors, actuators, MEMS

Joseph Kahn

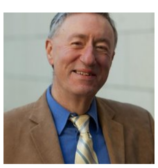
Professor

Expertise: Fiber optics, communication, imaging, spatial multiplexing

Mark Kasevich

Professor

Expertise: Atomic, molecular and optical physics



Leonid Kazovsky

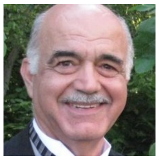
Professor, Emeritus

Expertise: hybrid optical / wireless networks, energy efficiency

Thomas Kenny

Professor

Expertise: MEMS, sensors, actuators



Butrus Khuri-Yakub

Professor, Emeritus

Expertise: Ultrasound imaging, therapy, transducers, fluid ejectors

Matthias Kling

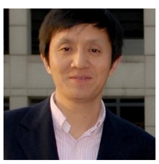
Professor

Expertise: Ultrafast optics, ultrafast electronics, nanophotonics

Benjamin Lev

Professor

Expertise: quantum many-body physics, quantum neural networks, quantum optics, ultra cold atoms, condensed matter physics



Liqun Luo

Professor

Expertise: neural circuitry, developmental biology, neurobiology

David Miller

Professor

Expertise: nanophotonics, quantum-well optoelectronics, optics in information sensing, interconnects, and processing

Subhasish Mitra

Professor

Expertise: Robust Computing & Hardware Reliability, NanoSystems & Emerging Nanotechnologies, Validation & Testing of Circuits and Systems

Daniel Palanker

Professor

Expertise: optical and electronic technologies for diagnostic, therapeutic, surgical and prosthetic applications, biomedical optics

Manu Prakash

Associate Professor

Expertise: Biological matter, morphological computing, tools for biology

David Reis

Professor

Expertise: Ultrafast phenomena, X-ray scattering, high-harmonic generation

Amir Safavi-Naeini

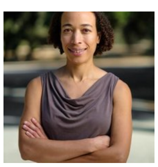
Associate Professor

Expertise: Integrated quantum systems, nanosystems, chip-scale optoelectronics, photonics, quantum technologies

Alberto Salleo

Professor

Expertise: large-area and flexible electronic/photonic devices, polymers, biosensors



Monika Schleier-Smith

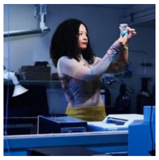
Associate Professor

Expertise: Quantum optics, laser cooling, atomic control, quantum simulation, metrology, computation

Mark Schnitzer

Professor

Expertise: neural circuit dynamics and optical imaging



Debbie Senesky

Associate Professor

Expertise: nanomaterials for extreme harsh environments, high-temperature electronics, and microgravity synthesis of nanomaterials

Olav Solgaard

Professor

Expertise: design and fabrication of nano-photonics and micro-optical systems

Jelena Vuckovic

Professor

Expertise: nanophotonics, quantum and nonlinear optics

Brian Wandell

Professor

Expertise: Vision Science

Gordon Wetzstein

Associate Professor

Expertise: Computational imaging, artificial intelligence, AR/VR

1.5 Acknowledgements

Science and innovation is ultimately about people, so we would like to acknowledge the insistu-tions and people who made this event possible:

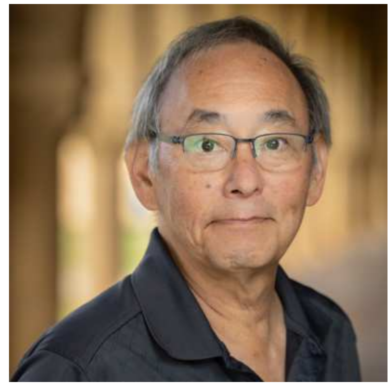
- **NTT-Research**: Without our co-organizers at NTT Research there would not have been an SPRC Symposium this year. Thank you very much Kazu Gomi, Tetsuomi Sogawa, Yoshi-hisa Yamamoto, Timothy McKenna, Chris Shaw, Sasha Dzeletovic, Kyoko Ohashi, and their teams.
- **SPRC Team**: Olav Solgaard, Jennifer Dionne, Mark Brongersma, Marty Fejer, Bob Byer, David Milller, Tom Baer, Waguih Ishak, Joseph Kahn, Shanhui Fan, and SPRC Faculty, as well as May Varlaro, Sara Lefort, Yurika Peterman, Darla Le-Grand-Sawyer, Shu-Chien Chang, María-Belén Pérez-Ramírez, Sonny Vo, Sadegh Dana, Lance Bell, and Steve Moskovitz.
- **Ginzton Lab**: Miguel Hernandez and team
- **Applied Materials**: Robert Visser and team
- **Bio-X**: Heideh Fattaey and team
- **Catalight**: Hidenobu Nagata, Kazuhiko Takahashi, Timothy McKenna and the whole team
- **Corning**: Claudio Mazzali, Boh Ruffin, Matt Dejneka, Paulo Dainese, Siavash Yazdanfar, James West, Ruchi Tandon, Steven Ogunwumi, and teams
- **Credo**: Bob Gardner and team
- **DP2Ventures**: DP Prakash and team
- **EE Times**: Cyrus Krohn, Chuck Davis, and team
- **Eyekick visual**: Richard Rudolph and team
- **GDS Factory**: Joaquin Matres and team
- **GLAM**: Marley Bauce and team
- **Gordian Knot Center**: Joe Felter and team
- **Greenfish café**: Eric Kim, Mina Park, Jean Martinez, Michelle Kim, and their catering team
- **Hamamatsu**: Reinhard Pahl, Ken Kaufmann and team
- **Jenoptik**: Thilo von Freihold, Stefan Steiner, Stephan Fahr, Ralf Kuschnereit, Adrian König, and teams

- **Keymaker**: Homan Yuen and team
- **PhotonDelta**: Jorn Smeets and team
- **Pumpkinseed**: Jack Hu and team
- **Q-farm**: Junna Gui and team
- **Seagate**: Zoran Jandric and team
- **Stanford Optical Society**: Michael Wahrman, Gabriel Moreau, Carson Valdez, Luke Qi, Devin Dean, Ryosuke Mashiko, and the whole team team
- **SystemX**: Ivo Bolsens, Rachel Zhang, and team
- all of the speakers, poster presenters, session chairs, and helpers
- and a huge thank you to all of you for attending, asking great questions, interacting, networking, and contributing to our photonics community!

2 – Sept 14: Computing, data centers, and copackaged optics

Themes and sessions at a glance:

- The opening day of the Symposium is dedicated to computing, the data center, and the optics that bind them together, and begins with a keynote address by **Professor Steven Chu**, Nobel laureate in Physics and former U.S. Secretary of Energy. He asks what role artificial intelligence can play in reaching net-zero greenhouse gas emissions, and what the growing energy appetite of AI itself will demand in return.
- **Session 1: Future of computing.** This session looks past conventional acceleration to machines whose own physics performs the computation. It opens with the path to large-scale, fault-tolerant quantum computing with photons, continues with gain-driven photonic dynamics and the coherent Ising machine, revisits whether programmable interferometer meshes still have a place in today's AI hardware, and closes with AI-assisted discovery of algorithms and architectures co-designed for real photonic hardware.
- **Session 2: Datacenter communication.** After the lunch break, attention turns to the links that hold AI clusters together. The session surveys the optics that AI infrastructure now demands, presents coherent detection that dispenses with the local oscillator laser, makes the case for reliability as a first-order design constraint rather than an afterthought, and closes with an industry perspective on assembly and testing for co-packaged optics.
- **Session 3: Copackaged optics.** The final session of the day follows co-packaged optics from architecture to the factory floor. It opens by asking where the optical beachfront of a package will ultimately sit, turns to a wafer-scale opto-electronic platform that collapses interposers, substrates and photonic interconnects into a single integrated structure, draws lessons from heat-assisted magnetic recording, one of the most successful high-volume deployments of photonics in a commercial product, and closes with the materials and design methods that could make the next generation of these links more efficient.



Steven Chu

William R. Kenan, Jr. Professor of Physics and Professor of Energy Science and Engineering
Stanford University

Interests and expertise:
Laser cooling and trapping of atoms, Optical tweezers, Atom interferometry, Single-molecule biophysics, Climate and energy policy, Batteries and direct air carbon capture.

Keynote, Monday, September 14, 2026

The role of AI in meeting the challenges of getting to net-zero GHG emissions

AI will play an important role in how the world deals with the challenges in mitigating risks and adapting to climate change. The challenges how to provide clean energy, water, air and food in a world of 8.3 billion people and projected to be 9.7 B by 2050 are formidable. Future applications of AI are likely to include the coordination of future electricity production, transmission and distribution, the development of new materials as enabling needed technologies, and transforming agriculture and health care. Simultaneously, the rapid growth and huge energy appetite of AI are adding significant challenges to eliminating GHG emissions and water use.

Bio: Steven Chu is Professor of Physics, Molecular and Cellular Physiology and Energy Science and Engineering at Stanford University. He received the 1997 Nobel Prize in Physics for laser cooling and trapping of atoms. Other contributions include the first optical tweezers manipulation of biomolecules, precision atom interferometry with ultra cold atoms and single molecule FRET of biomolecules. His current research includes fundamental molecular and cell biology, ultrasound imaging, batteries and direct air carbon capture.
From 2009 to 2013, he was U.S. Secretary of Energy, where he began ARPA-E and the Energy Innovation Hubs. As the first scientist Cabinet member in U.S. history, he recruited dozens outstanding scientists and engineers to the Department of Energy and was personally tasked by President Obama to help BP stop the Macondo Oil spill. Since joining Stanford in 1987, he helped initiate Bio-X, linking the physical and biological sciences with engineering and medicine, and the Kavli Institute for Particle Astrophysics and Cosmology.

2.1 Day 1, Session 1: Future of computing

Session host:

Timothy McKenna
Principal Scientist, Physics & Informatics Laboratories, NTT Research, Sunnyvale
Senior Technologist, Catalight Capital, Silicon Valley

Interests and expertise:
Computing, AI/neural networks, integrated photonics, nonlinear optics, quantum devices.

Bio: Timothy McKenna leads the Thin-Film Lithium Niobate (TFLN) team at NTT Research and builds photonic integrated circuits for optical AI acceleration and related applications. At Catalight Capital, he guides investments for technologies over the full AI datacenter stack, with a focus on hardware. Tim earned a Ph.D. at Stanford University where he developed cryogenic electro-optic transducers for quantum networking and developed the first TFLN optical parametric oscillator with colleagues. Before graduate school, he worked at the Johns Hopkins Applied Physics Laboratory conducting research in the fields of optical fiber communications, microwave photonics, and millimeter-wave systems. He holds a B.S. in electrical engineering from the University of Pennsylvania and M.S. and Ph.D. degrees in electrical engineering from Stanford University for work done in the group of Amir Safavi-Naeini.

Pete Shadbolt

Co-founder and Chief Scientific Officer
PsiQuantum

Interests and expertise:
Photonics, Quantum, Computing.

Session 1, invited talk, Monday, September 14, 2026

Progress towards large-scale fault-tolerant quantum computing with photons

In this talk we will describe progress towards large-scale, fault-tolerant quantum computing with photons. This talk will span materials innovations for high-performance photonics, improvements in photonic component performance with an emphasis on improved optical loss, prototype systems of entangled photonic qubits, qubit networking, and novel high-power cryogenic cooling solutions designed for future datacenter-scale quantum computers. We will show new prototype systems designed to progressively overcome the key challenges to scaling up photonic quantum computers. We will also give an overview of the architecture of fusion-based photonic quantum computers, describe near-term systems milestones, cover progress at PsiQuantum's main production sites, and give a view on the long-term roadmap to useful, fault-tolerant machines.

Bio: Pete Shadbolt is a co-founder and Chief Scientific Officer at PsiQuantum. He has worked on quantum computing for the last 15 years. Pete has a PhD in experimental quantum photonics from the University of Bristol and completed a postdoc in the theory group at Imperial College in London. In 2016, Pete and his co-founders moved to Palo Alto, California to start PsiQuantum.
PsiQuantum's only goal is to build and deploy a useful, fault-tolerant quantum computer. The company's photonic approach allows it to leverage high-volume semiconductor manufacturing and existing cryogenic infrastructure to rapidly scale its systems. PsiQuantum will build its first utility-scale quantum computers in Brisbane, Australia and Chicago, Illinois with public-private partnerships; and recently broke ground in Chicago on America's largest quantum computing project.

Hiroki Takesue

Senior Distinguished Researcher
NTT Basic Research Laboratories

Interests and expertise:
Photonic computing, Gain-based computing, Quantum communication.

Session 1, talk, Monday, September 14, 2026

Beyond photonic acceleration: Computing with gain-driven dynamics

Gain-driven photonic systems offer a distinct route to computation, in which the physical dynamics of light itself performs information processing. In this talk, I will introduce the coherent Ising machine as a platform for such gain-based computing. Originally developed for combinatorial optimization, the same system can also be used for sampling and, more recently, for prototype recall, where patterns that were never explicitly stored can emerge from correlated memories. These examples illustrate how different computational functions can arise from the same driven photonic dynamics, and suggest a broader vision of photonic computing that goes beyond accelerating conventional mathematical operations.

Bio: Hiroki Takesue received his B.E., M.E., and Ph.D. degrees in engineering science from Osaka University, Japan, in 1994, 1996, and 2002, respectively. After joining NTT Laboratories in 1996, he has been engaged in research on optical communication, quantum communication, and optical computing. He is currently a Senior Distinguished Researcher at NTT Basic Research Laboratories. He was a Visiting Scholar at Stanford University, Stanford, CA, from 2004 to 2005, and a Guest Researcher at the National Institute of Standards and Technology (NIST), Boulder, CO, in 2014.

Sunil Pai

Manager, Design Automation @ PsiQuantum
Stanford Physics ’15, EE PhD ’22

Interests and expertise:
Photonic computing, AI, quantum computing

Session 1, talk, Monday, September 14, 2026

Revisiting prospects of photonic computing in the AI era

Programmable meshes of Mach-Zehnder interferometers were proposed three decades ago as universal linear optical processors, and a decade ago they were recast as optical mode processors and neural network accelerators. The latter launched a wave of startups and well over a billion dollars of investment on the premise that matrix multiplication with light would break the energy scaling of deep learning. In 2022, we demonstrated the missing piece of that vision: in situ backpropagation, in which gradients for every phase shifter in a multilayer photonic neural network are measured optically by interfering forward and backward propagating light, and applied through an analog update that avoids digital subtraction. Our silicon photonic chip trained classification tasks on-chip in agreement with digital simulation, and our scaling analysis projected an energy advantage for 64-port systems.

That paper was in review when ChatGPT launched. In the years since, AI has transformed multiple industries and new interconnect bottlenecks have emerged for photonics (e.g. compute vs memory bandwidth, CPO vs pluggables), raising the question of whether such designs remain relevant in today’s ecosystem. This talk revisits mesh computing with the benefit of that hindsight. Drawing on our own experimental results and on what the field has since reported, I will examine whether there is still room for classical photonic computing in the AI era, identify the key energy bottlenecks, consider future development trajectories, and ask what other options may exist for the technology.

Bio: Sunil Pai is Manager of Design Automation at PsiQuantum, where he leads photonic simulation and EDA infrastructure for quantum computing hardware. He holds a B.S. in Physics (2015) and a Ph.D. in Electrical Engineering (2022) from Stanford, where he demonstrated the first in situ backpropagation on a photonic chip (Science, 2023). He previously worked on photonic inverse design at Google X.

Timothée Leleu

Senior Scientist, Group Head of Algorithm and Applications
PHI Lab, NTT Research (Sunnyvale, California); Visiting Scholar, Stanford University

Interests and expertise:
Combinatorial optimization, Ising machines, spin glasses, unconventional computing hardware, AI-assisted algorithm discovery.

Session 1, talk, Monday, September 14, 2026

AI-Assisted Discovery for Hardware–Software Co-Design Across the Computational Stack

The rapid growth of artificial intelligence is placing increasing demands on computing infrastructure in energy consumption, latency, and scalability. Analog and photonic accelerators offer a promising path toward more efficient AI computation, but physical non-idealities such as phase noise, crosstalk, gain errors, and quantization can fundamentally change which algorithms and neural network architectures perform well on hardware.

In this talk, I will discuss how large language models can be integrated into autonomous discovery loops for hardware–software co-design, while keeping evaluation grounded in physical models and measurements. As an example, I will present an approach for neural architecture discovery on Mach–Zehnder interferometer-based photonic accelerators. The method identified mechanisms that improve the robustness of neural network architectures to realistic photonic hardware noise. More broadly, I will discuss how AI-assisted discovery can identify new algorithms and design principles across the computational stack.

Bio: Timothée Leleu is a Group Head and Senior Research Scientist in the PHI Lab at NTT Research, where he leads the Algorithms & Applications group. His research spans Ising machines, combinatorial optimization, machine learning theory, and hardware–software co-design. Previously, he was a Project Associate Professor at the University of Tokyo, working on neuromorphic computing algorithms and architectures.

2.2 Day 1, Session 2: Datacenter communication

Session host:

Krishna Muralidharan
Director, Center for Semiconductor Manufacturing; Professor
University of Arizona

Interests and expertise:
Integrated computational materials engineering, semiconductor device technologies, advanced manufacturing, energy storage, planetary materials

Bio: Krishna Muralidharan is a Professor in the Department of Materials Science and Engineering at the University of Arizona, with joint appointments at the Lunar and Planetary Laboratory and in the Graduate Interdisciplinary Program in Applied Mathematics. He currently serves as Director of the Center for Semiconductor Manufacturing at the University of Arizona. His research focuses on implementing integrated computational materials engineering paradigms to push the frontiers of semiconductor device technologies, advanced manufacturing, multiscale energy storage systems, and planetary materials analysis. Muralidharan received his Ph.D. from the University of Arizona in 2004, and prior to joining the University of Arizona as a faculty member he worked at Los Alamos National Laboratory and at the University of Florida.

Andreas Bechtolsheim

Founder and Chief Architect
Arista Networks

Interests and expertise:
Extensive experience with system packaging, reliability and designing for high volume manufacturing

Session 2, invited talk, Monday, September 14, 2026

Optics for AI infrastructure

I will discuss the spectrum of optics applicable to AI Fabrics in terms of power consumption, robustness, cost effectiveness, and volume maturity.

Bio: Andreas ”Andy” Bechtolsheim is Co-Founder and Chief Architect of Arista Networks, a leading vendor of cloud networking solutions.
Previously, Andy was a Co-Founder and Chief System Architect at Sun Microsystems, responsible for next generation server, storage, and network architectures.
As a private venture investor, Andy has been involved in the funding of numerous companies including Google, VMware, Mellanox, and Brocade. He has served on the Board of Directors of over 25 companies, the majority of which went public or were acquired.
Andy earned a M.S. in Computer Engineering from Carnegie Mellon University in 1976 and was a doctoral student in Computer Engineering at Stanford University from 1977 to 1982.
He has been honored with a Fulbright scholarship, a Studienstiftung scholarship, the Stanford Entrepreneur Company of the year award, the Smithsonian Leadership Award for Innovation, and is a member of the National Academy of Engineering.

Joseph M. Kahn

Friis Professor of Electrical Engineering
E. L. Ginzton Laboratory, Stanford University

Interests and expertise:
Coherent optical communications; free-space optical communications; modulation, detection and signal processing methods; electro-optic combs; optimization-based photonic design; multimode and multicore fibers, amplifiers and passive components; modeling and control of multimode propagation

Session 2, talk, Monday, September 14, 2026

Near-Ideal Coherent Detection Without a Local Oscillator

Coherent detection of the Jones vector enables a fourfold increase in the capacity of optical communication systems compared to simple direct detection. Future scaling of information technology depends on intimate integration of photonics with electronics, and a grand challenge is how to adapt coherent detection to denser systems and shorter length scales. Coherent detection typically involves mixing a received signal with light at the same frequency from a local oscillator laser. While easily justified in telecommunications, this may be problematic in densely integrated systems, where we would like to avoid temperature stabilization of photonics. We have developed a coherent detection scheme that replaces the local oscillator laser with passive integrated photonics and digital signal processing algorithms. These algorithms combine several estimation and detection methods built on classical and quantum models of optical propagation and noise. Our scheme offers performance within about 0.5 dB of standard local oscillator-based coherent detection in short-reach optically amplified links.
Joint work with Thomas Horton-King (Stanford) and Thomas Strohmer (UC Davis).

Bio: Joseph M. Kahn is the Harald Trap Friis Professor of Electrical Engineering at Stanford University, where he leads the Optical Communications Group. He received a Ph.D. in Physics from the University of California, Berkeley in 1986. His achievements include: first successful synchronous (coherent) detection using semiconductor lasers (1989); first probabilistic shaping in optical communications (1999); founding of StrataLight Communications, market leader in first-generation phase-modulated fiber transmission systems (2000); first electronic compensation of fiber Kerr nonlinearity (2002), leading to digital backpropagation (2008); and elucidation of principal modes in multimode waveguides (2005), leading to statistics of strongly coupled modal group delays and gains/losses (2011). His current research interests include spatial multiplexing in submarine links, optical frequency comb generators, coherent data center links, and modal multiplexing and turbulence compensation for free-space optical communications. Kahn received the NSF Presidential Young Investigator Award (1991) and is an IEEE Fellow (2000).

LK Bhupathi

AVP, Product
Credo

Interests and expertise:
High-speed interconnects, optical solutions, semiconductor products, AI infrastructure and system architecture.

Session 2, talk, Monday, September 14, 2026

Reliability-first Optical Links for AI Clusters

Discussions of optical links usually focus on throughput, lane speed, power, and latency with reliability being an afterthought. In large-scale AI clusters, that order is backwards. At millions of endpoints and terabit-scale fabrics, a single flapping link can stall a training job across thousands of GPUs, making link-level resilience a first-order design constraint rather than a qualification checkbox.
This talk examines the technical and market pressures reshaping link reliability. We consider how wide-parallel optical architectures – many slow lanes rather than a few fast ones – shift the reliability equation by reducing the equalization burden that high-rate serial links demand while allowing for spare lanes. Drawing on Credo's ZeroFlap work as a case study, we discuss how distributed telemetry and intelligent optics deliver energy efficiency and scalability alongside a 100x improvement in MTBI (Mean Time Between Interruptions).

Bio: LK is Associate Vice President (AVP) of Product at Credo where he is responsible for defining, driving, and delivering innovative interconnect solutions to resolve high data-rate connectivity challenges in AI and data center infrastructure. He joined Credo from Ayar Labs where he served as Vice President of Products, Strategy and Ecosystem. Prior to this, LK was with Marvell Semiconductor in a variety of leadership roles across design, product, and technical marketing including Vice President, Product Management/Marketing at Aquantia (acquired by Marvell). He served as the President and Marketing Chair for the NBASE-T Alliance which has since merged with the Ethernet Alliance.
LK holds a Bachelor of Technology degree in Electrical Engineering from the Indian Institute of Technology, Madras; a Master of Science degree in Computer Engineering from Iowa State University; and an MBA from the University of California, Berkeley, Haas School of Business.

Gaurang Choksi

Strategic Advisor
Center for Semiconductor Manufacturing, University of Arizona, Tucson, Arizona

Interests and expertise:
Electronic packaging, assembly and testing; Co-packaged optics, Modeling, simulation and metrologies related to heterogenous integration.

Session 2, talk, Monday, September 14, 2026

May the Fiber Be With (and Without) You! – An Industry Perspective on Assembly & Testing for Co-Packaged Optics

Advances in electronic packaging have supported and sustained Moore's Law scaling and have increasingly evolved to enable technology integration and product / performance differentiation. The drive to ultra high bandwidth, lower energy per bit, and reduced latency in AI workloads has led to significant interest in co-packaged optics (CPO) technologies. This includes novel constructs, new materials, manufacturing processes, and associated modeling, simulation, and component/system level metrologies. Enabling high volume, cost-effective co-packaged optics-based systems necessitates significant improvements to the quantification and understanding of the complex response and interactions. The talk will highlight challenges and opportunities related to: Design & integration of optical engines with XPU's and associated co-design; Assembly complexities to be addressed for handling, alignment and coupling; Need for new reliability models and fundamentals of end-use conditions; Lack of in-line and off-line metrologies to support characterization and process control; and Standardization and supply chain readiness.

Bio: Gaurang Choksi retired as a Vice-President in the Technology Development organization at Intel Corporation in December 2024 and has over 38 years of experience in research & technology development. He joined Intel in 1988 after receiving his Ph.D. and during his tenure at Intel, he contributed to various areas related to 2.5D/3D heterogenous integration and electronic packaging & assembly process development. This included structural analysis and testing, electrical and physical design and analysis, analysis tool development, power delivery, high speed signaling, and thermal technologies. The scope of the organization included a diverse set of experimental, modeling, and simulation capabilities, supporting the fundamental understanding and quantification for optimization of assembly process, materials selection & characterization, and providing / assessing technology solutions. He is currently an advisor to the Center for Semiconductor Manufacturing at the University of Arizona and also serves as a technical advisor to companies in the semiconductor industry.

2.3 Day 1, Session 3: Copackaged optics

Session host:

Bob Gardner
AVP ALC Engineering
Credo Semiconductor

Interests and expertise:
Fiber-optic, optoelectronic, and microelectronics fabrication; advanced packaging; photonic interconnects; high-volume manufacturing and commercialization.

Bio: Bob Gardner leads development of ALC optical links complementing Credo's Active Electrical Cable (AEC) solutions. He has more than 30 years of experience in applied research, technology development, commercialization, and high-volume manufacturing, including 15 years at Hewlett-Packard's Optoelectronics Division and HP Labs/Integrated Circuits Business Division. His work spans fabrication of fiber optics, LEDs, and microelectronics; multi-chip modules and advanced packaging; and microdisplays. In automotive lighting, he co-invented and helped ramp what became the Dominant Design for LED-based lighting. At Flextronics, he helped ramp mobile-phone camera modules from zero to a $1B revenue run rate in just over a year. He is co-inventor of 60+ patents, including the Parallel Optical Transceiver Link, issued in 1996, an architecture that foreshadowed many of today's emerging parallel optical links. Bob holds a B.S. in Mechanical Engineering from Rice University and an S.M. in Management of Technology from MIT, where he studied technology innovation under Jim Utterback, co-originator of the Dominant Design concept.

Phil Winterbottom

SVP and CTO, Data Center Networking Business Group
Marvell

Interests and expertise:
Systems, Photonics, Memory/Compute Architecture.

Session 3, invited talk, Monday, September 14, 2026

The Next Beachfront Might be Optical

The transition path from Near-Packaged Optics (NPO) to Co-Packaged Optics (CPO) is well established. While significant work remains to scale manufacturing and test infrastructure, the underlying technology is well understood. Similarly, scaling higher-order modulation beyond 100G–first via Thin-Film Lithium Niobate (TFLN) and eventually plasmonic modulators–presents manufacturing challenges, but the foundational physics is clear. Where, then, are the next research frontiers in photonics? The answer lies in optical interfaces for increasingly dense packages with massive thermal footprints. Delivering light to embedded modulators and signal fibers within large complex packages–while maintaining compatibility with reflow assembly and overmolding–presents fertile ground for novel research.

Bio: Phil Winterbottom is Senior Vice President and CTO of the Data Center Networking Business Group at Marvell. Prior to Marvell's acquisition of Celestial AI, he served as Chief Technology Officer and co-founder of Celestial AI, where he architected the company's Photonic Fabric™ optical interconnect platform for disaggregated compute and memory systems.
Winterbottom is a veteran computer systems architect whose career spans key contributions to distributed operating systems at Bell Labs–including co-authoring the Plan 9 operating system–as well as founding multiple networking startups focused on advanced optical access platforms and high-speed communications architecture.

Ameet Bhansali

VP, Advanced Packaging & New Business Development
Office of the CTO, Applied Materials

Interests and expertise:
Advanced Packaging, Photonics, Quantum Computing & Sensing, Ideation & Incubation, Value Creation & Capture

Session 3, talk, Monday, September 14, 2026

An Opto-Electronic Heterogeneous Integration Platform to address AI Hardware Challenges

In this presentation we will discuss a disruptive heterogeneous integration platform to meet next-generation AI datacenter and HPC challenges. We collapse separate interposers, substrates, and photonic interconnects into a single wafer-based opto-electronic integration platform that is massively scalable. The platform holistically optimizes for interconnect performance, power delivery, warpage and thermals while using a novel approach to integrate photonic interconnect layers for extreme bandwidth needs.

Bio: Ameet Bhansali is Vice President at Applied Materials leading advanced packaging and business development in emerging and adjacent markets for the Office of the CTO. His previous roles include Vice President, Strategy & Corporate Development at Samsung Electronics and Vice President, Mergers, Acquisitions, Investments & Business Development at Intel Corporation. He has over three decades of experience in engineering, entrepreneurship, and corporate business development. He is a co-inventor of flip-chip technology and has made groundbreaking contributions to advanced packaging, heterogeneous integration, and photonic interconnects. He received his undergraduate degree from the Indian Institute of Technology (1986), an M.S. from Stanford (1988), and a Ph.D. from Stanford (1992).

Zoran Jandric

Senior Engineering Director
Seagate Technology / Seagate Research

Interests and expertise:
Photonics, Co-Packaged Optics, Advanced Sensing, Optical Data Storage, AI-Enabled Physical Systems.

Session 3, talk, Monday, September 14, 2026

Heat Assisted Magnetic Recording (HAMR) Journey

Heat Assisted Magnetic Recording (HAMR) represents one of the most successful high-volume deployments of photonics in a commercial product, enabling a new era of ultra-high-capacity data storage. This talk will highlight the multi-decade journey of developing and manufacturing HAMR technology, where a nanoscale laser, advanced optics, magnetic recording elements, and electronic control systems are co-packaged within the HDD read/write head and produced at massive scale. The presentation will discuss key technology innovations, integration challenges, and manufacturing breakthroughs required to transform a complex photonic system from research concept to billions of shipped devices, offering valuable lessons for the future of co-packaged optics and photonic-electronic integration across the industry.

Bio: Dr. Zoran Jandric is a Senior Engineering Director at Seagate Research, where he leads the Photonics & Physical Intelligence Vector, driving innovation across photonics, advanced sensing, robotics, and next-generation information technologies. Over the past two decades, he has led the development and commercialization of breakthrough technologies spanning photonics, LiDAR, MEMS/NEMS, precision electromechanical systems, and automation. Prior to his current role, Dr. Jandric founded and scaled Seagate's photonics and LiDAR research programs, advancing multiple technologies from early research through system-level demonstrations, strategic partnerships, and commercialization activities. He holds a Ph.D. in Mechanical Engineering from Southern Methodist University, is an inventor on 34 patents, and has authored more than 28 peer-reviewed publications. His current interests include photonics, co-packaged optics, advanced sensing, optical data storage, automation, and AI-enabled physical systems.

Giovanni Scuri

Staff Research Scientist
Department of Electrical Engineering, Stanford University

Interests and expertise:
Integrated photonics, Nanophotonics, Quantum photonics, Heterogeneous integration, Nonlinear photonics, Quantum information and networks

Session 3, talk, Monday, September 14, 2026

Materials and Design for Next-Generation Photonics

The rapid growth of artificial intelligence and quantum technologies is creating new demands for optical interconnects with higher bandwidth, lower energy consumption, and increased integration density. Meeting these requirements will require advances not only in photonic device design, but also in the materials used for active optical modulation. I will discuss our work on strontium titanate (STO), a highly tunable electro-optic material that exhibits an exceptionally large optical response at cryogenic temperatures, and its integration with scalable photonic platforms for efficient modulation and switching. Such materials provide new opportunities for optical interconnects in quantum systems and, more broadly, for high-performance active photonics and co-packaged optical architectures. I will also discuss photonic inverse design, which uses large-scale electromagnetic optimization to create compact, efficient, and fabrication-compatible photonic components with functionality difficult to achieve through conventional design. Together, new electro-optic materials and computationally optimized photonic circuits offer a path toward scalable, energy-efficient optical systems for next-generation computing and quantum technologies.

Bio: Giovanni Scuri is a Staff Research Scientist in the Department of Electrical Engineering at Stanford University, working in the group of Professor Jelena Vučković. His research focuses on nanophotonics and quantum science, with an emphasis on novel electro-optic materials for active photonic systems. He develops hybrid photonic platforms that combine advanced materials with optimized photonic circuits to enable efficient optical modulation, interconnects, and interfaces for quantum technologies. His work spans photonic inverse design, nonlinear and electro-optic materials, and solid-state quantum photonics. For this research, he was awarded the Bloch Postdoctoral Fellowship in Quantum Science and Engineering from the Stanford-SLAC Quantum Initiative (QFARM). Giovanni received a B.A. in Physics from Columbia University and a Ph.D. in Physics from Harvard University. As a doctoral student in Professor Hongkun Park's group, he developed optoelectronic devices in atomically thin semiconductors to explore quantum phenomena and realize miniaturized optical components.

3 – Sept 15: Materials, systems, and entrepreneurship

Themes and sessions at a glance:

- The second day turns from computing itself to the materials and systems that make it possible, and to the people who carry them to market. It opens with a keynote by **Haisheng Rong** on the light source for co-packaged optics, the component most often assumed to be solved and least ready to scale. He argues that its future may lie inside the package rather than on the front panel, and that what stands in the way is array yield, wavelength accuracy and materials rather than physics.
- **Session 1: Materials.** The morning works upward from the material itself. It begins with glass engineered specifically for photonics, moves to metasurfaces that fold optical function directly into optoelectronic devices, considers what ultrafast science and machine learning together reveal about electronics operating at the quantum limit, and closes with radiative cooling, where careful spectral design turns the sky into a heat sink.
- **Session 2: Systems.** The afternoon assembles those pieces into working systems. It opens with the history of photolithography and the question of what has kept Moore's Law alive so much longer than expected, continues with curved and freeform metaoptics produced by large-scale inverse design, turns to three-dimensional programmable photonic integrated circuits, and closes with photonics and AI fused for the maritime domain.
- **Open Session: Entrepreneurship & innovation.** The day then leaves the lecture format behind. Investors take the stage to discuss what it takes to fund a breakthrough, a series of startups pitch their companies to the room, and the session opens out into the poster session, where the conversation continues in front of the work itself.
- **Conference dinner.** The day concludes with our social and networking-focused conference dinner. This dinner is particularly geared towards *strengthening the fabric* of the photonics community by including not only scientists and R&D-focused industry leaders, but also investors, lawyers, advisors, and other members of the wider tech and innovation community. The Dinner Keynote sets the tone for the evening: **Jungsang Kim** looks back at the photonics done at our own Ginzton Lab in the 1990s, when a cluster of wartime buildings kept fiber and nonlinear optics, quantum optics, superconductivity and condensed matter within earshot of one another, and at the people who did it.

Haisheng Rong

Senior Fellow, Photonics Technology
Advanced Micro Devices, Inc.

Interests and expertise:
Silicon photonics, co-packaged optics, heterogeneous photonics integration, fiber optics, optical compute interconnect.

Keynote, Tuesday, September 15, 2026

Lasers for Co-packaged Optics

As high-density AI clusters and hyperscale data centers push conventional pluggable transceivers toward their bandwidth, power, and scalability limits, Co-Packaged Optics (CPO) has emerged as the leading architecture for next-generation optical interconnects. A critical enabler of scalable CPO platforms is the laser source, which must simultaneously deliver high optical power, high efficiency, low noise, precise wavelengths, and long-term reliability under demanding operating conditions. This talk reviews recent advances, evaluates key architectural trade-offs, and addresses the remaining technical and manufacturing challenges in laser development for CPO. Furthermore, it examines the system-level implications of laser integration, highlighting the co-design of optical engines, packaging architectures, and thermal management strategies that are essential for commercially viable, high-volume production. Finally, the presentation discusses emerging trends and future directions in laser technologies that will drive scalable, energy-efficient optical connectivity for next-generation AI infrastructure.

Bio: Haisheng Rong is a Senior Fellow for Photonics Technology at AMD, leading laser technology development for co-packaged optics. Before joining AMD, he led silicon photonics research at Intel Labs, where he and his team pioneered several industry breakthroughs, including the first silicon-based continuous-wave laser, high-speed microring modulators exceeding 100 Gb/s, heterogeneously integrated optical transceiver chips, quantum-dot lasers on 300 mm silicon wafers, and high-volume optoelectronic testing platforms. He received his Ph.D. in physics from Heidelberg University, holds over 60 US patents, and has authored more than 120 publications. He is a Fellow of IEEE, Optica, and SPIE, and serves on the IEEE Photonics Society Board of Governors. His honors include the Scientific American 50 Award, the Paul F. Forman Team Engineering Excellence Award, the Photonics 100 Award, and the Intel Achievement Award.

3.1 Day 2, Session 1: Materials

Session host:

Elham Fadaly
Senior Photonics Research Scientist
Apple Inc.

Interests and expertise:
Advanced semiconductor materials epitaxy and characterization, integrated photonics, and their applications in sensing, optical communications, quantum technologies, and display systems.

Bio: Elham Fadaly is currently a senior photonics research scientist at Apple, US. Cupertino. She earned her Ph.D. in Applied Physics with cum laude (honors) from Eindhoven University of Technology. She holds a dual master's degree in Nanoscience and Nanotechnology with a concentration on nanoelectronics from Katholieke Universiteit Leuven (Belgium) and Chalmers University of Technology (Sweden), and a bachelor's degree in Electronics Engineering from The American University in Cairo (Egypt); both completed with the highest honors.
Fadaly's pioneering research work on direct bandgap hexagonal silicon-germanium has been internationally recognized, earning her the Christian Huygens Science Award, the 2023 Martinus van Marum Prize from the Royal Dutch Society of Sciences and Arts, and inclusion in MIT Technology Review's Innovators Under 35 Europe (2022). Her research was also celebrated with the Physics World "Breakthrough of the Year" (2020) and the Falling Walls Foundation's "Breakthrough of the Year in Physical Sciences" (2021). In 2024, she was awarded the Egyptian-American Organization Youth Leadership Award is that recognizes the promise and potential of Egyptian Americans under 40 and in 2021, she was named among the 21 influential Egyptian women inspiring the next generation of women in STEM by the Dutch embassy in Cairo.

Matthew J. Dejneka

Corporate Fellow
Corning Research & Development Corporation

Interests and expertise:
Glass, glass-ceramics, rare earth doped materials, ion exchange optical materials.

Session 1, talk, Tuesday, September 15, 2026

Glass for Photonics

Matthew J. Dejneka, Alex Streltsov, Lars Brusberg, Jorge Holguin-Lerma, Luis Zenteno, Lauren Taylor, Charisse Spier, and Jonathan Walter.
Glass has unique properties that enable everything from spectral tunability, fiber drawing, and refractive index grading for fiber amplifiers to precision sheet forming and ion exchange for planar waveguides to thermal history dependence for thermal tempering and laser waveguide and lens writing. We will explore how the oddities of glass give rise to these capabilities and how they can be harnessed to create advanced photonic structures and devices including multichannel optical amplifiers, micro lens arrays, 3-D upconversion displays, and record low loss planar waveguides used to make 6.4 Tb/s fiber to chip fan ins that can take the heat of tomorrow's data centers. Finally, we will discuss the coupling, modeling, supply, and mechanical challenges that remain on the frontiers of glass technology. Come join the discussion.

Bio: Matt is a Corporate Fellow at Corning. He designs and discovers new glass and glass-ceramic compositions for mechanical, optical, electrical, magnetic, and aesthetic properties. He joined the Glass Research department at Corning in 1995. Dr. Dejneka invented compositions and processes to make novel fiber lasers, filters, amplifiers and Corning® Gorilla® Glass. He invented families of transparent glass-ceramics including rare earth fluorides, ferrite spinels, tungstates, and tantalates. He also contributed to record low loss ion exchange waveguides and record high gain fiber amplifiers. Matt earned a Ph.D. in ceramic science and engineering from Rutgers University in 1995. He was the recipient of the 2004 Weyl International Glass Science Award and the Karl Schwartzwalder Professional Achievement in Ceramic Engineering (PACE) Award in 2005. He was appointed a Fellow of the American Ceramic Society in 2012. He has 156 granted patents and 50 referenced publications, including two book chapters.

Mark Brongersma

GLAM Director, Steve Harris Professor of Materials Science and Engineering and, by courtesy, of Applied Physics
Geballe Laboratory for Advanced Materials, Stanford

Interests and expertise:
Nanoscale Optoelectronics and Photonics Metasurface Optics.

Session 1, talk, Tuesday, September 15, 2026

Metasurface-based optoelectronics devices

In the field of optics, we are used to direct and control light waves with bulky optical components, such as a glass lens. The recent development of metasurfaces has brought many exciting new ways to manipulate the flow of light. These are essentially flat optical elements comprised of dense arrays of nanostructures that can cleverly harness light scattering and interference effects to redirect and control light waves. They can be created by nanopatterning thin glass, semiconductor and metal films. I will argue that these metasurfaces are ideal building blocks for the next generation of optical elements and optoelectronic devices. As for examples, I will highlight how metasurface functionalities are starting to impact a variety of optical sensing, imaging and display technologies. The proposed optical elements can be fabricated by scalable fabrication technologies, opening the door to many commercial applications.

Bio: Mark Brongersma is the Stephen Harris Professor of Engineering at Stanford University. He leads a research team of ten students and five postdocs. Their research is directed towards the development and physical analysis of new materials and structures that find use in nanoscale electronic and photonic devices. He is on the list of Global Highly Cited Researchers (Clarivate Analytics). He received a National Science Foundation Career Award, the Walter J. Gores Award for Excellence in Teaching, the International Raymond and Beverly Sackler Prize in the Physical Sciences (Physics) for his work on plasmonics, and is a Fellow of the OSA, the SPIE, and the APS. Mark received his PhD from the FOM Institute AMOLF in Amsterdam, The Netherlands, in 1998. From 1998-2001 he was a postdoctoral research fellow at the California Institute of Technology.

Matthias F. Kling

Director, Stanford PULSE Institute, SLAC National Accelerator Laboratory
Professor of Photon Science and (by courtesy) of Applied Physics, Stanford University; Co-founder, Matter42

Interests and expertise:
Ultrafast Electronics, Nanophotonics, Optoelectronics, Laser Optics, X-ray Science

Session 1, talk, Tuesday, September 15, 2026

AI for the Future of Electronics at the Quantum Limit

The performance and energy footprint of tomorrow's electronics depend on our ability to measure, control, and manufacture materials and devices at the quantum limit. I will discuss how AI is reshaping research and development in this space: physics-informed surrogate models that predict materials behavior orders of magnitude faster than first-principles simulation, and machine learning that turns data into physical insight. Together these threads point to a tighter loop between fundamental science, AI, and the design of the energy-efficient electronic and quantum materials and related devices the coming decades will demand.

Bio: Matthias Kling is Professor of Photon Science at SLAC and Applied Physics (by courtesy) at Stanford University and Director of the PULSE Institute, jointly operated between Stanford and SLAC. With a background spanning physics, laser physics, and physical chemistry, he earned degrees from the Universities of Göttingen and Jena before completing postdoctoral research at UC Berkeley and AMOLF in Amsterdam. From 2007 to 2021, he led a research group within the Laboratory of Attosecond Physics at the Max Planck Institute of Quantum Optics and held faculty positions at Kansas State University and the University of Munich. Matthias joined SLAC and Stanford in 2021. He has been serving as Director of the Science and R&D Division at the Linac Coherent Light Source (LCLS) until 2026, when he became the third Director of the Stanford PULSE Institute. He is co-founder of Matter42, a startup focused on AI models and platforms for materials characterization and processing.

Shanhui Fan

The Joseph and Hon Mai Goodman Professor of the School of Engineering
Department of Electrical Engineering, and Ginzton Laboratory, Stanford University

Interests and expertise:
Nanophotonics; Renewal Energy; Radiative Cooling; Optical Computing

Session 1, talk, Tuesday, September 15, 2026

Radiative Cooling

The earth's atmosphere has a transparency window in the wavelength range near 10 microns. This window coincides with the peak thermal radiation wavelength of objects at ambient temperatures. Consequently, any object on earth, given clear sky access, can radiate heat out through the transparency window to the outer space and achieves radiative cooling. In this talk, we discuss the basic concepts of radiative cooling and some of our recent efforts in further developing these concepts.

Bio: Shanhui Fan is the Joseph and Hon Mai Goodman Professor of the School of Engineering at the Stanford University. He did his undergraduate study in Physics at the University of Science and Technology of China, and received his Ph. D in 1997 in theoretical condensed matter physics from MIT. His recent awards include the William Streifer Scientific Achievement Award from the IEEE Photonics Society, the R. W. Wood Prize from the Optica, a Simons Investigator in Physics, and a Vannevar Bush Faculty Fellowship. He is a member of National Academy of Engineering, National Academy of Sciences and American Academy of Arts and Sciences, and a Fellow of APS, Optica, SPIE, NAI, and IEEE.

3.2 Day 2, Session 2: Systems

Session host:

DP Prakash
Founder & Chief Executive Officer
DP2Ventures

Interests and expertise:
Semiconductor scaling, AI for smart manufacturing, workforce development.

Bio: DP Prakash, is the founder and CEO of DP2ventures, an innovation company in New York accelerating AI DigitalTwin Transformation in semiconductor industry and translating the insights and transformative impact to other industries including construction, medicine, law, education and entertainment. Using co-packaged optics technology AI engines are being accelerated for next generation workflows. Concurrently, skills gap is being addressed using virtual factory Digital Twins and AI-agentic-avatars that tell the story within big data.
Earlier, as the Global Head of Innovation at Global Foundries, DP guided semiconductor fabs in the United States, Germany and Singapore with industry-leading use cases in AI, automated Machine Learning, Virtual and Augmented Reality. He is also a recipient of outstanding technical achievement awards from IBM in Research and Manufacturing where he worked across ten generations of Moore's law scaling.
DP holds a Ph.D., in Electrical Engineering from University of California, Los Angeles (UCLA), an MBA with honors from Jack Welch Management Institute, a certificate in Film Producing from UCLA School of Film & Television, a BTech in Electronics and Communication engineering from Indian Institute of Technology (IIT), Madras, and a certificate on leading Innovation at scale from the Wharton School at the University of Pennsylvania.

Ronald Goossens

Sr Strategy Manager @ ASML
Prof. Nanolithography @ Purdue University

Interests and expertise:
Nanolithography, semiconductor manufacturing, high-performance computing

Session 2, invited talk, Tuesday, September 15, 2026

A brief history of photolithography and the longevity of Moore's Law

Moore's Law stated that transistor functionality will double every (two) year(s) for roughly the same price. In this presentation I review how photolithography was an essential engine for progress from the humble beginnings of just a few transistors per IC to today with $>$ 300 billion transistors per IC. I then finish up with a look at what the future may hold, both w.r.t advanced packaging and w.r.t. shorter wavelength.

Bio: Ronald Goossens was born and raised in the Netherlands where he studied Physics at Utrecht University. During his study, he worked on computer modeling of nucleosynthesis in stellar interiors and the impact on stellar evolution. This became the start of a life-long love affair with modeling and simulation of complex physical and chemical processes. During his years with Philips Research, Stanford University, National Semiconductor, and NXP Semiconductor, he worked on modeling of electron transport in transistors, of analog circuit behavior, and of system-level digital designs. For the last 20 years, he has worked at ASML on Computational Lithography with emphasis on control applications in semiconductor manufacturing. In early 2022, Ronald retired from full-time work. Currently, he holds positions as a part-time Senior Strategy Manager for ASML, as Adjunct Professor of Nanolithography at Purdue University, and as a Board Member of the Boys & Girls Club of Silicon Valley. Ronald is an avid outdoor photographer and skier.

Jonathan Fan

Associate Professor of Electrical Engineering
Department of Electrical Engineering, Stanford University

Interests and expertise:
Nanophotonics, metasurfaces, scientific computing, deep learning, additive manufacturing.

Session 2, talk, Tuesday, September 15, 2026

Meta-Refractives: Curved and Freeform Metaoptics by Inverse Design

Metasurfaces are usually treated as flat components, yet the optical systems they are meant to replace are not: lenses are curved, and the surfaces available inside a real instrument are rarely planar. This talk considers meta-refractives, subwavelength-structured elements that take on the work of refractive optics while conforming to the surfaces a system actually offers, and the design machinery required to make them practical.

Large-scale inverse design is the enabling tool. Topology optimization over high-dimensional, non-convex landscapes, together with geometric neural parameterization of freeform geometries, allows devices to be designed directly against an electromagnetic objective rather than assembled from a library of unit cells, while holding fabrication constraints inside the optimization loop so the resulting patterns remain manufacturable.

Two directions illustrate what this buys. Large-area, high-numerical-aperture freeform metasurfaces push metaoptics toward the apertures and collection angles that conventional lens groups occupy. Conformal spaceplates take the complementary route, replacing a length of free-space propagation, and correcting the aberrations that accompany it, with a thin element that follows a curved surface. Together they point toward meta-refractive optics that conform to the optical system, rather than requiring the system to be flattened around them.

Bio: Jonathan Fan is an Associate Professor in the Department of Electrical Engineering at Stanford University, where he is researching topics at the intersection of electromagnetics, optics, and sustainability. He received his bachelor’s degree with highest honors from Princeton University and his doctorate from Harvard University. He is the recipient of the Air Force Young Investigator Award, the Sloan Foundation Fellowship in Physics, the Packard Foundation Fellowship, and the Presidential Early Career Award for Scientists and Engineers.

Bijoy Krishna Das

Chief Investigator of Silicon Photonics CoE-CPPICS
Professor in Electrical Engineering, IIT Madras

Interests and expertise:
Si Photonics Technology, Microwave and Quantum Photonics

Session 2, talk, Tuesday, September 15, 2026

3D Programmable Photonic Integrated Circuits

In this talk we discuss 3D programmable photonic devices using optical tunnel vias in a silicon photonics foundry platform. Today's silicon photonics technology allows both SiN and Si waveguide devices to be integrated in two layers separated by a thin oxide layer. Close proximity of the SiN layer to the silicon-on-insulator device layer is preferred to achieve nearly 100% light coupling between Si and SiN waveguides for circuit hybridization, but that same proximity causes unwanted cross-talk between the layers elsewhere, so no advantage can be availed in terms of areal density. We have recently introduced a compact optical-tunnel-via (OTV) design which allows efficient light coupling between SiN and Si waveguide with a reasonable gap while avoiding unwanted cross-talks elsewhere. This concept enables heterogeneous integration of best performing photonic devices and helps scale up areal density. We'll explore how this proposed OTV design can be adopted in implementing large-scale programmable photonic integrated circuits.

Bio: Prof. Bijoy Krishna Das obtained his MSc in solid-state physics from Vidyasagar University, Midnapore, India (1996) and his Ph.D. (Dr.rer.nat) in integrated optics from the University of Paderborn, Germany (2003). Before that he began his career in integrated optics at the Microelectronics Centre, IIT Kharagpur (1996–1998). His postdoctoral work spanned three countries: FRC Postdoctoral Fellow at the Graduate School of Engineering, Osaka University, Japan (2004–2005); postdoctoral researcher at the Center for Optical Technologies, Lehigh University, Bethlehem, PA, USA; and, from 2005, Wissenschaftlicher Mitarbeiter back at the Integrated Optics Group in Paderborn, continuing work on integrated nonlinear optical devices. He also spent time at Laboratoire Aime Cotton, CNRS, Orsay, France. Since 2006 he has been with the Dept. of Electrical Engineering, IIT Madras, where he is now a full Professor with higher academic grade (HAG). There he has been establishing state-of-the-art silicon photonics research ecosystems following the Product Research Development and Manufacturing (PRDM) model for indigenously developed Co-Packaged Optics Transceiver Engine, Quantum Photonic Integrated Circuits (Q-PICs) and Microwave Photonic Integrated Circuits, etc. He is the founder and Chief Investigator of the Silicon Photonics CoE-CPPICS, IIT Madras.

John Wood

Lead Systems Engineer for Command & Control
Naval Information Warfare Center Pacific, U.S. Navy

Interests and expertise:
Systems Engineering, Innovation, Organizational Strategy

Session 2, talk, Tuesday, September 15, 2026

Fusing Photonics and AI for the Maritime Domain

Advancements in photonic technologies are vital to maintaining maritime superiority across distributed, multidomain operations. This presentation outlines current photonics research and engineering initiatives at Naval Information Warfare Center (NIWC) Pacific. Following a brief overview of NIWC Pacific's mission and history, we examine current photonics-related work including mobile laser weapons, pulsed lasers for modulated applications, RF-optical integration, and laser communications. Next, we discuss the system of systems engineering challenge of fusing these diverse photonic technologies together with artificial intelligence at the tactical edge to enable rapid, mission-critical decision making aboard a resource-constrained ship at sea.

Bio: John Wood, PhD has dedicated his career to solving mission and safety critical challenges within healthcare, aviation, and defense. He currently serves as the Command and Control Department Lead Systems Engineer at the Naval Information Warfare Center Pacific. There, he leads nearly 800 engineers and scientists building future warfighting capabilities for the US Navy and other Department of Defense customers. Dr. Wood holds a BS in Electrical Engineering from the US Naval Academy and a PhD in Systems Engineering from The George Washington University.

3.3 Day 2, Open Session: Entrepreneurship & innovation

Session host:

Homan Yuen
Managing Partner
Keymaker

Interests and expertise:
Optoelectronics, entrepreneurship, venture capital, Cal sports.

Bio: Homan Yuen is Managing Partner at Keymaker, an early-stage venture capital firm investing in technical companies in compute & data centers, energy, and physical AI.
Homan has a unique combination of financial and investing experience, business and startup operations and management, and deep technical expertise in semiconductor materials and devices. Prior to Keymaker, he was a Partner at Fusion Fund for close to nine years, where he led investments into deeptech companies. Homan also co-founded Solar Junction, a company which produced and sold world-record solar cell products to space and terrestrial markets. Here, he is credited with taking a new class of materials from the lab to mass-production based on his knowledge and experience with semiconductor research and manufacturing utilizing tools like molecular beam epitaxy (MBE). His research at Stanford involved developing the first GaAs-based lasers at 1.3 and 1.55 μm for fiber communications. Homan has extensive experience in lasers, detectors, and other opto-electronic devices and materials. He holds over 60 patents in the fields of materials, semiconductors, devices, and energy.
Homan received his Ph.D. and M.S. in Materials Science and Electrical Engineering from Stanford University and his B.A. in Physics from the University of California at Berkeley.

Jorn Smeets

Managing Director, North America
PhotonDelta

Interests and expertise:
Silicon photonics and startup development

Session 3, podium discussion, Tuesday, September 15, 2026

Integrated photonics is about to take off

Integrated photonics is emerging as a crucial technology for tackling some of today's biggest global challenges, from providing the bandwidth needed for AI to reducing its massive energy footprint. Photonic integrated circuits (PICs) are not competitors to the semiconductor industry but powerful enablers; growth in photonics fuels growth across the broader semiconductor value chain. While datacom remains a primary driver, integrated photonics has the potential to revolutionize a wide range of multi-billion-dollar markets, including life sciences, mobility, agrifood, quantum, and defense. As the industry matures, with shared platforms, foundry access, packaging standards, and design tools, entirely new classes of applications will be unlocked, just as CMOS scaling once unleashed the explosion of electronics. Realizing this potential will require global collaboration: Europe brings deep R&D and supply-chain capabilities in InP, SiN, and packaging, while the U.S. offers unparalleled access to capital, customers, and commercialization pathways. Together, these strengths can accelerate market entry and scale. Yet critical challenges remain: bridging the transition from lab prototype to manufacturable product, and avoiding fragmentation as national strategies risk duplicating efforts. Overcoming these blockers is essential to achieve global competitiveness and to fully capture the transformative value of integrated photonics.

Bio: Jorn Smeets is the Managing Director for North America at PhotonDelta, an industry accelerator for photonic chip technology. Based in Silicon Valley, his mission is to advance the photonic chip industry by fostering collaboration between European and North American entities. Smeets previously served as the Chief Marketing Officer (CMO) and Board Member at PhotonDelta, where he played a key role in expanding the ecosystem to more than 70 companies and securing $1.2 billion to drive research, development, and startup growth in the photonic chip sector. Before joining PhotonDelta, Smeets gained extensive experience in business development, marketing, and sales in high-tech sectors around the globe.

Roozbeh Parsa

Head of Global Strategic Investment
imec.ventures

Interests and expertise:
Deep-tech venture investing, semiconductors, photonics, startup scaling, strategic partnerships

Session 3, podium discussion, Tuesday, September 15, 2026

Building deep-tech semiconductor ventures for long-term impact

Transforming a breakthrough technology into a successful venture requires far more than technical innovation and capital. Founders must navigate the journey from product development and market validation to fundraising, strategic partnerships, scaling, and ultimately a credible path to exit. For deep-tech startups, the challenge is amplified by long development cycles, significant capital requirements, and the need to bridge cutting-edge research with commercial execution.
Success often depends on assembling the right combination of technology, infrastructure, expertise, and ecosystem support. Strategic investors, corporate partners, and research organizations can help startups accelerate development, access customers, reduce technical risk, and scale globally. At the same time, founders must make deliberate decisions around growth, financing, and market positioning to maximize long-term value creation.

Bio: Roozbeh Parsa is Head of Global Strategic Investment at imec.ventures, where he leads investment initiatives and strategic partnerships across emerging technology sectors. Throughout his career, he has held executive leadership roles spanning operations, product and commercial strategy, product development, and business growth in both startups and established technology companies.
Prior to joining imec, Parsa held senior leadership positions at Cellanome and Rockley Photonics, as well as industry leaders Texas Instruments and National Semiconductor. Over the past decade, he has been actively involved in venture capital and corporate investments, helping secure funding and driving strategic growth initiatives for innovative technology companies.
A named inventor on more than 20 U.S. patents, Parsa brings expertise in semiconductors, photonics, optics, and MEMS technologies, combined with extensive experience in commercialization and venture investment. He holds a Ph.D. in Electrical Engineering from Stanford University and a B.S. in Electrical Engineering and Computer Science from the University of California, Berkeley.

Hidenobu Nagata

Founding Partner
Catalight Capital

Interests and expertise:
Photonic networking, datacenter innovation, startup development

Session 3, podium discussion, Tuesday, September 15, 2026

Photonics Comes Full Circle: Scaling AI Infrastructure to Distributed Enterprises

As AI scales beyond single datacenters, moving from scale-up and scale-out to scale-across, connectivity and energy efficiency have become primary bottlenecks. Datacenters are undergoing multidimensional innovation across silicon, memory, thermal management, and networking, opening massive business opportunities across the entire stack. Simultaneously, as semiconductor scaling slows, optical interconnects are navigating both convergence and divergence: unifying physical scales from components to networks while driving a divergence in materials, packaging, and domain-specific architectures. Structural shifts toward edge inference and upgrading telecom and CDN assets to build unified “AI grids” further amplify these opportunities. Building sustainable AI infrastructure also demands hardware-software solutions that optimize distributed compute and enable low-latency optical CXL and memory sharing. As this paradigm shift redefines the traditional industrial ecosystem, the greatest opportunities for success lie with startups and university spin-offs capable of fusing deep system-level expertise in photonics with cutting-edge academic research, thereby seamlessly compiling groundbreaking scientific achievements into true industrial innovation. The window of opportunity is wide open.

Bio: Hidenobu Nagata is Founding Partner at Catalight Capital. He has over 20 years of experience across R&D, technology strategy, and business development, including ASIC, DSP, accelerator, and embedded IP development. He is focused on emerging technologies shaping the next generation of AI infrastructure, particularly photonics, optical interconnects, AI networking, advanced inference ASICs, and next-generation memory. He also supported the launch of the IOWN AI Fund and Catalight Capital, focusing on business viability assessment and supporting portfolio startups.

Startups showcase

Besxar

Besxar Space Industries, Inc. (Besxar) is the Exoindustrial company building advanced semiconductor materials. Its reusable, autonomous manufacturing units (‘Fabships’) are designed to use the space environment itself as a production input, growing the compound semiconductor substrates, epitaxial layers, and thin films that are expensive, scarce, and defect prone on Earth. These materials underpin AI data centers, power electronics, radar and satellite communications, quantum systems, nuclear technologies, and defense applications.

DP2Ventures

DP2ventures is an innovation company addressing skills gap in semiconductor manufacturing industry and accelerating workforce development using Virtual Factory Digital Twins and Speaking Machines powered by AI Engines. Leveraging deep expertise in semiconductors and photonics, and a collection of capabilities, its team of developers translate their impact in chip industry to support and accelerate innovation in other industries.

GDSFactory

GDSFactory is an open-source, Python-based framework for chip design (photonics, quantum, analog) that enables reproducible layout, verification, and validation workflows. Its GDSFactory+ platform supports over 25 PDKs and integrates schematic, DRC/LVS checking, simulations, and foundry tools. Widely used in academic and industrial settings, it accelerates development from concept to chip with automated design, robust tooling, and collaborative infrastructure.

Startups showcase, continued

Lucintis
Lucintis is developing a new optical computing architecture for AI that combines the massive parallelism of photonics with a practical, foundry-compatible path to deployment. It performs large-scale matrix operations while reusing each memory access across many optical computations, addressing both the energy cost and the memory-bandwidth bottlenecks that increasingly limit AI hardware. Supported by five patents and independent experimental demonstrations, the company is building a first-generation accelerator for low-latency AI inference at dramatically higher energy efficiency, without sacrificing throughput.

Matter42
Materials intelligence for labs and fabs: characterization, analysis, and process optimization. Matter42 turns Raman, PL, XRD, and AFM measurements into defect densities, uniformity maps, and film-quality metrics, with the method and calibration status attached.

Sinovia Technologies
Sinovia Technologies is building the world's most complete foundry for flexible printed electronics. The company prints OLEDs and circuitry directly onto thin films via roll-to-roll flexography to replace the tens of billions of custom LED, waveguide, and light-pipe assemblies used across consumer products each year. It runs a TSMC-style model: customers design to Sinovia's process rules, and Sinovia manufactures, cutting optical engineering spend, assembly time, and tooling costs. The company is now in commercial production at its Silicon Valley facility with 70% initial yield for its first customer designs.

Startup elevator pitches

Amplify Computing
SiPho optical interconnects.

Ely SensorTech
We're rewriting the role of photonics.

Optaric
Optaric makes enterprise-grade smart safety glasses and delivers AI to the frontline, where it's actually needed.

Pumpkinseed
Protein sequencing to illuminate biological function.

3.4 Day 2, Conference dinner

Featured guest:

Kazu Gomi
President & Chief Executive Officer
NTT Research Inc.

Interests and expertise:
Basic research, internet, datacenter, academia-industry collaboration.

Bio: Mr. Gomi has been with NTT for more than 40 years and played various business/technical roles that include the business head of NTT's Global Internet Backbone service. He was the CEO of NTT America Inc. from 2010 to 2019, and also served on the Board of Directors at NTT Communications.
Mr. Gomi became the CEO of NTT Research Inc. in 2019 when the organization was established. This organization conducts basic/fundamental research in the areas of Physics and Informatics, Cryptography and Information Security, Bio-Digital Twin and Physics of AI (exploring AI's fundamental mechanism). Mr. Gomi received a MSIE from the University of Illinois at Urbana-Champaign, and a MSEE from Keio University, Tokyo. Mr. Gomi is also the president of Japanese Chamber of Commerce of Northern California.

Jungsang Kim

Schiciano Family Distinguished Professor of ECE, and Chief Science and Technology Strategist
Duke University

Interests and expertise:
Quantum Computing and Applications

Evening Plenary, Tuesday, September 15, 2026

Ginzton Labs in 1990s: Photonics at Stanford

Photonics was an exciting field of research at Stanford in 1990s: from fiber and non-linear optics to quantum optics and electronics. We worked among the buildings from the 2nd World War era, where the building layout stimulated a strong cross-section of interaction among people working on various topics in optics and electronics, superconductivity and complex materials, atomic force microscopes, and condensed matter physics. It was the home for cross-disciplinary research in applied physics and engineering. I will look back on some of the incredible research done by incredible people at Ginzton Laboratories in the 1990s that I experienced.

Bio: Jungsang Kim is the Schiciano Family Distinguished Professor of Electrical and Computer Engineering and the Chief Science and Technology Strategist for the Provost at Duke University. Kim is an internationally renowned pioneer in quantum information sciences and engineering. He is a co-founder of IonQ, a company commercializing quantum computing technology, and served as its Chief Technology Officer. IonQ became the first publicly-traded pure play quantum computing company on New York Stock Exchange in 2021.
He received his B.S. from Seoul National University and his Ph.D. from Stanford University, both in Physics. He worked as a Member of Technical Staff and a Technical Manager at Bell Laboratories, and joined Duke faculty in 2004. He is the recipient of the 1st Class Order of Science and Technology Merit from South Korea, and a Fellow of the National Academy of Inventors, the American Physical Society and Optica.

4 – Sept 16: Life science, sensing, and the future of photonics

Themes and sessions at a glance:

- The final day of the Symposium opens with a keynote by **Yasaman Soudagar**, who founded the neurophotonics company Neurescence and led it from prototype to acquisition. She asks how to judge whether a problem being solved in the laboratory can become a product, and shows, from both the successes and the mistakes along the way, what that transition demands of the people who attempt it.
- **Session 1: Life Sciences.** The morning puts photonic instruments to work on biological questions. It opens with single-molecule tracking applied to drug discovery, continues with label-free interferometric microscopy that resolves structure inside living cells, turns to metasurface-enhanced Raman spectroscopy for molecular sequencing and single-cell phenotyping, and closes with a photovoltaic subretinal implant that substitutes for the photoreceptors lost to retinal degeneration.
- **Session 2: Sensing.** The afternoon asks how far photonic measurement can be pushed. It begins with the instruments that might one day detect life on planets around other stars, turns to nonclassical light generated on a chip and the question of when quantum resources genuinely help, continues with sensing based on atoms and atom-like defects, and closes with a scanning interferometer built to image stars directly.
- **Session 3: Future of Photonics.** The closing session looks ahead. It opens with wide-and-slow optical interconnects that trade per-lane speed for massive parallelism, moves to free-space reconfigurable interconnects, considers the open-source design automation that is changing how photonic chips are built, and ends with a thirty-year perspective on the tera era and the peta society that may follow it.
- **Conclusion.** The Symposium closes here, having traced three days from computing and the data center, through materials, systems, and the business of building them, to the life sciences, sensing, and the future of the field.

Yasaman Soudagar

Serial Photonics Entrepreneur; Founder, CEO
Stealth-mode photonics startup

Interests and expertise:
Optics & photonics, technology commercialization, product & market development, team building

Keynote, Wednesday, September 16, 2026

The Breakthrough Is Just the Beginning: Lessons from Taking Photonics from Lab to Market

Researchers are trained to solve difficult scientific problems. But how can we determine whether the problem we are solving in the laboratory can become the foundation of a commercially viable product, and what does it take to make that transition?
This talk draws on the journey of Neurescence, a neurophotonics company founded to develop optical tools for studying the brain and acquired by Bruker in 2022. Starting from an early prototype built with essentially no budget, Neurescence grew by learning directly from neuroscientists, developing and commercializing new imaging and stimulation technologies, building a multidisciplinary team, and continuously adapting its products to customer needs. Along the way, some of the most important lessons had little to do with optics: understanding the culture of your customer, recognizing that people and networks are critical assets, knowing when technical excellence is not enough, and using constraints as a catalyst for creativity.
Drawing on both successes and mistakes, I will share lessons on assessing the commercial potential of research, understanding customers and markets, building the right team and network, and turning a technical breakthrough into a product with lasting real-world impact.

Bio: Yasaman Soudagar is a physicist, inventor, serial entrepreneur, and angel investor working at the intersection of photonics and technology commercialization. She received her Ph.D. in experimental quantum optics under the supervision of Dr. Aephraim Steinberg at the University of Toronto and Dr. Nicolas Godbout at École Polytechnique de Montréal.
She co-founded Neurescence and, as CEO, led it from concept to commercial optical imaging technologies used by neuroscience researchers worldwide. Under her leadership the company brought multiple products to market, established international distribution and strategic partnerships, and was acquired by Bruker in 2022, returning approximately 50× the capital invested. She then led the Neurescence business unit as Senior Director of R&D at Bruker.
She holds patents in optical systems, has published in Physical Review Letters, and has served as a Board Director of the Optical Society Foundation (now Optica Foundation) and on photonics councils and judging panels. Today she mentors founders and invests in deep tech.

4.1 Day 3, Session 1: Life Sciences

Session host:

María Belén Pérez-Ramírez
Basic Life Research Scientist, Department of Neurology
Stanford University School of Medicine

Interests and expertise:
Neuroscience, electrophysiology, translational epilepsy research, thalamocortical networks, myelin plasticity.

Bio: María Belén Pérez-Ramírez is a Basic Life Research Scientist in the Department of Neurology at Stanford Medicine in the Knowles Lab. Her research focuses on the cellular and circuit-level mechanisms underlying neurological diseases, with particular emphasis on the consequences of focal status epilepticus and, currently, on the role of myelin plasticity in absence epilepsy. She has developed and applied translational animal models to investigate pathophysiological changes in the thalamocortical network and to evaluate potential prophylactic drugs.
Dr. Pérez-Ramírez is an expert in electrophysiological techniques for studying the striatum, neocortex, thalamus, and white matter tracts. She integrates these approaches with immunocytochemical, stereological, calcium imaging, and statistical methods to study the mechanisms of injury and repair. As part of her postdoctoral work at Stanford, she described structural and functional abnormalities not only in cortical but also in thalamic neurons, as well as long-lasting protective effects of pharmacological interventions in status epilepticus.
She received her PhD in Biomedical Sciences (Applied Neuroscience) from the Universidad Nacional Autónoma de México (UNAM), where she studied how KCNQ currents regulate synaptic transmission in the striatum. Prior to joining Stanford, she held research fellowships in Mexico and Europe, including work at ICFO – The Institute of Photonic Sciences in Barcelona. Furthermore, she worked in industry conducting research to develop a neurostimulation device. As a postdoctoral fellow, she has been awarded fellowships from the American Epilepsy Society, the Mexican National Council for Science and Technology (CONACYT), and the National Institute of Neurological Disorders and Stroke (NINDS).

Camille Pataki

AI Applications Engineer and AI strategy Coordinator
Eikon Therapeutics

Interests and expertise:
Single molecule tracking, drug discovery, computational biology, agentifying biology

Session 1, invited talk, Wednesday, September 16, 2026

Leveraging single molecule tracking for drug discovery

Eikon's single molecule tracking (SMT) microscopy enables the direct observation of protein dynamics in living cells at unprecedented spatiotemporal resolution, opening new avenues for target identification and drug candidate evaluation. At Eikon Therapeutics, we have built an integrated discovery platform that combines large-scale SMT data acquisition with computational pipelines to characterize how small molecules alter protein behavior in real time. This talk will describe how we translate raw single molecule trajectories into pharmacologically meaningful readouts, from quantifying changes in protein mobility and localization to linking these signatures with downstream phenotypic outcomes. I will also discuss the computational and data science challenges of operating at this scale, and the role of AI in accelerating interpretation.

Bio: Camille Pataki leads enterprise-wide application of AI at Eikon Therapeutics, a clinical-stage biotech whose drug discovery engine is built on super-resolution microscopy and high-throughput single-molecule tracking in living cells. A biochemist by training, she earned her B.S. from Tufts University and her PhD from Stanford University School of Medicine, where she also did her postdoctoral fellowship in biomedical informatics. She then moved into the biotech industry, building analytical pipelines and software for metabolomic and precision-medicine data where she has been for a decade. Camille joined Eikon in 2023 as an externally facing Biological Data Scientist, working with academic partners to translate single-molecule imaging data into biological insight, then went on to apply multi-omic approaches to target identification and build computational tools for automating analysis of complex assays before taking on her current role driving AI adoption across the organization, from scaling R&D to streamlining clinical tasks.

Michelle Kueppers

Postdoctoral Researcher, Department of Chemistry
W.E. Moerner lab, Stanford University

Interests and expertise:
Super-resolution Microscopy, Interferometric Scattering Microscopy, Label-free Imaging, Live-cell Imaging, Biophotonics

Session 1, talk, Wednesday, September 16, 2026

Label-free live-cell imaging: Interferometric Image Scanning Microscopy provides 120 nm lateral resolution inside live cells

Light microscopy remains indispensable for studying cellular structures and dynamics. Fluorescence-based methods dominate biological imaging for the molecular specificity they provide, but they face photobleaching, limited observation times, phototoxicity and potential perturbation of native function. Demand for label-free imaging is therefore growing, yet after decades of work, matching fluorescence in resolution, sensitivity and imaging depth remains elusive.
Here we present interferometric Image Scanning Microscopy (iISM), a label-free live-cell imaging method combining interferometric scattering contrast with parallelized confocal detection and computational image reconstruction. By replacing the physical pinhole and point detector with a camera and applying a phase-aware pixel-reassignment algorithm, iISM achieves ~120 nm lateral resolution and improved contrast-to-noise ratio in the scattering intracellular environment. We demonstrate label-free visualization of endoplasmic reticulum, mitochondria, lysosomes and vesicles in living cells over extended durations. iISM is also compatible with simultaneous confocal fluorescence microscopy, enabling correlative imaging that adds molecular specificity when needed. This opens new avenues for quantitative studies of intracellular trafficking, host–pathogen interactions, cytoskeletal rearrangements and organelle network dynamics under near-native conditions, with minimal perturbation.

Bio: Dr. Michelle Kueppers received her Ph.D. in Physics from the Max-Planck-Institute for the Science of Light in the Nano-Optics group of Prof. Vahid Sandoghdar in Germany in 2023, where she pioneered confocal interferometric scattering microscopy for label-free live-cell imaging. At Stanford she spearheaded the development of interferometric Image Scanning Microscopy (iISM) and serves as co-PI on a Stanford instrumentation grant deploying it as a shared facility resource. She holds the Emerson Collective Consequential Scholarship at Stanford, was a visiting scientist at the 74th Lindau Nobel Laureate Meeting and, on an Emmy Noether Travel Grant, at Oxford University, and was named Physicist of the Week by the German Physical Society.

Jen Dionne

Professor
Stanford University; co-founder, Pumpkinseed

Interests and expertise:
Nanophotonics, metasurfaces, spectroscopy, analytic biology

Session 1, talk, Wednesday, September 16, 2026

Metasurface-Enhanced Raman Spectroscopy for Molecular Sequencing and Single-Cell Phenotyping

The proteome encodes far more molecular states than the genome, yet most goes unread by conventional methods. Raman spectroscopy reads a molecule's vibrational fingerprint, but low cross-section and irreproducible plasmonic "hotspots" have confined it to unscalable measurements. We present high-Q silicon-compatible metasurfaces resolving this: wafer-scale manufacturable, with over 100 million resonators per cm^2, delivering SERS enhancements rivaling plasmonics while remaining reproducible, transforming Raman into a scalable, single-cell and few-to-single-molecule platform. We show two applications. First, combining dynamic Raman with computational metadynamics, we demonstrate de novo peptide sequencing, identifying disease-relevant modifications. Second, we show spatial characterization of the tumor immune microenvironment, predicting drug resistance and immune state. The metasurface's $>$5-order-of-magnitude enhancement turns what would be $\sim$100-day profiling into under an hour, predicting immunotherapy resistance where conventional methods struggle.

Bio: Jennifer (Jen) Dionne is a Biohub Investigator, Deputy Director of the Q-NEXT National Quantum Information Science Center, and co-founder of the protein-sequencing company Pumpkinseed. A pioneer of nanophotonics, she designs nanophotonic resonators and cavities that enhance light-matter interactions to detect molecules and direct their transformations, enabling single-molecule spectroscopy, catalysis and quantum networking, with a focus on global health and sustainability. Her lab has shown how AI-enabled Raman spectroscopy can characterize cellular phenotypes, predicting antibiotic resistance and immunotherapy response, and has pioneered proteomic and glyco-sequencing approaches. She has also advanced plasmon catalysis, linking atomic-scale photocatalyst structure resolved by in-operando microscopy to catalytic function for sustainable manufacturing. Her work has been recognized with the NSF Alan T. Waterman Award, the NIH Director's New Innovator Award, the Moore Inventor Fellowship and the Presidential Early Career Award for Scientists and Engineers. Jen received her B.S. degrees in Physics and in Systems Science and Mathematics from Washington University in St. Louis, her Ph.D. in Applied Physics at Caltech, and postdoctoral training in Chemistry at Berkeley.

Daniel Palanker

Professor of Ophthalmology and, by courtesy, of Electrical Engineering
Stanford University

Interests and expertise:
Optical and electronic technologies for diagnostic, therapeutic, surgical & prosthetic applications, primarily in ophthalmology.

Session 1, talk, Wednesday, September 16, 2026

Prosthetic vision with a photovoltaic substitute for the lost photoreceptors

Retinal degenerative diseases cause visual impairment due to loss of photoreceptors, while inner retinal neurons survive. Photovoltaic retinal prosthesis substitutes the lost photoreceptors. Images captured by a camera are projected from augmented-reality glasses onto a subretinal implant using pulsed near-infrared (880 nm) light. Photovoltaic pixels convert light into electric current, stimulating the second-order retinal neurons, which transmit visual information to the brain. This wireless approach preserves natural coupling of eye movements and visual perception, simplifies surgery, and enables scaling the number of pixels to thousands.

In patients blinded by age-related macular degeneration, photovoltaic implants provide monochromatic form vision simultaneously with residual peripheral natural vision. Clinical trials in 43 patients across 17 centers in 5 European countries demonstrated letter acuity matching the 100-μm pixel size (20/420). Electronic zoom enabled reading and writing smaller fonts, improving acuity, on average, by five lines on the vision chart, up to 20/63.

Higher resolution requires smaller pixels, but reduced penetration of electric field becomes a major limiting factor. Using current steering and three-dimensional electrodes, we increased penetration depth of electric field and demonstrated that with 40-μm pixels, grating acuity matches the pixel pitch, while with 20-μm pixels it reaches the natural resolution limit of 28 μm in rats. If successful clinically, 20-μm implants could provide acuity approaching 20/80 without zoom, enabling highly functional restoration of sight, potentially benefiting millions of patients worldwide.

Bio: Daniel Palanker is Professor of Ophthalmology and, by courtesy, of Electrical Engineering at Stanford, where he was trained as a postdoc in ultrafast laser physics in 1996–1998, after a Ph.D. in applied physics at the Hebrew University of Jerusalem in 1994. Dr. Palanker studies interactions of the electric field with biological cells and tissues, and develops optical and electronic technologies for diagnosis, therapy, surgery and prosthetics in ophthalmology. His group developed the Pattern Scanning Laser Photocoagulator (PASCAL, Iridex), the femtosecond cataract laser (Catalys, J&J) and electrosurgical tool with single-cell precision (PlasmaBlade, Medtronic), the photovoltaic subretinal prosthesis (PRIMA, Science Corp) and a tear-secretion stimulator (TrueTear, Allergan). He also works on optoretinography using phase-resolved OCT.

4.2 Day 3, Session 2: Sensing

Session host:

Maxwell Drimmer
Postdoctoral Researcher
Vučković Lab, Stanford University

Interests and expertise:
Optomechanics, solid-state quantum technologies, nanophotonics, quantum transduction, nanofabrication

Bio: Maxwell Drimmer is a postdoctoral researcher in Jelena Vučković's group at Stanford University, where he works on quantum networking of tin-vacancy defects in diamond nanophotonic cavities using strain tuning.
He completed his Ph.D. in physics at ETH Zürich in Yiwen Chu's group, with a thesis on bulk acoustic quantum transduction: achieving quantum-efficient microwave-to-optical transduction between a superconducting transmon qubit and a telecom-frequency photon using a bulk acoustic wave transducer. That work included building a Brillouin spectroscopy experiment in a liquid helium cryostat to characterize the optomechanical properties of candidate materials, advancing the fabrication of bulk acoustic wave resonators for a demonstration of a mechanical qubit, and studying cryogenic dielectric loss and quasiparticle dynamics in superconducting circuits.
He received his M.Sc. in applied physics from TU Delft, where in Simon Gröblacher's group he developed a pick-and-place technique for transferring nanostructures between substrates and integrated silicon photonic crystal cavities with thin-film lithium niobate electromechanical resonators.

Ruslan Belikov

Astrophysicist
NASA Ames Research Center

Interests and expertise:
Exoplanets, high contrast imaging, space telescopes, coronagraphs, photonics

Session 2, invited talk, Wednesday, September 16, 2026

How Advances in Photonics Can Enable Us to Find Life Beyond the Solar System

The field of exoplanetary science has revolutionized astronomy over the past three decades. While indirect detection methods continue to yield monumental discoveries, the ability to directly image distant worlds is becoming an increasingly vital frontier. Furthermore, while exploring the immense diversity of these alien planets provides crucial scientific insights, the quest to discover and characterize "Earth 2.0" – a rocky planet with an atmosphere capable of supporting life – remains the ultimate goal of the field.

In this presentation, we will explore how NASA plans to advance this search with the upcoming Habitable Worlds Observatory (HWO) flagship mission, and how recent breakthroughs in high-contrast imaging and integrated photonics may enable performance levels far beyond traditional bulk-optic astronomical instruments. This discussion will highlight cutting-edge technologies being developed at NASA Ames, including a collaboration with Stanford that exemplifies a successful interdisciplinary approach – achieving technological advancements that neither discipline could have accomplished independently.

Bio: Ruslan Belikov is an astrophysicist and leads the Exoplanet Technologies research group at NASA's Ames Research Center. For nearly two decades, his work has focused on developing the advanced technologies and mission concepts required to directly image exoplanets, with a special emphasis on potentially habitable worlds.

Dr. Belikov and his team have developed several pioneering technologies for starlight suppression. Notably, he invented the Multi-Star Wavefront Control method, designed to detect planets in multi-star systems such as Alpha Centauri, our closest stellar neighbor. This technology recently flew on NASA's Roman Space Telescope flagship mission. He also serves on the project office for the Habitable Worlds Observatory and has contributed to numerous high-profile space telescope mission studies, including the Astrophysics 2020 decadal survey.

He holds a B.S.E. in Electrical Engineering from Princeton University and a Ph.D. in Electrical Engineering from Stanford University. Dr. Belikov's innovative work in the search for "Earth 2.0" has been featured in major media outlets, including Scientific American, The New York Times, and the Huffington Post.

Charles Santori

Chief Science Officer
Fringe Labs Research

Interests and expertise:
Quantum optics, interferometry, spectroscopy, astronomy

Session 2, talk, Wednesday, September 16, 2026

Development of a Scanning Interferometer for Imaging Stars

Obtaining detailed images of the surfaces of stars, and eventually planets, outside our solar system at optical wavelengths requires effective telescope apertures in the range of ~50 meters to hundreds of kilometers. The most feasible method to achieve this is stellar interferometry, where light from multiple smaller telescopes is combined and measured to obtain information about the coherence function, which is used to reconstruct an image. The stellar interferometer facilities developed over the last few decades, while producing many important scientific results, are still limited in the level of detail that can be obtained, partly because the telescopes are fixed in place, or at best can be reconfigured between a small number of fixed positions. In this talk, I will describe our idea to combine rapidly movable telescopes with a simplified atmospheric phase retrieval scheme to obtain denser baseline sampling and hopefully higher-resolution images of stars. I will then describe our experimental progress in developing a simplified stellar interferometer using low-cost components, including recent tests at a fixed 10.7 m baseline, in preparation for building the full system.

Bio: Charles Santori performed his PhD and post-doctoral research in the Yamamoto group at Stanford (Applied Physics ’03) studying photon antibunching, two-photon interference and other quantum-optical effects in semiconductor structures such as InAs quantum dots coupled to microcavities. Afterwards he worked as a researcher for 10 years at HP Labs on integrated photonics for quantum and classical computing applications. He then worked at Verily Life Sciences on high-throughput hyperspectral imaging of labeled and unstained tissue for ML-based stain prediction. A few years ago, he left industry to launch the stellar interferometry venture described here, together with former Stanford colleagues.

Amir H. Safavi-Naeini

Associate Professor of Applied Physics & EE
Ginzton Lab, Stanford University

Interests and expertise:
Integrated photonics; thin-film lithium niobate; squeezed light and nonlinear optics; optomechanics and quantum acoustics; quantum sensing

Session 2, talk, Wednesday, September 16, 2026

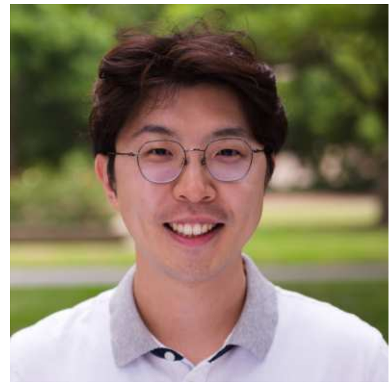
Nonclassical Light on a Chip: New Tools for Sensing, and Knowing When Quantum Helps

Integrated nonlinear photonics has quietly changed what a sensor can be built out of. In thin-film lithium niobate, components that used to fill an optical table (parametric amplifiers, squeezed-light sources, frequency converters reaching from the visible into the mid-infrared) now fit on a millimeter of chip and can be made in a foundry. I will show where our group has taken this platform and what it newly makes possible for sensing: chip-scale sources of nonclassical light, and efficient conversion into the spectral windows, such as the mid-infrared, where molecules actually absorb.
I will then argue that the harder problem is not making the light but knowing when it helps. Quantum advantage in sensing is more fragile than it is usually advertised: once loss, dephasing and finite bandwidth are accounted for, a coherent state with good inference often matches or beats a carefully engineered quantum state. The open challenge, and the one I would most like to discuss with this audience, is identifying the measurements where quantum resources survive contact with a real device, and co-designing the optics and the estimation together rather than separately.

Bio: Amir H. Safavi-Naeini is an Associate Professor of Applied Physics at Stanford University, where he leads the Laboratory for Integrated Nano-Quantum Systems in the Edward L. Ginzton Laboratory. His group works at the interface of nonlinear and quantum optics, nanomechanics and integrated photonics, developing thin-film lithium niobate devices that generate, convert and detect light in regimes where quantum noise matters: squeezed-light sources and optical parametric oscillators, microwave-to-optical transducers, and nanomechanical resonators used as sensors. Current efforts span quantum-enhanced and computational sensing, mid-infrared photonics for molecular spectroscopy, and quantum acoustics.

Joonhee Choi

Assistant Professor of Electrical Engineering
Stanford University



Interests and expertise:
Quantum sensing and computing, atomic physics, solid-state devices, and nanophotonics.

Session 2, talk, Wednesday, September 16, 2026

Quantum sensing with atoms and atom-like systems

Programmable quantum devices built from atoms and atom-like systems offer powerful platforms for quantum sensing, combining their intrinsic sensitivity to the environment with precise control over their quantum states and interactions. In this talk, I will discuss how neutral-atom arrays and solid-state spins provide complementary opportunities for quantum sensing and information processing, opening new avenues for addressing scientific questions and technological challenges. I will highlight how coherent control, engineered interactions, and advances in quantum hardware can push the boundaries of quantum sensing – unlocking new ways to extract information from both coherent and incoherent signals and enabling multimodal exploration of complex physical systems. I will also briefly introduce quantum computational sensing, an emerging paradigm that integrates coherent quantum processing into sensing, with the goal of performing targeted tasks more efficiently than conventional approaches.

Bio: Joonhee Choi is an Assistant Professor of Electrical Engineering at Stanford University. He received his Ph.D. and master's degrees from Harvard University and his bachelor's degree from KAIST. Prior to joining Stanford, he was an IQIM postdoctoral fellow at Caltech. Joonhee's current research focuses on engineering the dynamics of quantum many-body systems using both neutral atoms and solid-state spins to explore fundamental science and enable practical applications in metrology, communication, and information processing. Throughout his career, he has worked across a wide range of fields, including ultrafast and nano-optics, solid-state and atomic physics, and quantum many-body physics. He is the recipient of the Outstanding Young Researcher Award from AKPA (2021), the KSEA Young Investigator Grant (2024), the AFOSR Young Investigator Program (YIP) Award (2025), the Google Research Scholar Program Award (2025), the DOE Early Career Research Program Award (2025), and the Terman Faculty Fellowship in the School of Engineering at Stanford.

4.3 Day 3, Session 3: Future of Photonics

Session host:

Stefan Steiner
Manager R&D, Digital Optics
Jenoptik Optical Systems GmbH

Interests and expertise:
Diffractive optics, micro- and nanostructures, meta-elements

Bio: Stefan Steiner is the Manager R&D of Digital Optics at Jenoptik Optical Systems GmbH (Jena, Germany), where he leads the engineering and R&D team responsible for diffractive optics and advanced micro and nano-optical components. He received his Ph.D. in physics from the Institute of Applied Physics at the Friedrich Schiller University Jena, focusing on microstructured and grating-based directional filter elements.
Prior to his current role, he served as Chief Technology Officer and Principal Scientist at LightTrans International, steering the technological roadmap and wave-optical modeling algorithms for VirtualLab Fusion. Throughout his career, he has worked at the convergence of fundamental wave optics, rigorous electromagnetic modeling, and industrial fabrication, bridging the gap between design concepts and scalable manufacturing for high-precision applications.
His current work and research focus on the design, optimization, and metrology of complex micro- and nanophotonic structures. This includes diffractive optical elements (DOEs), custom beam shapers and splitters, dielectric metasurfaces, and flat optics for semiconductor equipment, industrial laser systems, and advanced sensing. In this context, he actively explores hybrid optical design concepts, leveraging both classical diffractive principles and subwavelength meta-optics to enable next-generation compact photonic systems. Steiner regularly contributes to international conferences such as SPIE Photonics West and is involved in European photonics industry networks including EPIC and OptoNet e.V.

Dominik Schulten

Director, Digital Photonics Interconnect
ams OSRAM

Interests and expertise:
Optical Interconnects, Photonic AI Infrastructure, LED/VCSEL Technology, Co-Packaged Optics & Advanced Packaging, Optical Networking for Scale-Up and Scale-Out AI Systems

Session 3, invited talk, Wednesday, September 16, 2026

Wide & Slow Optical Interconnects for Optical Scale-Up

The rapid growth of AI infrastructure is shifting the primary system bottleneck from computation to communication. Future scale-up networks will connect thousands of accelerators across multiple racks and increasingly rely on disaggregated resource pools, creating a need for interconnects that combine longer reach, low latency, high bandwidth density, and copper-like energy efficiency.
In this talk, I will discuss the emerging requirements of AI scale-up fabrics and why conventional copper and optical interconnect approaches will struggle to meet future system demands. I will introduce Wide & Slow, an optical architecture that trades per-lane speed for massive parallelism, enabling optical reach with lower latency, reduced DSP complexity, and FEC-free NRZ operation.
I will present key building blocks including micro-emitter arrays, photodiodes, CMOS integration, advanced packaging, and multicore-fiber connectivity. Finally, I will highlight open challenges in system architecture, packaging, fiber interfaces, and standards, and discuss opportunities for collaboration to enable future optical scale-up fabrics.

Bio: At ams OSRAM, Dominik Schulten leads business strategy, customer engagement, and ecosystem development for next-generation optical interconnect solutions.
Over the past 15 years, Dominik has held leadership positions spanning business development, customer program management, application engineering, and product management across North America, Europe, and Asia. Before starting the Digital Photonics Interconnect business, he served in senior management and business development roles at Vixar and OSRAM Opto Semiconductors, helping drive innovation and commercialization in LEDs, VCSELs, display, wearable technologies, and optoelectronic systems.
Dominik holds a Master of Business Administration from the Technical University of Applied Sciences Regensburg (Germany) and a Bachelor of Science in Applied Physics from the University of Applied Sciences Ravensburg-Weingarten (Germany).

Olav Solgaard

Professor of Electrical Engineering
Robert L. and Audrey S. Hancock Professor in the School of Engineering

Interests and expertise:
Optical micro and nano systems, Silicon Photonics, optical sensors

Session 3, talk, Wednesday, September 16, 2026

Free-space Reconfigurable Optical Interconnects

Free-space optical interconnects have the potential to significantly reduce the power consumption of large electronic systems. We propose a micromirror-based optical interconnect system and experimentally demonstrate its operation principles, including vertical input/output, reconfigurability, and alignment. The proposed system enables reconfigurable, dense channels for next-generation datacenters based on many slow channels, potentially achieving $>$1 Tbps/mm bandwidth density with a total bandwidth of $>$10 Tbps. This work was a collaboration between Jaekwon Lee, Carson G. Valdez, Anne R. Kroo, David A. B. Miller, Olav Solgaard.

Bio: Olav Solgaard earned his Ph.D. degree from Stanford University in 1992. His doctoral dissertation was the basis for the establishment of Silicon Light Machines (SLM), co-founded by Dr. Solgaard in 1994. His work at UC Davis led to the invention of the multi-wavelength, fiber-optical switch, which has been developed into commercial products by several companies. In 1999 he joined Stanford University where he is now the Robert L. and Audrey S. Hancock Professor of Electrical Engineering.
Professor Solgaard's research interests include optical micro and nano systems, Silicon Photonics, optical sensors, and dielectric laser accelerators. He has authored more than 500 technical publications and holds 85 patents. Professor Solgaard is a Fellow of the IEEE, the Optical Society of America, the Royal Norwegian Society of Sciences and Letters, and the Norwegian Academy of Technological Sciences.

Joaquin Matres

Chief Technology Officer
GDSFactory

Interests and expertise:
Photonic integrated circuits, design automation, open-source PDKs, silicon photonics, layout verification

Session 3, talk, Wednesday, September 16, 2026

GDSFactory: Python-Driven Design Automation for Photonic and Analog Chips

GDSFactory is an open-source Python library for designing complex physical systems: photonic integrated circuits, analog and quantum devices, MEMS, PCBs, and 3D-printed components. This talk walks through the full chip design workflow in GDSFactory: parametric layout, schematic capture, DRC/LVS, and coupled circuit/FDTD/EME simulation. We'll show how a code-first approach shortens design iteration and improves reproducibility, with concrete examples across silicon photonics, quantum, and RF.

Bio: Joaquin Matres is the founder and CTO of GDSFactory, an open-source Python platform for photonic and analog chip design (5M+ downloads, 130+ contributors, 50+ foundry PDKs). Before GDSFactory he spent 15+ years designing chips at Intel, Hewlett Packard, PsiQuantum, and Google X. GDSFactory+ is used by hundreds of teams to build PDKs, automate layout, simulation and verification, and integrate cloud- and AI-assisted workflows for photonic, quantum, and MEMS chips.

Waguih S. Ishak

Advisory Board
Mojo Vision

Interests and expertise:
Optical interconnects, silicon photonics, microLED technology, optoelectronics, photonic infrastructure for AI data centers.

Session 3, talk, Wednesday, September 16, 2026

The Photonics Tera Era: A 30-Year Journey from Terabits to the Peta Society

In 1995, as Manager of the Photonics Technology Department at HP Laboratories, the author coined the term “Tera Era” to describe a coming period in which the tera prefix – one trillion, or 10^{12} – would become the natural unit of measure across computing and communications. Three decades later that forecast has arrived, and artificial intelligence has become its principal accelerant. This talk argues that AI is not one more workload driving incremental gains, but a forcing function pushing three previously distinct domains – communications, compute, and storage – past tera-scale simultaneously. Optical interconnects inside AI clusters now exceed a terabit per second, with co-packaged-optics switches at 50–400+ Tb/s and optical I/O chiplets bringing terabit-class bandwidth onto the compute package. TeraFLOPS and petaFLOPS of AI compute now live inside a single GPU die and, increasingly, a phone or laptop. Terabyte capacities are standard in consumer devices, while AI infrastructure is built on terabyte-per-second memory bandwidth and exabyte-scale data lakes. These three pillars are mutually reinforcing: AI has synchronized and compressed technology curves that previously advanced on separate timelines. The talk closes by looking beyond today’s tera-scale infrastructure to the Peta and Exa Societies now taking early shape, elaborating on the role of photonics in each, and outlines the strategic implications for technology leaders, investors, and engineering organizations navigating this transition.

Bio: Waguih S. Ishak is a photonics engineer and technical executive whose career spans five decades. He currently serves on the advisory board of Mojo Vision, advising on massively parallel microLED-based optical interconnects for AI data-center applications, and on the advisory board of Aeluma, Inc. He also serves on Sabancı University’s International Board of Overseers. He previously served as Division Vice President and Chief Technologist at Corning Inc., Vice President and Director of the Photonics Laboratories at HP Labs and Agilent Labs, and Vice President and Chief Technology Officer of Avago Technologies. He is an IEEE Life Fellow, a Member of the U.S. National Academy of Engineering (2022), and a Fellow of the Royal Academy of Engineering (2024), the Royal Society of Canada (2024) and the Canadian Academy of Engineering (2020). He received the IEEE Photonics Society Industry Achievement Award in 2024.

5 – Posters

The poster session is held on Tuesday, September 15, from 4:30 to 6:00pm in the Clark Center Courtyard, just above the auditorium, directly following the open session on entrepreneurship and innovation. The posters on show, each reproduced in full on the pages that follow:

	Presenter	**Poster**
5.1	Jamison Sloan	All-optical control of phase-sensitive amplification
5.2	Jiazhou Cheng	A General Differentiable Ray-Wave Framework for Hybrid Refractive-Diffractive System Modeling and Optimization
5.3	Ryosuke Mashiko	Broadband curved directional couplers based on an analytic model
5.4	Srijit Mukherjee	Directional Electric Fields Reveal Electrostatic Preorganization Beyond the Carbonyl in LADH
5.5	Michael Wahrman	Floquet transverse-field Ising dynamics in a Rydberg-dressed optical tweezer array
5.6	Sydney Mason	High-Performance Wavelength Division Multiplexers Enabled by Co-Optimized Inverse Design
5.7	Alexandra Mitchell	Interferometric Sensors for Gravitational Wave Detectors
5.8	Ekin Güneş Ozaktas	Isotropic Chiral Metamaterials with Spin-1 Weyl Points
5.9	Margaret Gao	Meta-Refractive: Conformal Meta-Optics on Freeform Substrates
5.10	Yixuan Shao	Multifunctional Spaceplates for Aberration Correction
5.11	Chou-Wei Kiang	Nanoscale Nitride Shadow Mask for Clean Metallization
5.12	Matt Beutel	Neural Inference of TCMT Parameters from Optical Spectra
5.13	Devin J. Dean	Practical Limits on Integrated Squeezers
5.14	Mohammed Azzouz	Reducing the Noise and Drift of a Chip-Scale Silicon Nitride Resonant Gyroscope
5.15	Sungjun Eun	Strong Electro-optic Materials based Integrated Photonic Modulators for Solid-state Quantum Systems
5.16	Marius Jürgensen	Synthetic Photonic Matter in a Twisted Optical Cavity with Rydberg Atoms

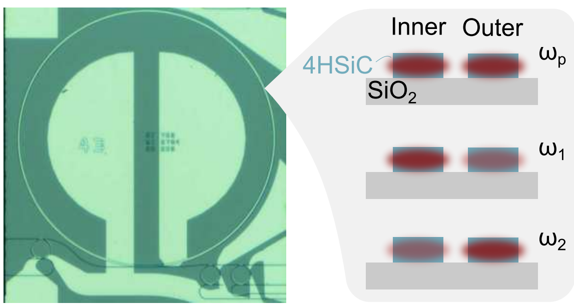
All-optical control of phase-sensitive amplification

Jamison Sloan[1], Eran Lustig[1,2], Louise Schul[1], Trung Kien Le[1], Melissa Guidry[3], Daniil Lukin[4], Shanhui Fan[1], Jelena Vučković[1]

[1]Stanford Electrical Engineering, [2]Technion, [3]MIT, [4]Harvard

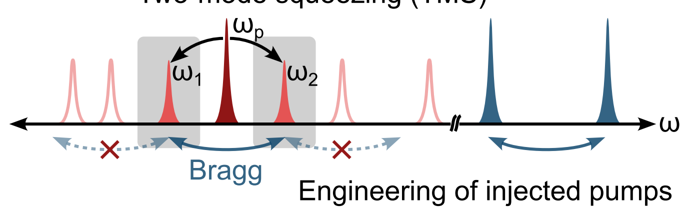
Motivation: control phase-sensitive behavior of light

- Phase-sensitive amplification
- Controllable two-mode-squeezing
- Quantum non-demolition measurements

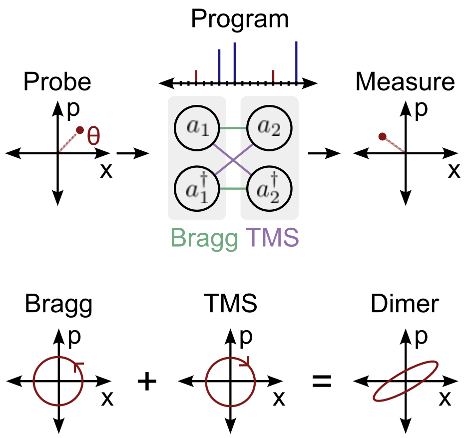


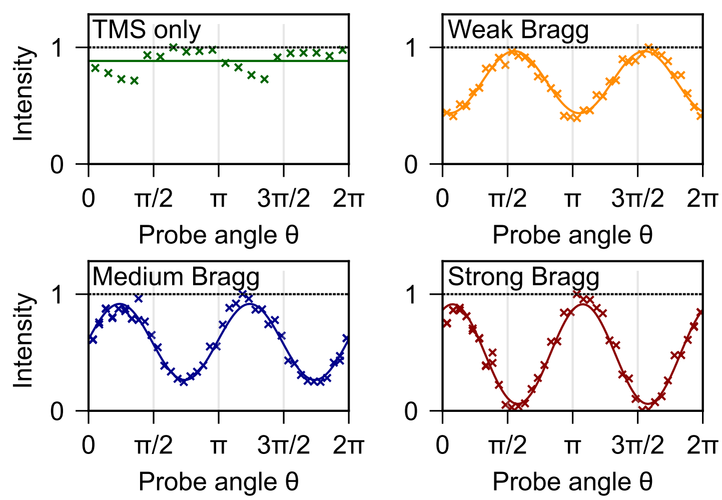
Squeezing Dimer Hamiltonian

$$H/\hbar = \lambda(a_1 a_2 + a_1^\dagger a_2^\dagger) + J(e^{i\phi} a_1^\dagger a_2 + e^{-i\phi} a_2^\dagger a_1)$$

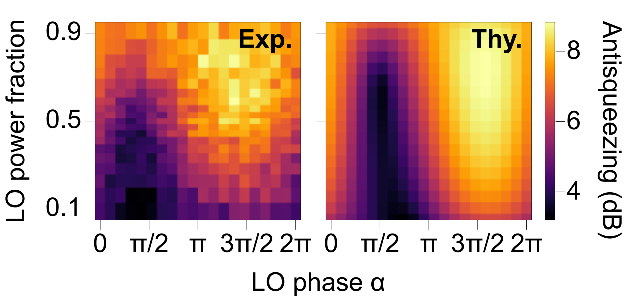


Phase-dependent probe reveals interference between TMS and Bragg





Quantum noise measurements



Summary of findings:

- Observation of interference between TMS and coherent scattering
- Quantum noise gets phase-dependent structure from interference, and asymmetry from losses

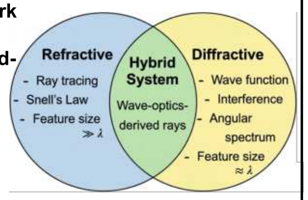
A General Differentiable Ray-Wave Framework for Hybrid Refractive-Diffractive System Modeling and Optimization

Jiazhou Cheng[1], Margaret Gao[1], Yixuan Shao[1], Chenkai Mao[1], Tom D. Milster[2], Jonathan A. Fan[1]
[1] Department of Electrical Engineering, Stanford University
[2] James C. Wyant College of Optical Sciences, The University of Arizona

Problem Statement

We provide a differentiable framework for hybrid refractive-diffractive systems that support advanced, hard-to-model optical functions.

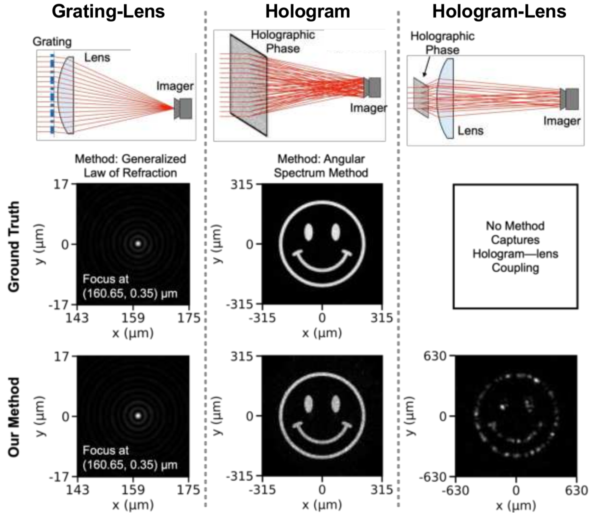
- 4f relay systems
- Achromatic / ultra-wide FOV lens
- AR/VR displays
- Conformal DOE, meta-refractive
- Metasurface optical cloak



Existing Methods

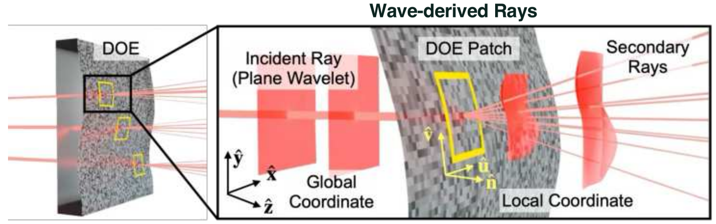
Method	Conformal DOE	Holographic Phase DOE	Complex-Amplitude Modulation	Flexible DOE Placement	Non-paraxial	Differentiable
Yu et al.[1]	✓	✗	✗ (phase only)	✓	✓	✓
Mout et al.[2]	✗	✗	✗ (amp. only)	✓	✓	✗
Zhu et al.[3]	✓	✗	✗ (phase only)	✓	✓	✓
Shih et al.[4]	✗	✗	✓	✓	✓	✓
Yang et al.[5]	✗	✓	✓	✗ (last)	✓	✓
Zhang et al.[6]	✓	✗	✗ (phase only)	✓	✓	✓
Cheng et al.[7]	✗	✗	✓	✓	✓	✗
Shi et al.[8]	✓	✗	✗ (phase only)	✓	✓	✓
Ellepola et al.[9]	✓	✗	✗ (amp. only)	✓	✓	✗
Our work	✓	✓	✓	✓	✓	✓

Benchmark Ray-Wave Tracing

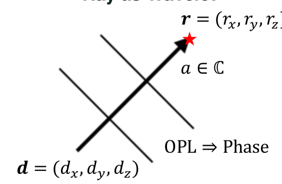


Ray-Wave Tracing Formulation

Wave-derived Rays



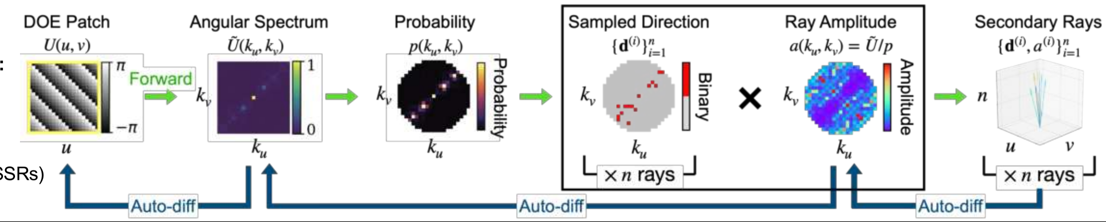
Ray as Wavelet



Local diffraction is converted into secondary-ray (wavelets) that propagate through conventional ray tracing and coherently sum at the sensor.

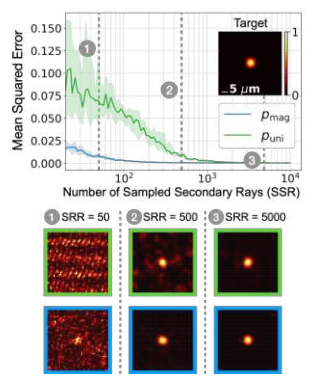
When a ray is incident on a DOE:

1. Extract local DOE patch
2. Compute angular spectrum
3. Form sampling distribution
4. Sample weighted wavevectors
5. Propagate as secondary rays (SSRs)



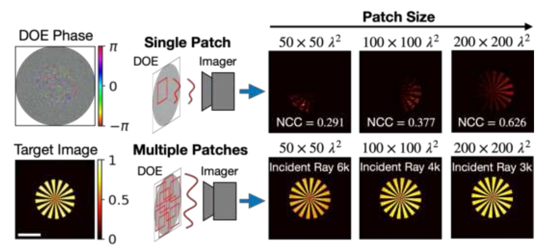
Analysis

Monte Carlo Convergence of a Patch



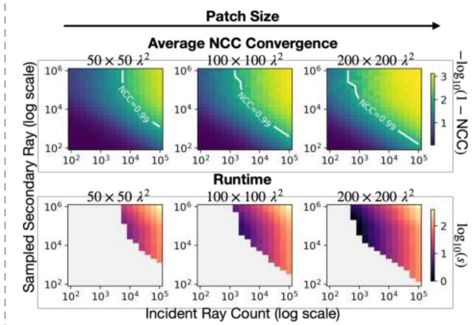
Single patch convergence depends on the SSR sampling distribution and density.

Field Reconstruction with Multiple Overlapping Patches



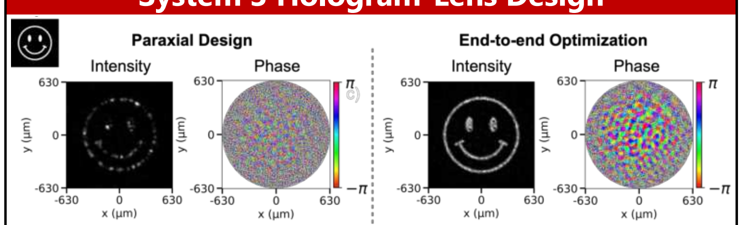
Accurate full-field reconstruction requires sufficient spatial coverage by overlapping DOE patches.

Reconstruction Accuracy and Computational Cost w.r.t. Ray Count

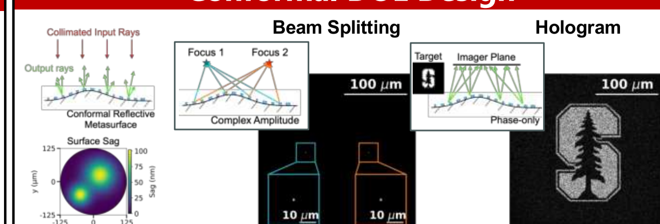


Accuracy and computational cost are jointly controlled by patch size, incident-ray count, and SSR count.

System 3 Hologram-Lens Design



Conformal DOE Design



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Broadband curved directional couplers based on an analytic model

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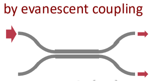
Introduction

Need for broadband directional couplers

Directional couplers (DC)
[Marcatili, BSTJ, 1969]

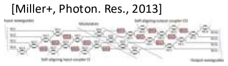
- Critical PIC building block
- Especially 50:50 splitter for MZI
- ✓ simple, compact
- ✗ narrow bandwidth

Split/ combine light by evanescent coupling



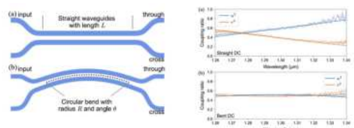
$T_{50:50} = \frac{1}{\sqrt{2}}\begin{pmatrix} 1 & i \\ i & 1 \end{pmatrix}$

Programmable photonic circuits
[Miller+, Photon. Res., 2013]



Broadband curved DC

- Need for WDM and sensing
- Use **local asymmetry** of couplers
- ✓ broadband
- ✗ simulation cost, unclear mechanism



[A. El-Saeed+, J.L.T., 2024]

Need for fast, intuitive, accurate analytic model for curved DC

Normal workflow v.s. Proposed analytic model

Full vectorial solvers

- FDE (single waveguide mode; coupled waveguide mode)
- ↓ CMT (analytic model)
- ↓ geometry candidate
- FDTD — Parameter Sweep
- ↓ Device spectrum

|---|---|---|
Speed	✗ $O(N^4)$	✓ $O(N)$ fast, one-shot, 1D only
Interpretability	✗ Low	✓ High, no fitting, intuitive
Accuracy	✓ High	✓ High, comparable with FDTD

Proposed analytic method

- **Mixed EIM**: Vertical (TE, straight) ↔ Horizontal (TM, curved); Tail reconstruction
- Single WG mode
- **3D CMT (semi-vectorial)**
- κ, δ, L_π
- **TMM (multi-section)**
- Device spectrum

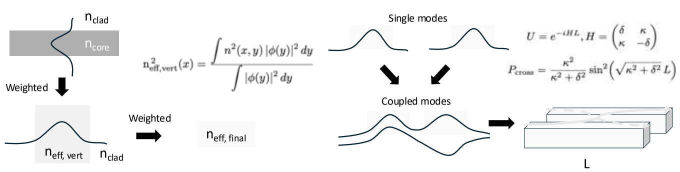
Problems of basic analytic models for DC

Effective index method (EIM)
[Knox+, Proc. Submm. Waves, 1970]

- Solve : sequential 1D mode + effective index
- Weighted EIM: field-based weighting
[Robertson+, JLT, 1989]

Coupled mode theory (CMT)
[Yariv+, IEEE JQE, 1973]

- Two waveguides: independent
- Coupling κ = overlap integral of modes
- Detuning δ = asymmetry of modes



$$n^2_{\text{eff,vert}}(x) = \frac{\int n^2(x,y)\,|\phi(y)|^2\,dy}{\int |\phi(y)|^2\,dy}$$

$$U = e^{-iHL}, H = \begin{pmatrix} \delta & \kappa \\ \kappa & -\delta \end{pmatrix}$$

$$P_{\text{cross}} = \frac{\kappa^2}{\kappa^2+\delta^2}\sin^2\left(\sqrt{\kappa^2+\delta^2}\,L\right)$$

But not enough accuracy just with these method

Theory

1D x 1D waveguide mode solve

Straight (TE vertical)

$$\frac{d^2u}{dx^2} + \left[k_0^2 n^2(x) - \beta^2\right]u = 0,$$

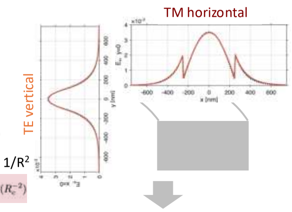
Curved (Bessel equation)

$$\frac{d^2u}{dx^2} + \left[k_0^2 n^2(x) - \frac{\nu^2 - \frac{1}{4}}{(R_c+x)^2}\right]u = 0,$$

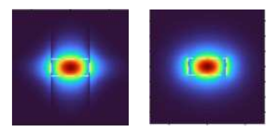
approximate by $1/R \gg 1/R^2$ (perturbated)

$$\frac{d^2u}{dx^2} + \left[k_0^2 n^2(x) - \beta^2\right]u = -\frac{2\beta^2}{R_c}xu + O(R_c^{-2})$$

TM horizontal



Analytic vs FDE
TE-like fundamental mode
w=500 nm, t=220 nm, R=30 µm



Merit

- ✓ speed: 120x faster than Bessel
- ✓ stable in design region (R>20µm)
- ✓ well-defined at R=> inf (Bessel: ill-conditioned)

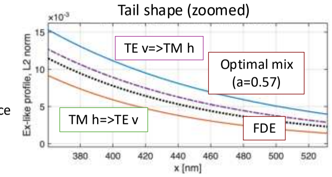
Mixed EIM

- linear mixture of two EIM orders brackets the true tail

$$E_{\text{mix}} = aE_{\text{TE}\to\text{TM}} + (1-a)E_{\text{TM}\to\text{TE}},$$

- a: full analytical and 1D-only derivation
  - the tail coupling reflects vertical dependence in the Helmholtz equation

Tail shape (zoomed)



3D CMT

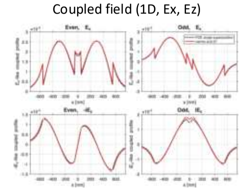
κ (coupling)

- Semi-vectorial decomposition
$K \approx K_x + K_y + K_z$
- Effect of Ez
$$\nabla\cdot\mathbf{D} = 0 \Longrightarrow E_z = \frac{i}{\beta\varepsilon}\left[\frac{\partial(\varepsilon E_x)}{\partial x} + \frac{\partial(\varepsilon E_y)}{\partial y}\right] \approx \frac{i}{\beta}\frac{\partial E_x}{\partial x},$$
  - Kx and Kz: opposite sign
  - Remaining residue may require full-vectorial CMT [Huang+, IEEE JQE, 1992]

δ (detuning)

- 1D solve captures correct asymmetry

Coupled field (1D, Ex, Ez)



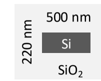
κ and δ (R=30µm, gap=100nm)

	Kx	Ky	Kz	κ	δ
Analytic	0.246	0.000	−0.127	**0.119**	**0.096**
FDE (single)	-	-	-	0.116	0.099

Numerical Simulation

Condition

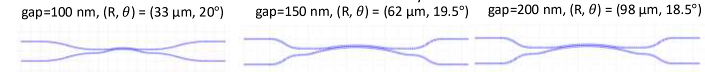
- 50/50 split @ 1550 nm
- Fundamental TE mode
- Coupling at S-bends L_s : 2.5µm



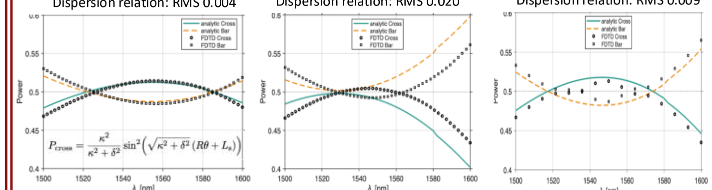
Result

- Larger gap requires weaker asymmetry to match kappa and delta amplitude
- Deviations come from geometry-dependent residual error between analytic and FDE

gap=100 nm, (R, θ) = (33 µm, 20°) gap=150 nm, (R, θ) = (62 µm, 19.5°) gap=200 nm, (R, θ) = (98 µm, 18.5°)



Dispersion relation: RMS 0.004 Dispersion relation: RMS 0.020 Dispersion relation: RMS 0.009



$$P_{\text{cross}} = \frac{\kappa^2}{\kappa^2+\delta^2}\sin^2\left(\sqrt{\kappa^2+\delta^2}\,(R\theta + L_s)\right)$$

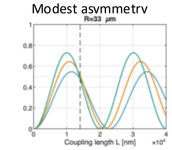
Mechanism for broadband

- Plot of coupling length vs coupled ratio:

$$P_{\text{cross}} = \frac{\kappa^2}{\kappa^2+\delta^2}\sin^2\left(\sqrt{\kappa^2+\delta^2}\,L\right)$$

- Quality knobs
  - Crosses happen at a single splitting ratio => broadband
  - Gradient at the cross is small => fabrication error-tolerant
- Opposite trend of κ and δ with λ => partially cancels out the dispersion

Modest asymmetry



Extension: multi-sectional curved DC

Method

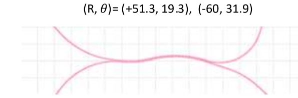
- Trasnfer matrix method

$$\begin{bmatrix} a_{N,t} \\ a_{N,b} \end{bmatrix} = T_N T_{N-1}\cdots T_1 \begin{bmatrix} a_{0,t} \\ a_{0,b} \end{bmatrix},$$

- Each section follows the analytic model

$$T_j(\lambda) = e^{-iH_j L_j}, H_j = \begin{bmatrix} \delta_j & \kappa_j \\ \kappa_j^* & -\delta_j \end{bmatrix}, L_j = R_j|\theta_j|,$$

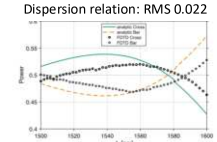
Waveguide geometry
gap=150,
(R, θ)= (+51.3, 19.3), (-60, 31.9)



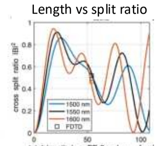
Result

- More design parameters => wider possibilities for broadband
- Better fabrication error torelance

Dispersion relation: RMS 0.022



Length vs split ratio



Summary

Summary

- Full analytic model based on 1D mode solve for curved/ snake DC
- Fast: O(N)/ intuitive: 1D-full analytic/ accurate: FDTD match 97%~
- Open up WDM capacity in PIC: spectroscopy/interconnects/ optical computing

Application

- Broadband component design: Dispersion-designed waveguide / Tunable phase shifter [ongoing]
- Sensitivity analysis [J. C. Mikkelsen, Opt. Exp., 2014]
- Complex for complex inverse design [Molesky+, Nat. Photon., 2018]

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Directional Electric Fields Reveal Electrostatic Preorganization Beyond the Carbonyl in LADH

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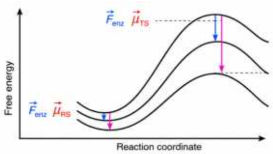
Electrostatic Preorganization

- The enzyme electric field preferentially stabilizes the transition state, lowering the activation free-energy barrier.
- This stabilization arises from interaction of the field with the dipole-moment change between the reactant state and transition state.

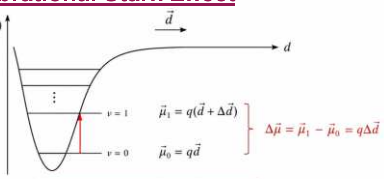


$$\Delta G_{\text{stabilization}} = -\vec{F}_{\text{enz}} \cdot (\Delta\vec{\mu}_{\text{TS}} - \Delta\vec{\mu}_{\text{RS}}) \quad \text{where } \Delta\vec{\mu} = \vec{\mu}_{\text{TS}} - \vec{\mu}_{\text{RS}}$$

$$\Delta\vec{\mu}_{\text{TS-RS}} = \vec{\mu}_{\text{TS}} - \vec{\mu}_{\text{RS}} \text{ (dipole change, TS − RS)}$$

Vibrational Stark Effect

- Dipole moment changes on ground state to the first excited state excitation.
- Electric field interacts with this dipole change, shifting the vibrational frequency through the linear Stark effect.



$$\vec{\mu}_1 = q(\vec{d} + \Delta\vec{d}), \quad \vec{\mu}_0 = q\vec{d}, \quad \Delta\vec{\mu} = \vec{\mu}_1 - \vec{\mu}_0 = q\Delta\vec{d}$$

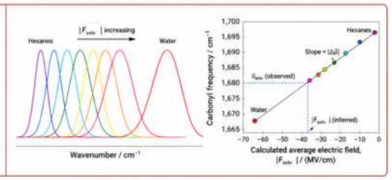
$$\Delta\bar{\nu} = -\Delta\vec{\mu} \cdot \vec{F}_{\text{ext}} = -q\Delta\vec{d} \cdot \vec{F}_{\text{ext}}$$

Three complementary calibrations of the Stark tuning rate ($\Delta\vec{\mu}$)

Converts frequency shift into local electric field

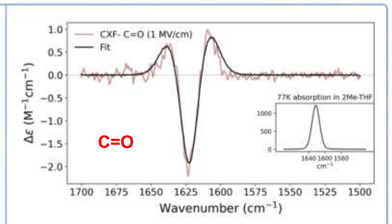
1. Vibrational Solvatochromism

Generic carbonyl frequency versus the MD-simulated solvatochromic field across a series of solvents.



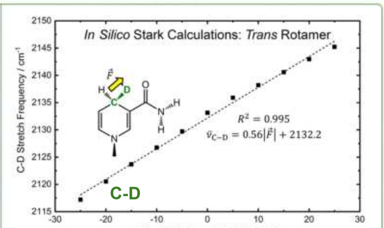
2. Vibrational Stark Spectroscopy

Stark spectra ($\Delta\varepsilon$) of the CXF C=O and C–D probes under an applied electric field in a frozen glass.

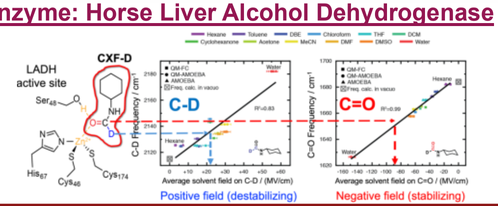


3. In-Silico Stark

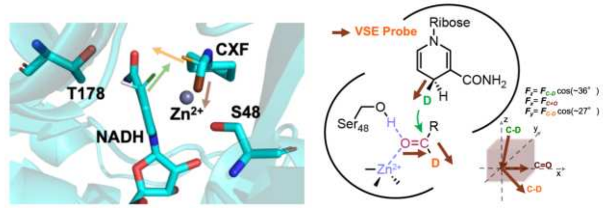
DFT-computed C–D stretching frequency versus applied electric field for the trans and cis rotamers of NAD[+] H



Enzyme: Horse Liver Alcohol Dehydrogenase

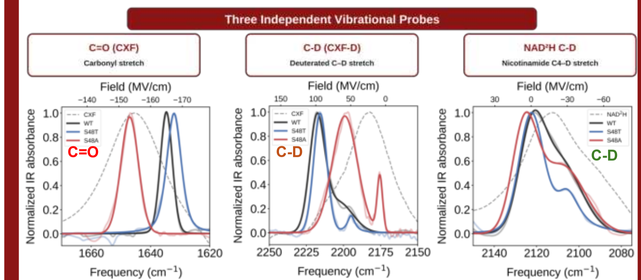


Functionally orthogonal VSE Probes in LADH



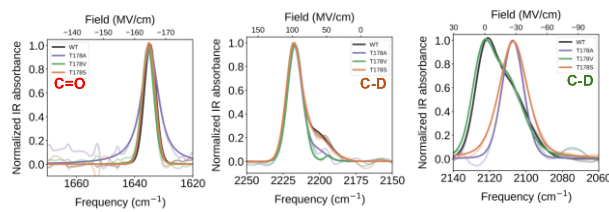
Orthogonal VSE probes in LADH: CXF C=O tracks charge redistribution, NAD²H C-D reaction coordinate tracks hydride transfer, and CXF C-D reports bond reorientation.

Directional Organization of the LADH Active Site



- WT, S48T, and S48A reveal **preorganization** across orthogonal IR probes.
- All probes shift upon enzyme binding relative to water (gray).
- Complex NAD²H C–D spectra motivate T178 variants to resolve alternative hydride-transfer geometries and local environments.

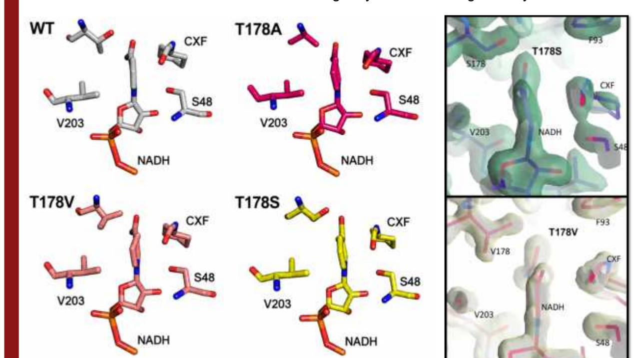
T178: Key to nicotinamide populations in IR spectra



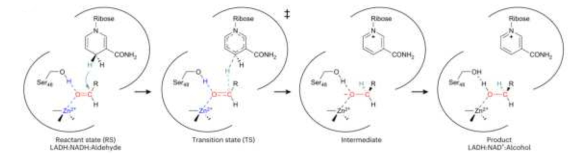
- T178 selectively reorganizes the NAD²H hydride-transfer coordinate.
- T178A/S collapses the NAD²H C–D spectrum from two populations to one, while the CXF C=O and CXF-D C–D spectra remain largely unchanged.

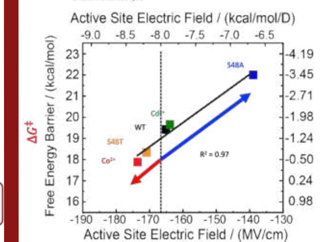
Residue 178 distorts nicotinamide ring

- T178 mutations alter NADH geometry while preserving the CXF - S48 interactions.
- Thr/Val methyl groups distort the NADH nicotinamide ring, whereas T178A/T178S remove this steric distortion and favor a single hydride-transfer geometry.

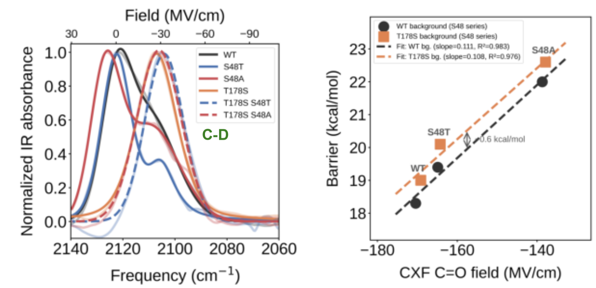


Field along C=O axis dictates catalysis



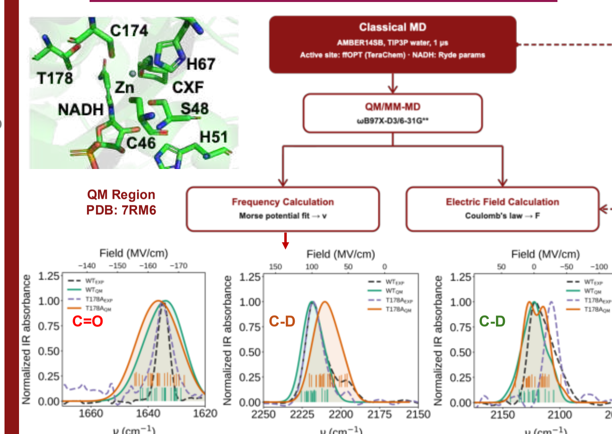


- LADH catalyzes NADH-driven **acetone reduction**, with **hydride transfer as the rate-limiting** step.
- CXF C=O electric fields stabilize the transition state and lower barrier CXF C–D and NAD²H C–D field contributions remain unresolved.
- **Double mutants of 48+178** created to see contribution of of hydride transfer to catalysis.



- T178S **retains S48-mediated electrostatic preorganization**.
- T178S adds a ~0.6 kcal/mol **field-independent** energetic penalty.

QM-MM-MD recapitulates experimental IR



- QM/MM-MD accurately reproduces the CXF C=O and CXF-D C–D spectra.
- QM/MM-MD captures the experimentally observed populations along NAD²H C–D.

Acknowledgements and Key References

We thank Chu Zheng, Jacob Kirsh, and Uyen Ta for valuable guidance and discussions. This work was supported by NIH R35GM118044 and HFSP grant RGP0047/2022 (S.G.B.). Synthetic compound characterization used Stanford Chemistry NMR and SUMS facilities, and computational analyses were performed on the Sherlock cluster (SRCC).

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Floquet transverse-field Ising dynamics in a Rydberg-dressed optical tweezer array

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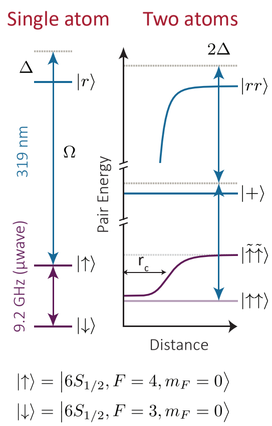
[1]Department of Physics, Stanford University; [2]Department of Applied Physics, Stanford University; [3]Department of Physics, University of Michigan

Optically controllable interactions with atomic qubits

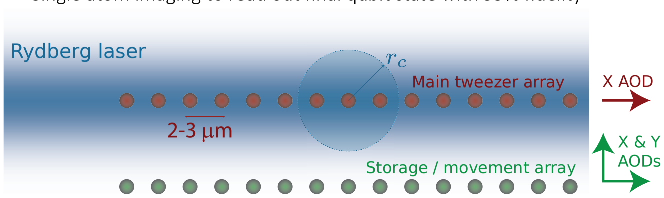
- Neutral atom platforms offer **long coherence times, simple scalability, and high fidelity** quantum operations
- Past work[1]: preparing metrologically useful states resulting from entanglement, e.g. squeezed spin states
- Naturally implement quantum simulation of **periodically driven (Floquet) systems** with no equilibrium analog[2,3]

Experimental setup

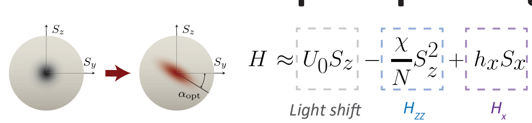
- Encode qubit states $|\uparrow\rangle, |\downarrow\rangle$ on cesium clock transition
- Use focused 1064nm light (1um waist) to trap and dynamically reconfigure atoms in a 1D array
- Single qubit gates: Global microwave drive
- Two qubit gates: UV laser causes state dependent, nearest neighbor Rydberg interaction (Rydberg blockade) resulting in a CPHASE gate[4]
- Single atom imaging to read out final qubit state with 99% fidelity



$|\uparrow\rangle = |6S_{1/2}, F=4, m_F=0\rangle$
$|\downarrow\rangle = |6S_{1/2}, F=3, m_F=0\rangle$

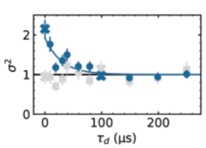


Previous work: spin squeezing

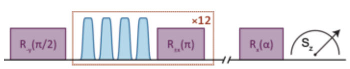


$$H \approx U_0 S_z - \frac{\chi}{N} S_z^2 + h_x S_x$$

- 10 ensembles of roughly 200 atoms prepared in parallel
- Off-resonant coupling between $|\uparrow\rangle$ and Rydberg state produces local interactions proportional to S_z^2
- Facilitated excitations and subsequent decay result in multibody loss from $|\uparrow\rangle$
- Dressing light applied as M shaped pulses; pulse length τ_p and delay τ_d affect loss and noise

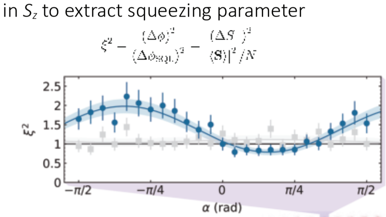


Microwave Rabi frequency	18 kHz
Principal quantum number	60
Rydberg laser power	300 mW
Rydberg Rabi frequency	1.3 MHz
Rydberg detuning	8 MHz

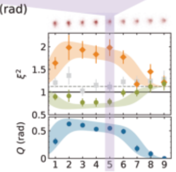


- Ising interactions with spin-echo produce one-axis twisting-like dynamics[5]
- Prepare state on the equator; allow atoms to interact until twisting strength Q=1
- Rotate state by angle α, measure variance in S_z to extract squeezing parameter

$$\xi^2 = \frac{\langle \Delta\phi \rangle^2}{\langle \Delta\phi_{SQL} \rangle^2} = \frac{\langle \Delta S_\perp \rangle^2}{|\langle \mathbf{S} \rangle|^2 / N}$$

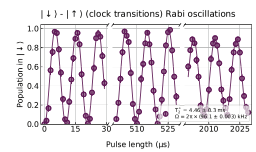


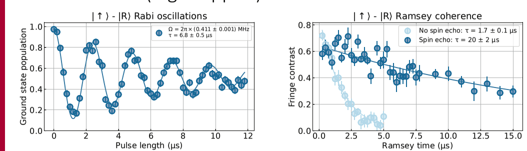
- **Best achieved squeezing parameter ξ^2_{min} = 0.77(9)**
- Prepared three independently squeezed states in parallel



Recent experimental progress

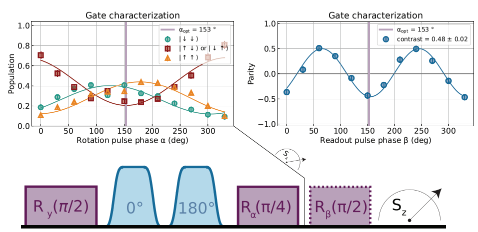
- 97 % state preparation to $|\uparrow\rangle$ thanks to 35 W microwave amplifier
- Imaging fidelity and tweezer waists improved by reducing aberrations frommirror mounts
- T_2^* on $|\uparrow\rangle$-$|r\rangle$ limited to 2 µs by slow noise, shot-to-shot fluctuations (e.g. Doppler)





Microwave Rabi frequency	100 kHz
Principal quantum number	60
Rydberg laser power	5 - 300mW
Rydberg Rabi frequency	0.5 - 4MHz
Rydberg blockade radius	5 µm

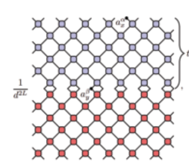
- Single photon gates benefit from lower lightshifts and no intermediate state scattering, but suffer from laser power constraints and Doppler sensitivity
- Initial test of Levine-Pichler[4] gate shows Bell-state fidelity of 0.64(2), limited by $\Omega \times T_2^*$ on $|\uparrow\rangle$ - $|r\rangle$



- Recovering 300 mW UV Rabi frequency to 4 MHz, allowing higher fidelities
- Time optimal or adiabatic dressing protocols could be employed to further increase fidelities

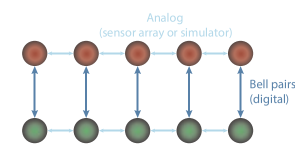
Digital + analog toolbox for quantum simulation & sensing

Single array: brickwork circuits



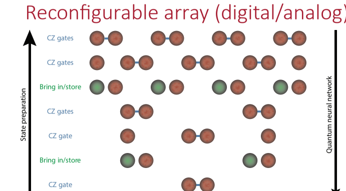
- Circuits can exhibit unitary dynamics in both time and space[6]
- This allows analytical calculation of correlation functions for large N
- Correlations spread along lightcone

Dual array (digital/analog)



- Operation as second copy or reference system
- Preparation of thermofield double states
- Distributed single-shot sensing of local Paulis-> exponential speedup for learning correlated noise[7]

Reconfigurable array (digital/analog)



- Secondary array enables reconfiguration of data qubits
- Tensor-network circuits (MERA, tree) for efficient preparation of long-range entanglement
- Reverse operation: quantum neural network for classifing spatially patterened fields or quantum phases

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High-Performance Wavelength Division Multiplexers Enabled by Co-Optimized Inverse Design

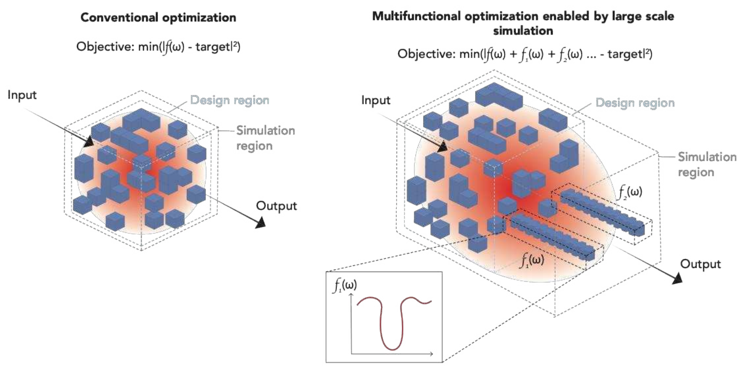
Sydney Mason, Geun Ho Ahn, Jakob Grzesik, Sungjun Eun, Jelena Vučković

Introduction and Motivation

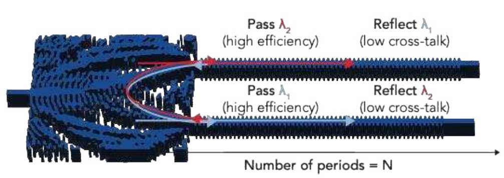
To achieve future data rate targets for optical interconnects there is need for integrated photonic WDM solutions with:

- Low insertion loss
- High crosstalk suppression
- Narrow channel spacing
- Small device footprint

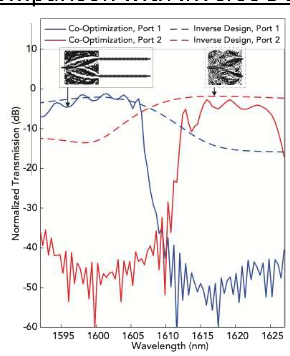
<u>To overcome existing device limitations, need creative design solution</u>



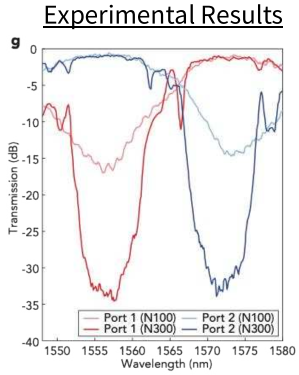
Co-Optimization Design Method



Comparison with Inverse Design

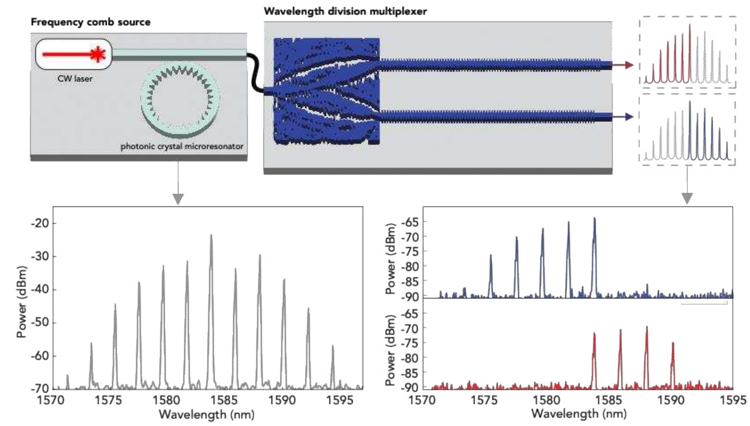


Experimental Results

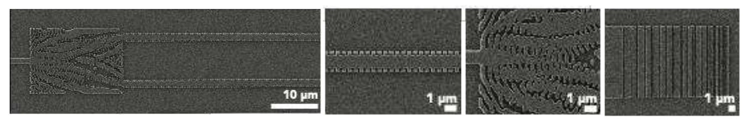


- Near unity reflection from Bragg gratings prevents use in WDM systems
- Can tailor Bragg gratings to WDM channels and use as initial condition for inverse design
- Optimization function handles coupling to Bragg mode + reflection
- Can arbitrarily increase crosstalk suppression with Bragg grating length while maintaining insertion loss

Experimental Demonstration

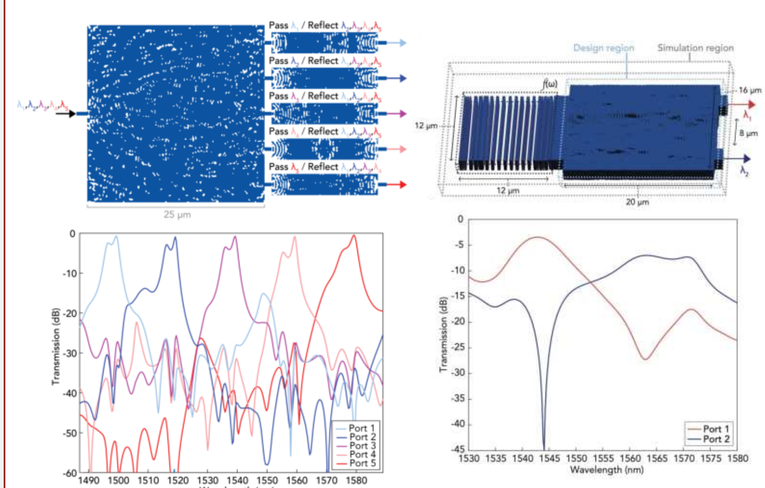


- Achieved < -40 dB of crosstalk with 15 nm channels
- System demonstration separating frequency comb
- Devices in silicon nitride show pathway towards direct integration with frequency comb source



Scanning electron microscope (SEM) images of devices in silicon nitride

Beyond 2 Channel WDMs



Summary and Outlook

- Devices are compatible with commercial foundry fabrication constraints
- Potential to explore alternative materials and shorter wavelengths for quantum applications and higher power handling

The authors acknowledge AMD for their support through the System-X Alliance

References:
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[2] S J Cooper et al 2023 *Rev. Sci. Instrum.* 94, 014502
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Interferometric Sensors for Gravitational Wave Detectors

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Homodyne Quadrature Interferometer (HoQI)

The HoQI is a compact interferometer which uses **polarisation** optics and **multiple photodiode readouts** to create a sub-wavelength, fringe-counting interferometer. Taking a static measurement of the HoQI tests the **sensor noise**. The sensor was upgraded and these results were compared to the previous best measurements [1]. Three HoQI's were setup as in Figure 2, with extension plates.

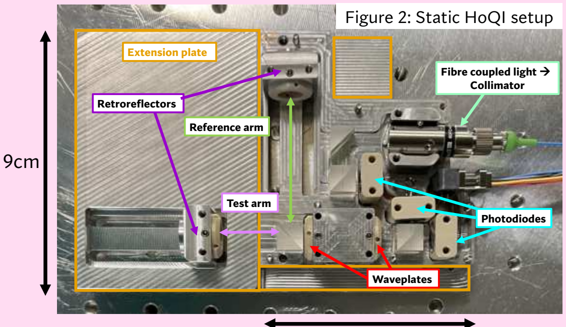

Figure 2: Static HoQI setup

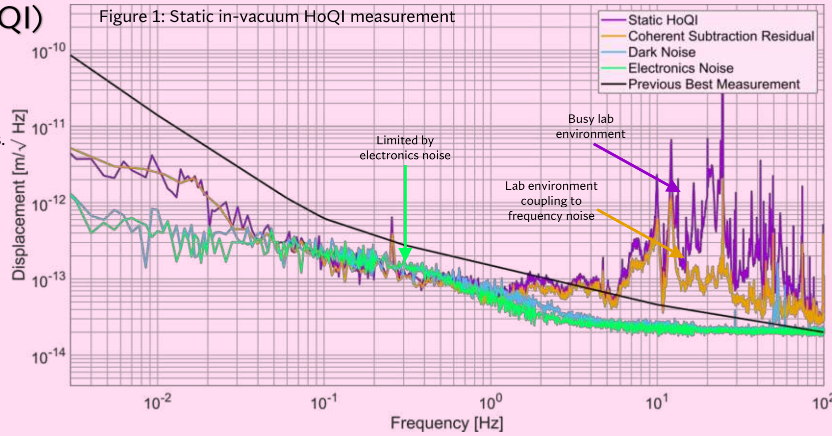

Figure 1: Static in-vacuum HoQI measurement

The new static measurements show a **reduction in noise below 5Hz** which is expected due to the vacuum. The busy lab environment creates many peaks above 5Hz but a **noise floor of** $\mathbf{3-4\times10^{-14}}$ can be extrapolated above 1Hz. The electronics and dark noise is limiting between 0.03-1.5Hz.

Frequency Noise

There are two sources of frequency noise in the HoQI: laser frequency noise and arm-length mismatch. Using multiple units laser frequency noise can be subtracted as it is common between them.
We measured frequency noise using two 30mm mis-matched arm-length HoQIs and one with matched arm-lengths. We assume that by mis-matching the arm lengths frequency noise will dominate. We can estimate the frequency noise in an arm-length-matched HoQI using the following equation

$$\Delta f_1 = \Delta f_2 \frac{\Delta L_1}{\Delta L_2}$$

Δf = frequency noise, ΔL = arm length mismatch, 1 = arm length matched HoQI and 2 = mis-matched HoQI

This measurement suggests we are limited by frequency noise, but as the matched HoQI noise is higher than the best static results in Figure 2 the arm lengths in the static tests must be matched significantly better (~0.5mm). Hence, with good arm-length matching the frequency noise can be greatly reduced. The coherent subtraction in both measurements indicate that there is frequency noise coupling at 20Hz. This is most likely from the propagation of ground motion to the laser.

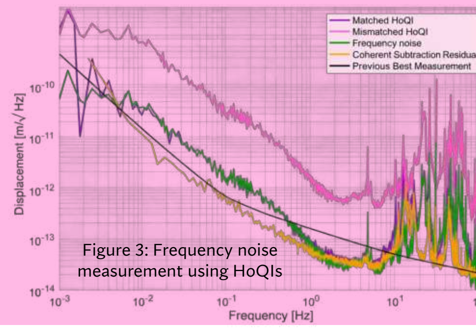

Figure 3: Frequency noise measurement using HoQIs

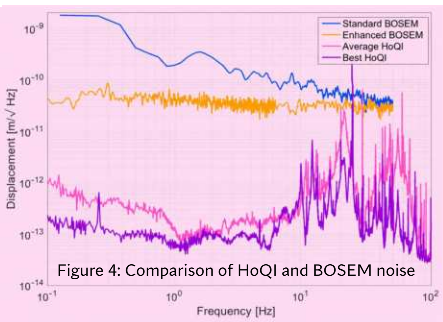

Figure 4: Comparison of HoQI and BOSEM noise

Comparison to current detector sensors

The BOSEMs are used for local sensing of the suspensions and damping on the top mass in LIGO. However, due to their noise floor they are unable to damp below the top mass. For future detector upgrades the BOSEMs would be a limiting noise source so must be replaced.

Figure 4 shows a comparison of the sensors using the static measurements as above and the BOSEM measurements as in [2]. For both sensors we take the best measurement of a unit and an average unit measurement (whilst keeping the nomenclature used in [2]). The average HoQI is similar to the 'previous best measurement' [1].

The HoQI has a **noise floor more than 1000 times lower** than the BOSEM. Hence, it can be used as a local sensor below the top mass, allowing for better damping of resonances. This has been modelled on the BBSS, see [3].

Comparing to other interferometric sensors

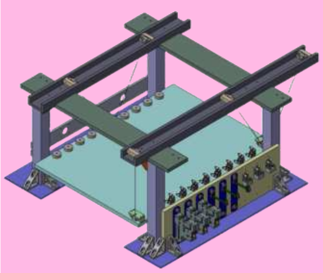
Figure 5: CAD of SensIT

There are two other interferometric sensors which have been developed in the gravitational wave community with similar reported static performance: the LPS [4] and the COBRI [5]. To determine which sensor would work best in the detector, a dynamic environment, a Sensor Integration Testbed (SensIT) was developed.

SensIT has a test mass suspended with 5 wires, constraining it's motion to 1 degree of freedom. Multiple units of each type of sensor measures the motion of the mass. The dynamic sensor noise of each sensor type can be found by doing a multi-channel coherent subtraction (mccs) [6] between units and compared.

This test is being done at a gravitational wave detector prototype facility at MIT, allowing us to probe the ease of integration and use of each sensor in the full-scale detector.

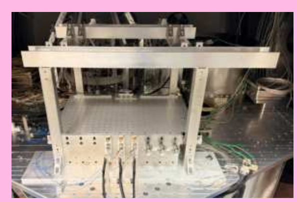
Figure 6: SensIT installed at MIT


Figure 7: left LPS, right COBRI

Uses in gravitational wave detectors

Displacement sensors are used throughout the detector in the seismic isolation systems. Sensor noise is at risk of limiting detector sensitivity in future upgrades so better technology is needed.

These upgrades target improvements in **the low-frequency** bandwidth, **below 20Hz**. Improving sensitivity in this range would mean **earlier detection** and **more signal** giving us **better waveform fitting** and potential for **multi-messenger events**. Additionally, it could allow detections of **higher mass**, **higher redshift** binaries.

Interferometric sensors could be used to damp the multi-mass pendulum resonances [3], be used as the readout for inertial sensors [6,7], and be integrated into the 'internal seismic isolation' (ISI).

The first interferometric sensors were installed in the detector in June 2026, on the cylindrical rotation sensor (CRS), an inertial rotation sensor designed to reduce the effect of tilt in the detector, which pollutes the low-frequency bandwidth.

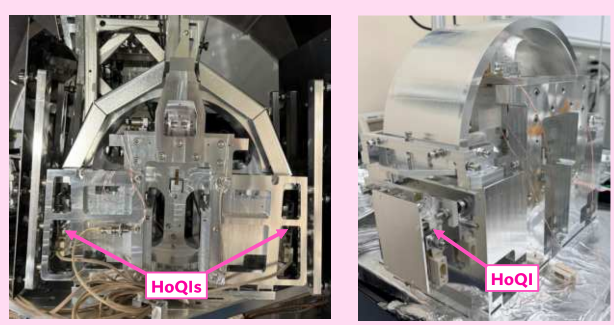

Figure 8: CRS installed in LIGO, left: installed in the detector, right: during construction

Isotropic Chiral Metamaterials with Spin-1 Weyl Points

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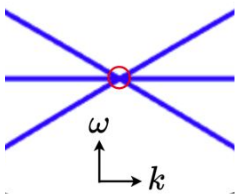
Abstract

We show that isotropic and chiral media can exhibit spin-1 Weyl points with charge 2. Our findings indicate the possibility of accessing nontrivial topology in self-assembled optical media. [1]

Spin-1 Weyl Hamiltonian

In a basis of linearly polarized plane waves, the most general Hamiltonian about **k** = 0 compatible with isotropy is:

$$\mathbf{H}_{\text{eff}}(\mathbf{k}) = \begin{pmatrix} \omega_0 & -ivk_z & ivk_y \\ ivk_z & \omega_0 & -ivk_x \\ -ivk_y & ivk_x & \omega_0 \end{pmatrix}$$

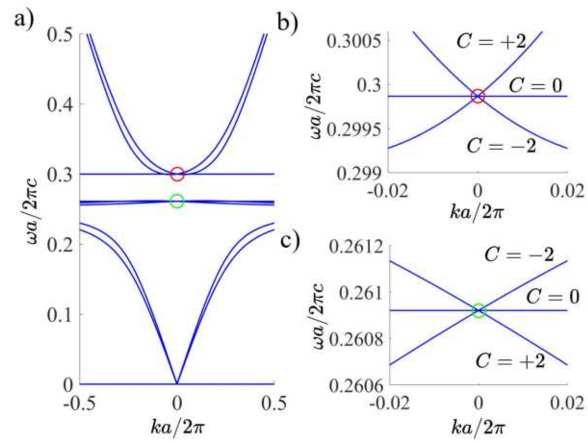


Triple degeneracy at **k** = 0 is topologically nontrivial, with charge 2: “Spin-1 Weyl point”

Chiral Lorentz Model

Nonzero *v* requires breaking inversion symmetry. Isotropic and chiral medium model, each term Lorentzian.

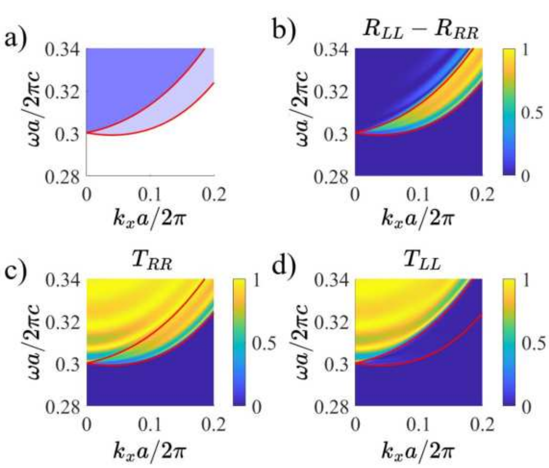
$$\begin{pmatrix} \mathbf{D}(\omega) \\ \mathbf{B}(\omega) \end{pmatrix} = \begin{pmatrix} \varepsilon(\omega) & i\kappa(\omega) \\ -i\kappa(\omega) & \mu(\omega) \end{pmatrix} \begin{pmatrix} \mathbf{E}(\omega) \\ \mathbf{H}(\omega) \end{pmatrix}$$



Reflectance and Transmittance

Circularly polarized light incident on a slab of chiral Lorentzian medium.

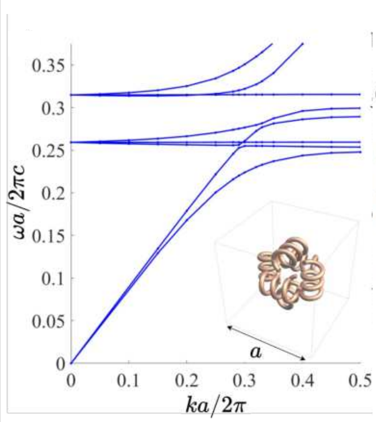
Measurement of polarization resolved reflectance and transmittance allows imaging projected band structure and spin-1 Weyl points.

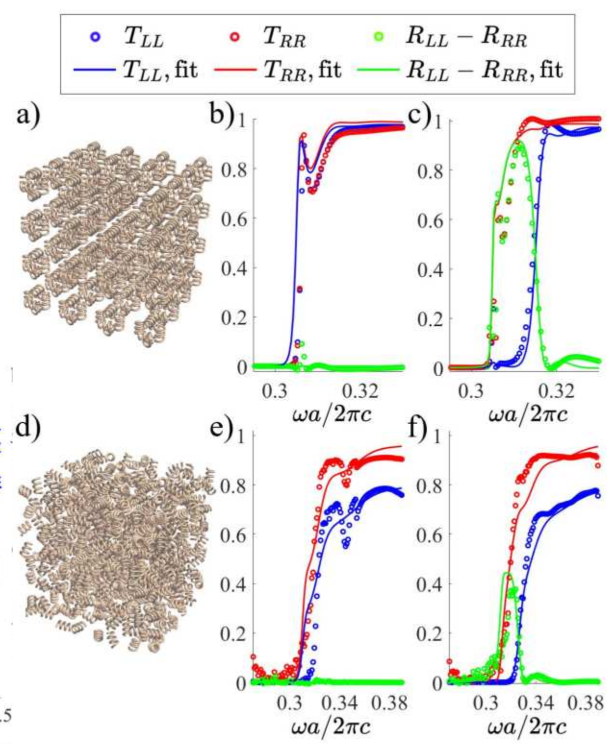


Metamaterial Realization

Realization in periodic and disordered metamaterials made with metallic helices.

Band structure and RT spectra exhibit evidence of spin-1 Weyl points.





References

[1] E. G. Ozaktas and S. Fan, “Spin-1 Weyl Points in Isotropic Chiral Metamaterials", *Physical Review Letters*, 137, 103801, 2026.

Acknowledgements

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Meta-Refractive: Conformal Meta-Optics on Freeform Substrates

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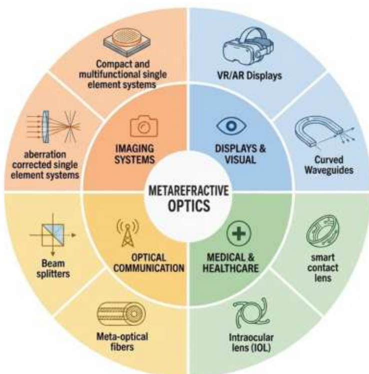
[2] *College of Engineering, Ohio State University*
[3] *Department of Electrical and Computer Engineering, Arizona University*

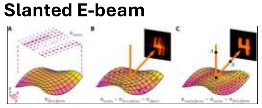
Push for conformal freeform nanophotonics:

Combining diffractive and refractive optics through hybrid ray-wave approaches enable a new class of optical element with large application spaces.



Prior Work

Slanted E-beam

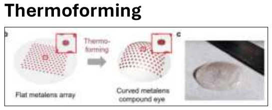


Nikolov et al.

Pros:
- High Precision

Cons:
- Not scalable
- Inherent limitations to curvature capabilities

Thermoforming



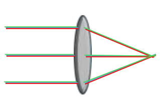
Martin-Monier et al.

Pros:
- Highly scalable

Cons:
- Limited to doubly convex
- Lens thickness difficult to control

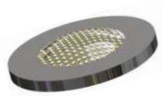
Imaging Systems

Metasurface
- Compact with precise wavefront shaping capabilities
- Highly Narrow-band and angular dependent



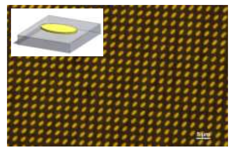
Refractive
- Broadband with low loss
- Bulky and heavy

We propose the Meta-Refractive:
- Larger FOV than the Metasurface
- Precise wavefront control on refractives
- Multifunctionality in a single element

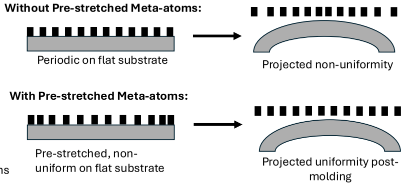


Created through a combination of standard nanofabrication and precision molding techniques.
We showcase 8.45um single element circular polarimetry with a 2.1x2.8 degree field of view

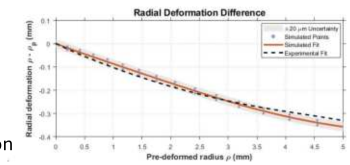
Materials and Methods



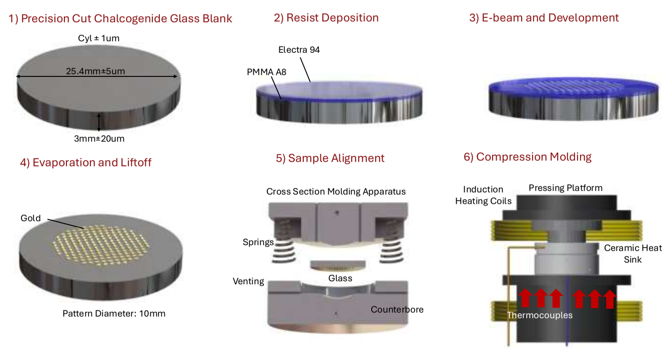
Period: 3um, b: 2um, a: 1.1um, h: 80nm.
Microscope image of patterned meta-atoms



To account for **non-uniform stretching** during molding, pre- and post-deformation atom locations were tracked and the difference was calculated experimentally and over simulation

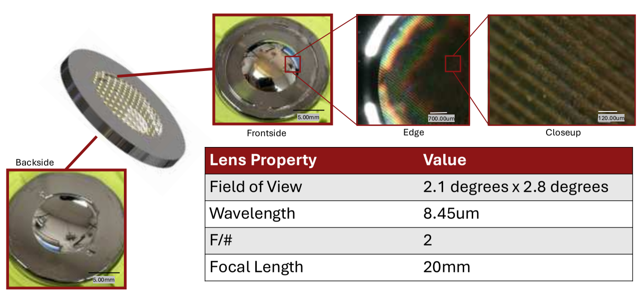


Fabrication Procedure



Leveraging established techniques **allow easy transition to mass-manufacturing.** Precision alignment is critical between stretched meta-surface and glass, as well as glass and mold. This technique allows **freeform curvilinear surfaces with large local slopes.**

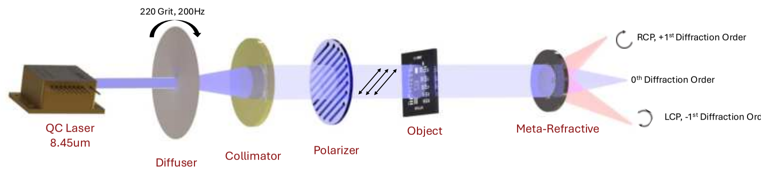
Meta-Refractive

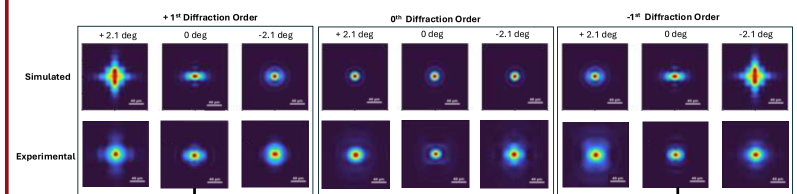


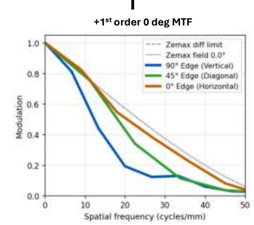
Lens Property	Value
Field of View	2.1 degrees x 2.8 degrees
Wavelength	8.45um
F/#	2
Focal Length	20mm

Results

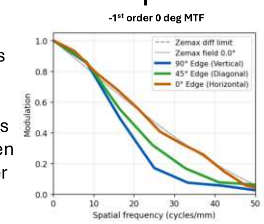
To create incoherent single wavelength collimated beam, we utilize a rotating diffuser than spins at 10 times the refresh rate of the sensor. A collimator and polarizer were placed after to linearly polarize the collimated beam.



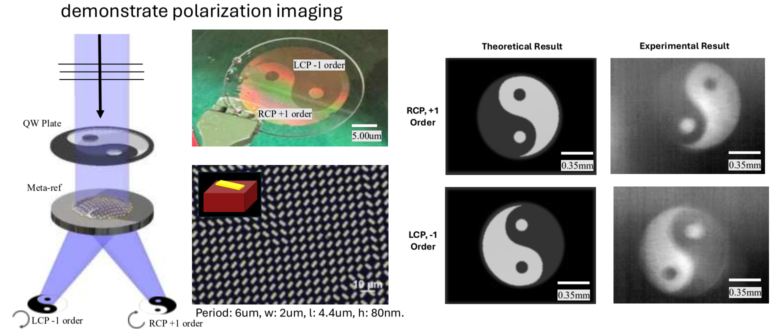




Slanted edge method was used to capture MTFs. Multiple different angles capture multiple 1D slices of the PSF which were then interpolated to fit together



A custom **Quarter Wave Yin yang Metasurface** was used as a polarization object to demonstrate polarization imaging



Period: 6um, w: 2um, l: 4.4um, h: 80nm.

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Multifunctional Spaceplates for Aberration Correction

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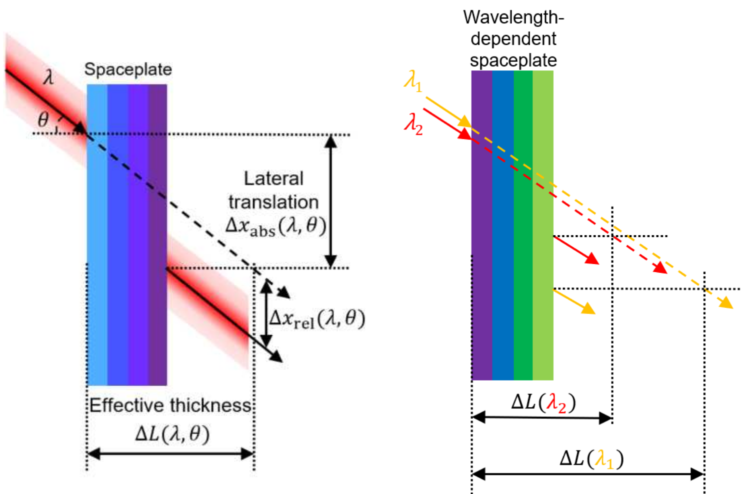
Motivation

- Spaceplates are optical devices that can provide equivalent optical responses as free space[1,2].
- It can either compress or expand its equivalent free-space thickness (effective thickness).
- The equivalent effective thickness can be optimized as a function of incident angle and wavelength.



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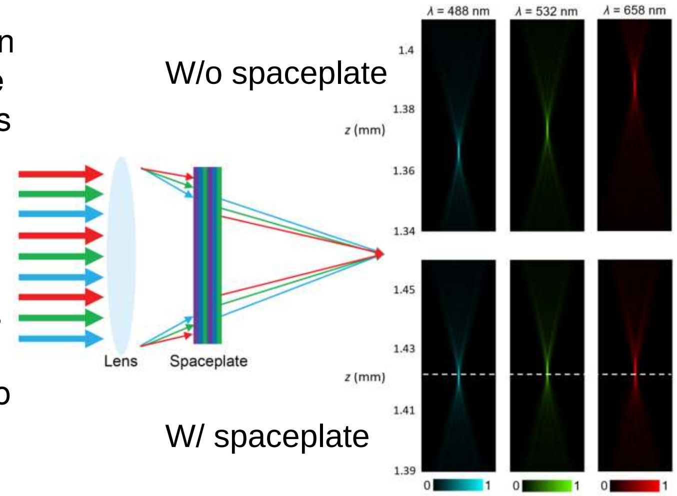
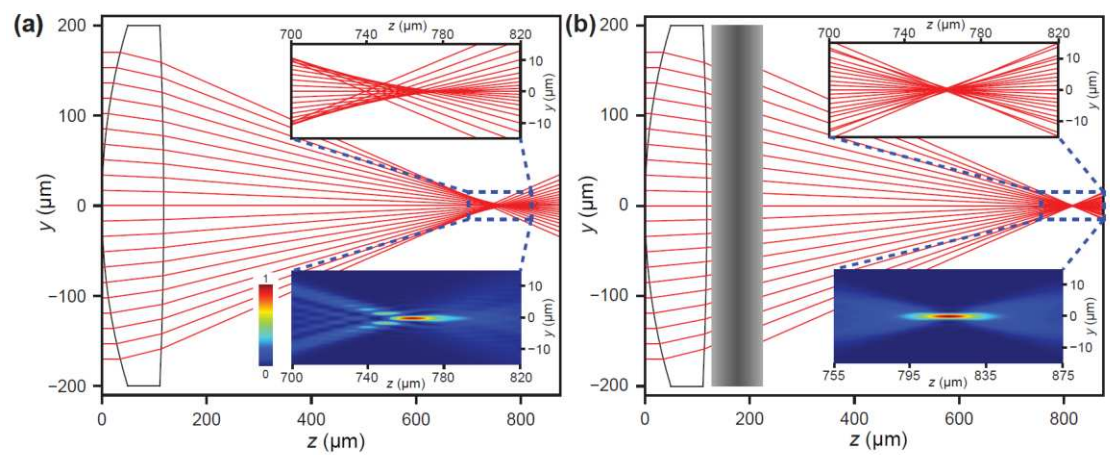
Chromatic Aberration Correction

- Chromatic aberration is a common problem in imaging systems. Blue light are focused closer to the lens because of the difference of the refractive indices at different wavelengths.
- The idea is to optimize the effective thickness of spaceplates as a function of wavelength to offset the focal lengths shift due to chromatic aberration.



Spherical Aberration Correction

- By compressing air gaps more for the paraxial rays than the marginal rays, the spherical aberration can be corrected.



Nanoscale Nitride Shadow Mask for Clean Metallization

Chou-Wei Kiang, Kaveh Pezeshki, Oliver A. Hitchcock, Matthew P. Maksymowych,
Takuma Makihara, Erik Szakiel, and Amir H. Safavi-Naeini

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Overcoming Surface Loss with Resist-Free Metallization

Problem. Nanoscale devices are highly sensitive to **fabrication-induced surface damage.** In materials like Lithium Niobate (LN), surface defects (like TLS) often mask the intrinsic material quality, limiting phonon lifetimes.

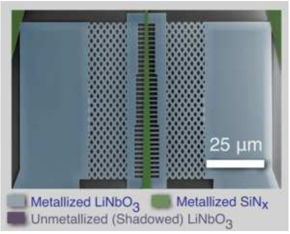
Lithography Bottleneck. While electron-beam lithography (EBL) routinely achieves sub-micron features, standard resist-based liftoff leaves tenacious organic contaminants.

Chemistry Conflict. Aggressive wet chemistry can strip fabrication damage and restore the surface, but these etchants are fundamentally incompatible with pre-deposited metal.

Solution. A nanoscale silicon nitride shadow mask.
By physically bonding a freestanding stencil to the target chip, we can evaporate metal through nanoscale apertures without resist.

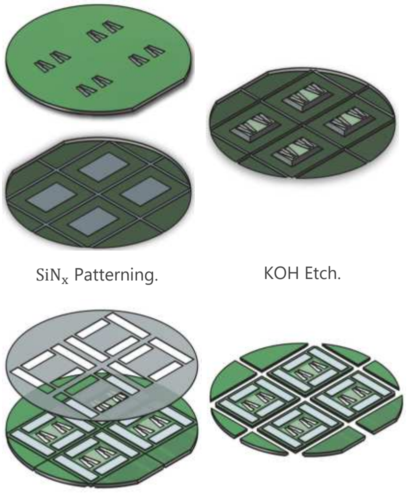
Workflow Advantage. Metal deposition can be performed after aggressive acid cleaning and device release.

Application. Promising for mitigating interfacial loss in nanomechanical, nanophotonic, and superconducting devices.



Colorized SEM of a shadow-mask metallized nanomechanical device.

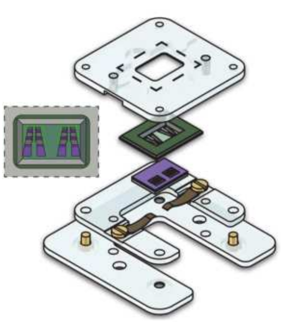
Shadow Mask Fabrication Workflow



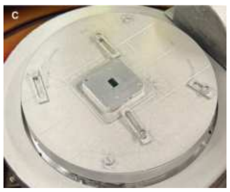
SiN$_x$ Patterning. KOH Etch. Spacer Deposition. Cleaving.

Pattern chip-scale windows on the backside of a SiN$_x$/Si/SiN$_x$ wafer.	**Optical lithography + CF4-based dry etch.**
Pattern nanoscale apertures on the frontside of a SiN$_x$/Si/SiN$_x$ wafer.	**E-beam lithography + CF4-based dry etch.**
Release freestanding membrane.	**Self-terminated Si etch w/ KOH.**
Deposit Al spacer layer between mask & target chip.	**E-beam evaporator.**
Hand-cleave through scribe lines etched into Si.	-

Device Integration & Metal Evaporation



Custom-machined fixture for clamping the mask and target chip after flip-chip alignment.

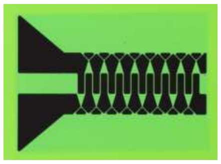


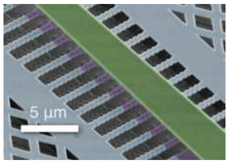
After aligned bonding in a Finetech Lambda 2 flip-chip bonder.

Full assembly with clamping plates.

Chip-fixture assembly ready for E-beam evaporation.

Applications: High-Q Resonators & Junctions





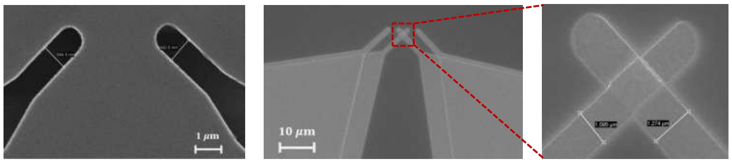
Shadow mask design for inter-digitated electrode patterning on lithium niobate (LN).

Shadow mask prevents metal deposition on the defect cell, ensuring the resonant mode interacts only with pristine LN surfaces.

Nanomechanical Resonator with Long Phonon Lifetime

- ✓ Ensures no photoresist or organic materials contact cleaned surfaces; requires no post-metallization processing prior to measurement.
- ✓ The shadow mask is reusable and scalable, supporting features ranging from huge 10^4 $(\mu m)^2$ patterns down to nanoscale features with high aspect-ratio.

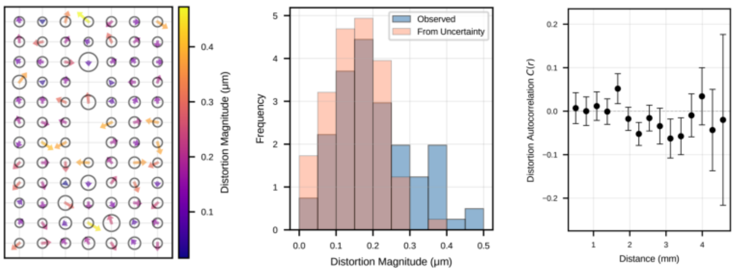
Superconducting Junction with Mitigated Defect Density



SEM of a junction shadow mask

SEM of a shadow-mask evaporated Al/AlOx/Al junction.

Analyzing Shadow Mask Distortion



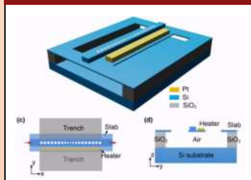
Measured displacement vector bounds membrane deformation

- **Alignment Challenge.** Standard flip-chip bonding introduces ~1 µm of global error. This is mitigated using a brute-force vernier array design to guarantee device yield.
- **Isolating Local Distortion (δ).** Beyond global translation/rotation, local misalignments can arise from membrane stress, asymmetric clamping, or lithographic stitching.
- **Empirical Upper Bound**. By optically tracking an 81-marker test grid (2.5 mm × 4 mm) and subtracting global shifts, local distortion is bounded to < 500 nm.
- **Uncertainty Limited.** The measured distortion distribution tightly aligns with the expected fitting error, indicating actual distortion is likely much lower.

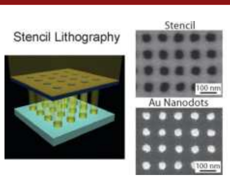
Spatial autocorrelation reveals negligible membrane deformation

- **Physical Signatures of Bowing.** If the shadow mask membrane were physically bowing or deforming during deposition, it would induce a position-dependent, spatially correlated shift in the deposited patterns.
- **Statistical Verification.** Calculating the spatial autocorrelation of the distortion magnitude across 300 µm bins reveals no self-similar length scales.
- **Systematic membrane deformation is negligible for this process.** Furthermore, normal-incidence metal evaporation is highly tolerant to minor variations in mask height.

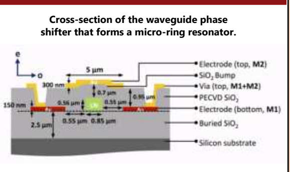
Potential Photonic Device Applications



Integrating metallic local heaters onto fragile suspended membranes (e.g., photonic crystals)[4]



Preserving pristine interfaces for plasmonic metasurfaces and nanoantennas[5]



Patterning high-efficiency RF electrodes for electro-optic modulators[6]

Acknowledgments

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Neural Inference of TCMT Parameters from Optical Spectra

Matt Beutel,[1] Shanhui Fan,[2]
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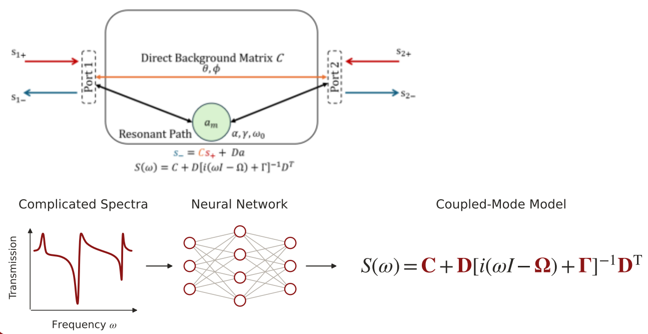
Stanford Applied Physics

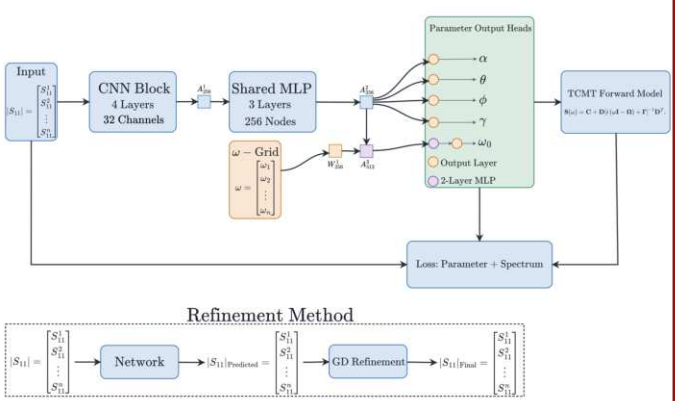
Objective

Can we use machine learning to map from optical spectra to physically Informative parameters? [1]



$$S(\omega) = \mathbf{C} + \mathbf{D}[i(\omega I - \mathbf{\Omega}) + \mathbf{\Gamma}]^{-1}\mathbf{D}^T$$

Network



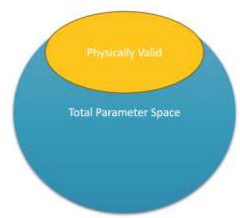
Method

This type of project has one large hurdle to overcome in order for it to be useful: the outputted parameters need to be physically valid

Outputs must be energy conserving and reciprocal

Can we do this automatically?

For unitary, symmetric matrix A
- VDV^T
- D: diagonal, V: unitary



$$S = C + \frac{dd^T}{i(\omega - \omega_0) + \gamma}$$

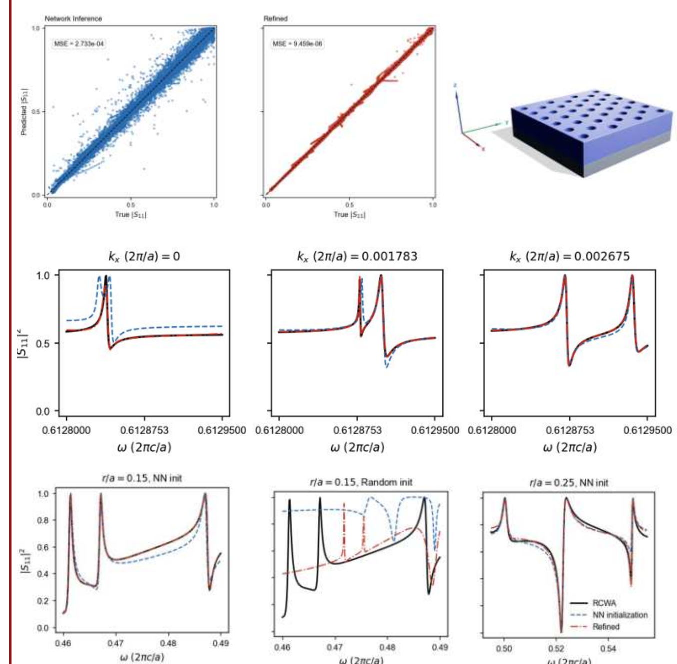
$C\,(n\times n)$	$d\,(n\times m)$	$\gamma\,(m)$	$\Omega\,(m)$
$\Theta\,(n) + \phi\,(1)$	$\alpha\,(m) + \gamma\,(m)$, Θ, ϕ	Free > 0	Free real

[3]

Results

We train our network on synthetic spectra constructed from the TCMT formalism, achieving nearly perfect fits on our single-mode validation set even without refinement. We also obtain strong results on simulated RCWA spectra, including for nonzero k. Neural initialization outperforms random initialization during refinement, and our model can fit up to three sharp modes.

Results



References

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3. M. Beutel, et al., to be submitted.

Practical Limits on Integrated Squeezers

Devin J. Dean[1], Taewon Park[2], Luke Qi[1], Sam Robison[1], Hubert S. Stokowski[1], Lars Madsen[4], Jesse Slim[4], Alex Terrasson[4], Yoonjae Chung[2], Darwin Serkland[5], Warwick Bowen[4], Martin M. Fejer[1], and Amir H. Safavi-Naeini[1]
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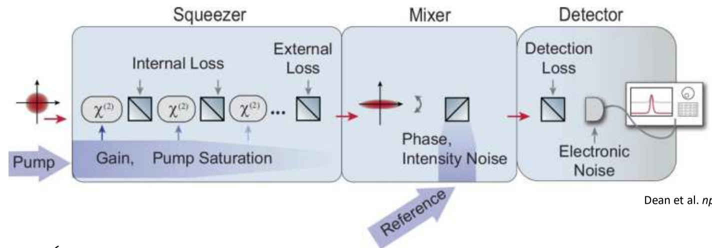
Background: Squeezed Light and Noise

Squeezed light has reduced noise in one quadrature and has been used to enhance gravitational wave detection[1] and biological microscopy[2] and shows promise to enhance integrated photonic sensors[3]. To utilize the reduced noise of squeezed light, all other noise sources must be mitigated[4].

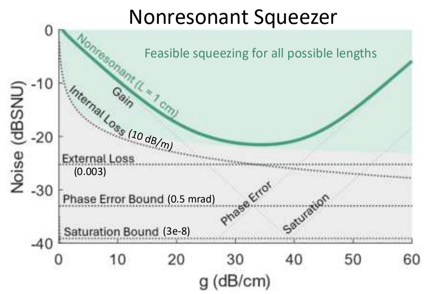


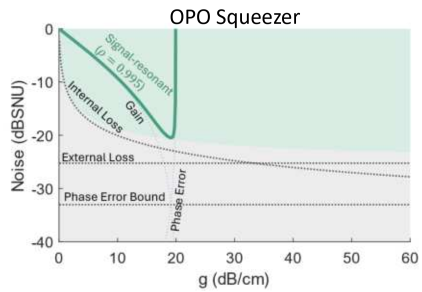
Dean et al. *npj Nanophotonics* 2026

$$V \approx \left(V_{\text{gain}} + \Delta V_{\text{internal loss}} + \Delta V_{\text{pump saturation}} + \Delta V_{\text{external loss}} + \Delta V_{\text{phase noise}}\right) + \left(\Delta V_{\text{intensity noise}} + \Delta V_{\text{detection loss}} + \Delta V_{\text{electronic noise}}\right)$$

We summarize common noise sources and combine them into a simple model.

Similar Limits on Different Squeezers





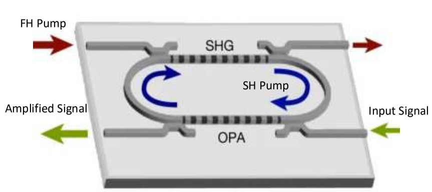
OPO squeezers same as nonresonant squeezers, but with reduced power requirements, added frequency locking.

Large-gain, Low-loss Amplifier[5]

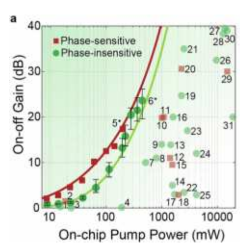
A good squeezer is a good amplifier

1. High gain
2. Large nonlinearity-to-loss ratio
3. Low loss

$$\text{Variance} \approx \frac{1}{\text{Gain}} + \frac{\text{Loss Rate}}{\text{Gain Rate}} + \text{Other} + \ \dots\ \text{Loss}$$



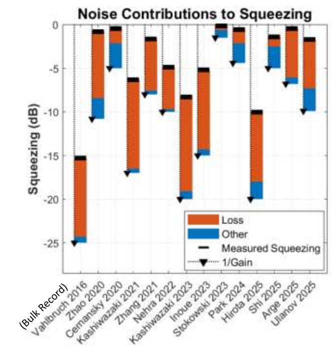
Dean, Park et al. *Nature* 2026



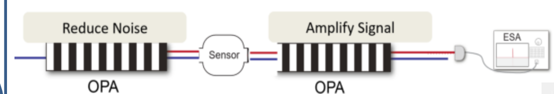
External Loss Limits Squeezing

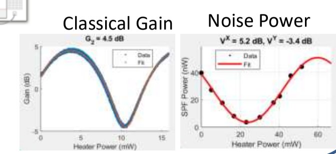
$$\text{Variance} \approx \frac{1}{\text{Gain}} + \text{Other} + \ \dots\ \text{Loss}$$

Loss going from chip to detector limits most squeezers



Second Amplifier to Mitigate Off-chip Losses

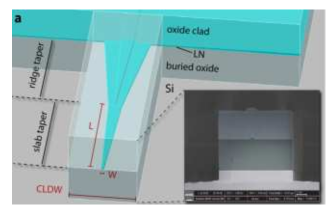




Boost on-chip signal far above off-chip noise

Caves. *Phys. Rev. D* 1981
Yurke et al. *Phys. Rev. A* 1986

Efficient Chip-Fiber Coupling



Qi, Dean et al. *In preparation* 2026

Convert light from small waveguide mode to large fiber mode with a silicon dioxide bilayer taper

Conclusion

We present a simple model accounting for the many noise sources that we expect to find in integrated squeezers, and discuss current efforts. "The future will show whether the result will be many dB of noise suppression or the discovery of new sources of optical noise."[6]

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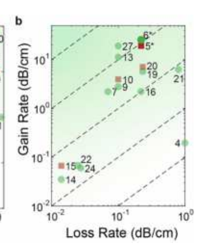
Funded by DARPA INSPIRED program. D.D. acknowledges support from the NSF GRFP (No. DGE-1656518). H.S. acknowledges support from the Urbanek Family Fellow-ship.



Reducing the Noise and Drift of a Chip-Scale Silicon Nitride Resonant Gyroscope

Mohammed Azzouz[1], Adele N. Zawada[1], Warren Jin[2], Nathan Abrams[2], Avi Feshali[2], Mario Paniccia[2], and Michel J. F. Digonnet[1]

[1]Ginzton Laboratory, Stanford University, Stanford, CA

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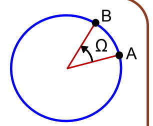
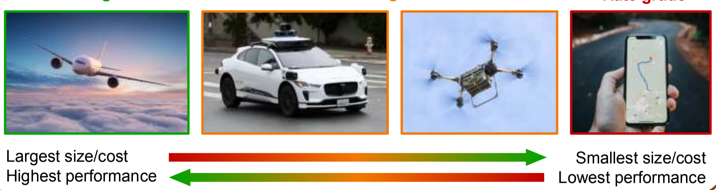
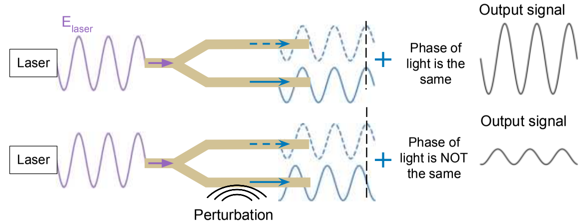
Introduction to Gyroscopes



- Gyros are sensors that detect rotation (Ω), critical for navigation
- Size of gyro market: **$5.32 billion** (and growing)
- Performance characterized by sensitivity, noise, and drift

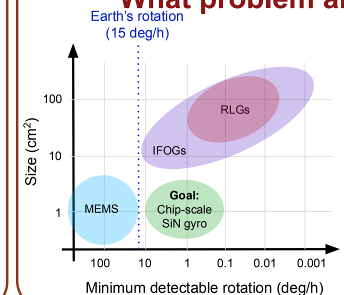


Photonics for Sensing



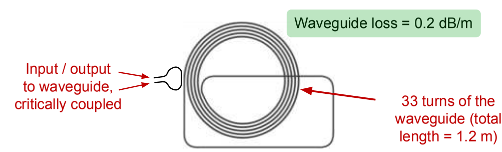
- Output phase, amplitude change when perturbation is applied – basis of interferometry
- Types of perturbations: pressure, temperature, strain, chemical change, **rotation rate**
- **Interferometry can be enhanced via high-Q resonators!**

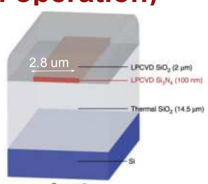
What problem are we aiming to solve?



- **Goal:** design miniaturized, low-cost, mass-producible, high-sensitivity gyro for tactical grade navigation
  - ARW < 3 deg/h/√Hz, Drift < 10 deg/h
- **Best solution:** resonant optical gyro on silicon chip
  - Recent breakthroughs in ultra-low-loss SiN photonics → high-Q resonators
  - Gyro sensitivity enhanced by resonator finesse
  - Easily scalable with CMOS-compatible fabrication
- Collaborating with ANELLO

Current SiN Gyro Design (1550 nm operation)





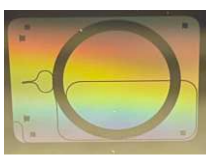
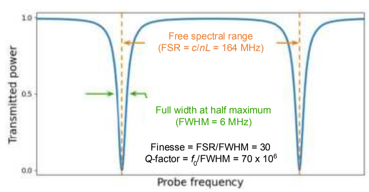
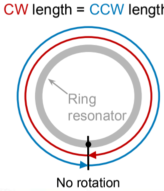


Photo of multi-turn waveguide on silicon nitride chip (radius = 6.1 mm)



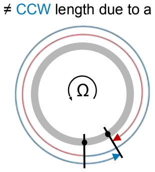
Stationary gyro

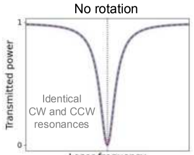
CW length = CCW length

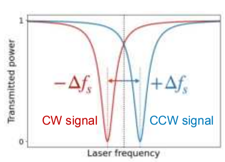


Rotated gyro

CW length ≠ CCW length due to a rotation (Ω)



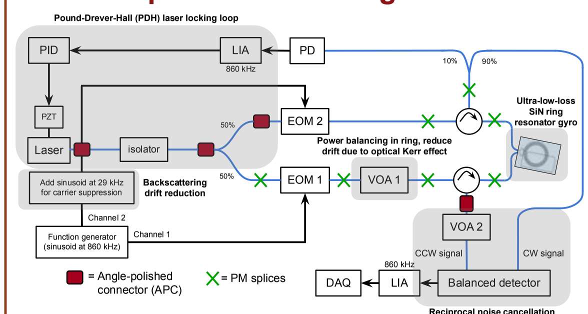




Sensing principle: Sagnac effect

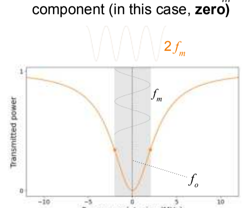
$$\Delta f_s = \frac{R f_0}{nc} \cdot \Omega$$

Experimental Configuration



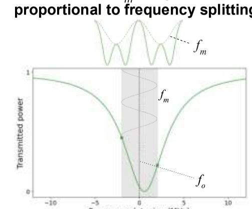
No rotation:

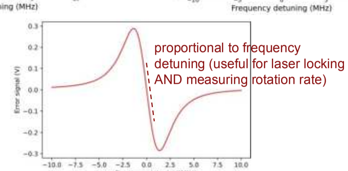
- Signal out of PD is at $2f_m$
- LIA measures amplitude of $1f_m$ component (in this case, **zero**)



Under rotation:

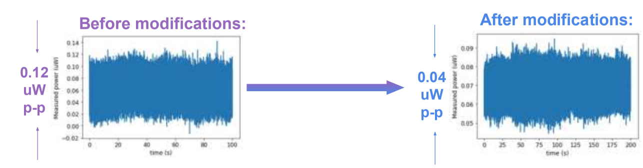
- Modulation around f_o is not symmetric
- Component at $1f_m$ in signal out of PD, **proportional to frequency splitting!**

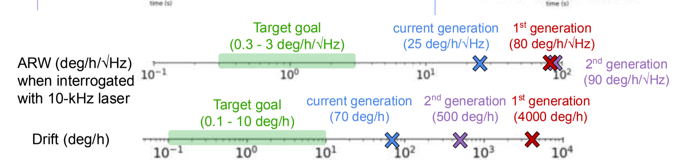




Results, Improvements, and Future Work

- Interrogated system with narrow-linewidth (10-kHz) semiconductor laser
- Sweep all the resonances between 1560 and 1610 nm to find resonance with lowest backscattering (-96 dB/mm best vs. -65 dB/mm worst)
- **Improvements from prior generation:**
  - Restructured system such that both EOMs are after 3-dB coupler
    - Benefit #1: closer to reciprocity!
    - Benefit #2: additional degree of freedom: **fine-tuning the relative phase between the two 860-kHz modulation signals to optimize the reciprocal laser frequency noise (LFN) cancellation.**
  - **New balanced detector with 25 dB CMRR instead of 18 dB**





- **Future improvements:**
  1. Backscattering drift–drive EOM1,2 with two different low-frequency signals
  2. Optical-Kerr-effect offset and drift–perform on/off modulation of the laser light at 164 MHz (inverse the roundtrip time of photons in the SiN ring)
  3. Polarization coupling drift–Remove 90/10 splitter, VOA1, VOA2, and finish the remaining few APC connections with PM splices
  4. Replace analog electronics with FPGA-based system
  5. Fabricate 3rd generation device with two input, two output ports (would eliminate the need for the circulators), gradually move towards integration!

With 10-Hz laser, anticipate ARW = 2 deg/h/√Hz and drift = 1 deg/h!!

Strong Electro-optic Materials based Integrated Photonic Modulators for Solid-state Quantum Systems

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[1]Department of Electrical Engineering, Stanford University, [2]Department of Physics, Stanford University
[3]Department of Applied Physics, Stanford University, [4]Department of Materials Science & Engineering, University of Illinois Urbana-Champaign

Introduction

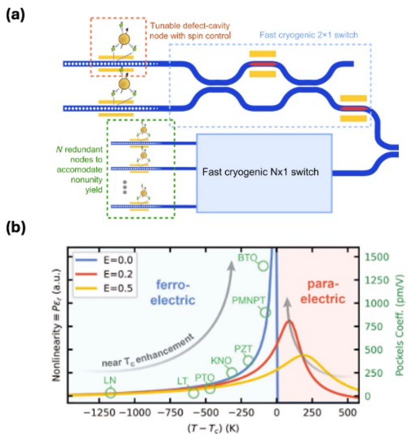
- Integrated photonics enables **high data rate** with **low power consumption** [1]
- Photonic modulators are the key components of **optical interconnects** and **cryogenic switches** in solid-state quantum systems [2]

Tunable photonic elements in solid-state quantum emitters

- Hybrid integration of active photonics with solid-state quantum emitters adds reconfigurability to passive solid-state quantum systems
- Application**: On-chip quantum networking** [3], **local cavity tuning** [4]

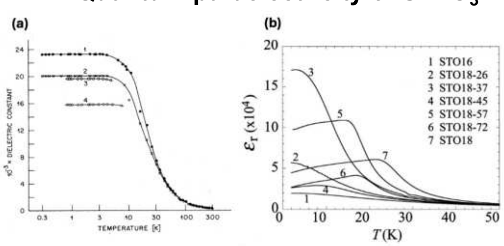
$SrTiO_3$ for efficient, fast reconfigurability at low temperature

- Typical gas condensation method is not suitable for local tuning and slow
- Strontium Titanate ($SrTiO_3$, STO) provides strong electro-optic response below 30K due to the **quantum paraelectricity** [5]
- In bulk crystal, we measured r_{33} of **530 pm/V** and enhanced it to **1060 pm/V** by oxygen isotope exchange, providing order of magnitude larger tunability compared to Lithium niobate (~ 30 pm/V)



(a) Proposed multi-node quantum networks based on combining multiple cavity QED nodes with cryogenic switches. (b) Comparison of multiple EO materials showing enhancement of nonlinearity near critical temperature T_c.

Quantum paraelectricity of $SrTiO_3$



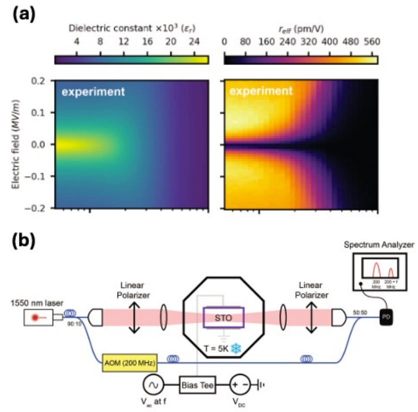
(a) Temperature-dependent dielectric constant of STO, indicating quantum paraelectricity [6] **(b)** ^{18}O exchange induced ferroelectricity and permittivity enhancement [7]

- Miller's rule

$$\chi^{(3)}(\omega_{\rm opt}, \omega_{\rm RF}, 0) \propto \chi^{(1)}(\omega_{\rm opt})\boldsymbol{\chi^{(1)}(\omega_{\rm RF})\chi^{(1)}(0)}$$

- STO ($SrTiO_3$) is a **quantum paraelectric** material [6] with T_c ~ 37K, where ferroelectric transition is suppressed at T_c with large ε enhancement at 4K
- Oxygen isotope exchange can make STO to be ferroelectric [7], which enables further enhancement of permittivity

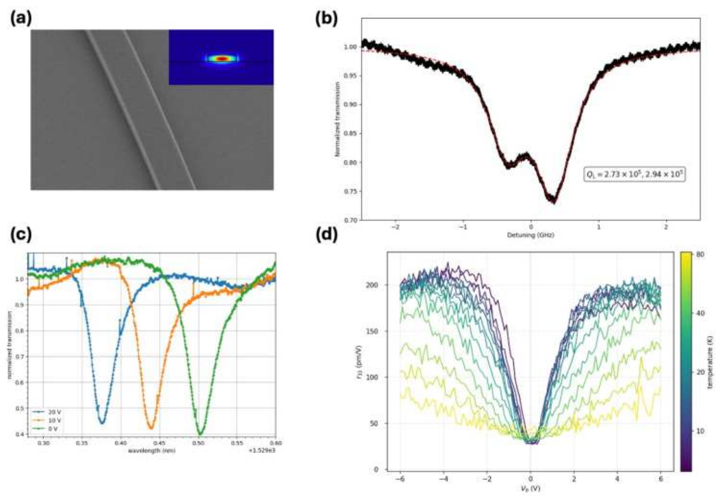
Cryogenic EO measurement of bulk $SrTiO_3$



(a) Temperature-dependent permittivity of STO showing quantum paraelectricity, **(b)** Heterodyne measurement setup for extracting r_{33} at 5K

- Giant permittivity of **20,000** at zero bias and **530 pm/V** peak r_{33} value at 5K. Oxygen isotope exchange (33% ^{18}O) enhances permittivity by ~ 3 fold and gives peak r_{33} value of **1060 pm/V**

Low-loss, strong EO heterogenous Si-STO modulator



(a) SEM image and mode profile of the Si on STO waveguide showing mode overlap 22.5% for STO. **(b)** High-Q resonance of Si on STO resonator. **(c)** DC tuning of ring resonator. **(d)** Heterodyne measurement based r33 extraction result

- Fabricated and measured proof-of-concept integrated photonic modulator with Si on STO structure.
- Successfully demonstrated low loss waveguides with optimized fabrication process showing loaded Q factor up to **294 • 10³**, corresponds to **2.4 dB/cm** (close to propagation loss of Si)
- DC resonance tuning was demonstrated, which is traditionally limited [8] by charge dynamics. AC response at 100kHz frequency was measured with heterodyne approach, which reveals r_{33} exceeding **210 pm/V** at 6.2 K

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Synthetic Photonic Matter in a Twisted Optical Cavity with Rydberg Atoms

Marius Jürgensen[1], Bowen Li[1], Cady Feng[2] and Jonathan Simon[1,2]

[1]Department of Physics, Stanford University

[2]Department of Applied Physics, Stanford University

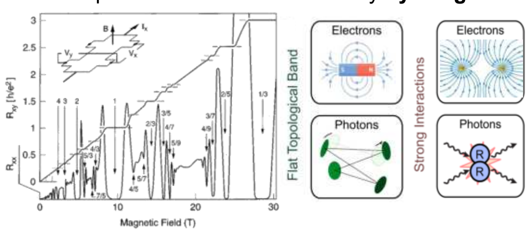
Motivation

The fractional quantum Hall effect (FQHE) has been an abundant resource for the discovery of exotic physics. As an ansatz for the FQHE, **Laughlin states** [1] host anyonic excitations with applications in topological quantum computing and a Hamiltonian given via:

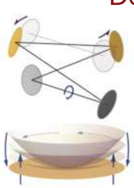
$$\hat{H}_0 = \int d^2\boldsymbol{r}\,\hat{\psi}^\dagger(\boldsymbol{r})\left[\frac{(-i\boldsymbol{\nabla} - e\boldsymbol{A})^2}{2M}\right]\hat{\psi}(\boldsymbol{r}) + \hat{H}_{\text{int}}$$

Importantly, the FQHE is not limited to electrons, but can also be studied with interacting bosons, e.g., in photonics, with the advantage of more flexibility and tunability. We combined a twisted optical cavity with ultracold atoms, to convert photons into **Rydberg polaritons** that create topologically ordered many-body states, e.g., **Laughlin states.**

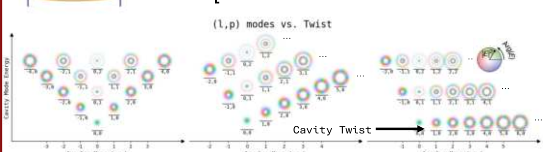
1. Synthetic magnetic field via **twisted cavity** leads to **photonic Landau levels**
2. Photon-photon interactions mediated by **Rydberg atoms**



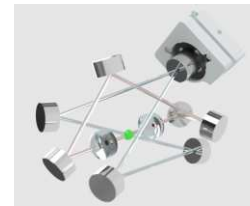
Degenerate Twisted Cavity



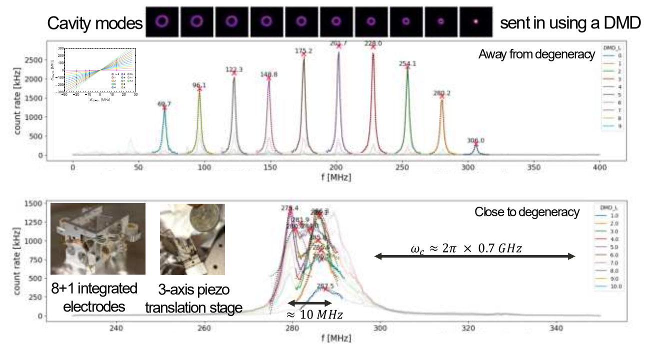
Twisted bow-tie cavity exhibits a **synthetic magnetic field** for photons that travel within it. The resulting eigenstates are circularly polarized Laguerre-Gaussian modes, exactly the eigenstates of Landau levels. [



To suppress off-axis optical aberrations, we combined plane mirrors with a **spherical lens** pair [4].

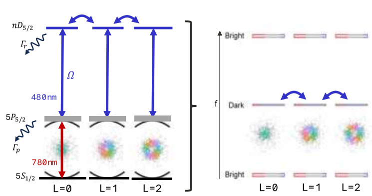


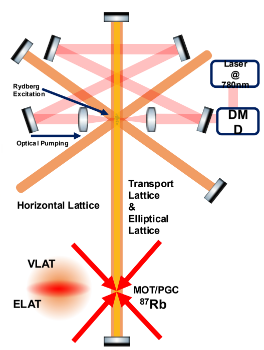
Our twisted cavity is also back-scatter suppressed to the order of 0.5ppb [5]. *Finesse: 1200, Waist at Atoms: 18μm, Linewidth: 2.9MHz*



Rydberg Polaritons

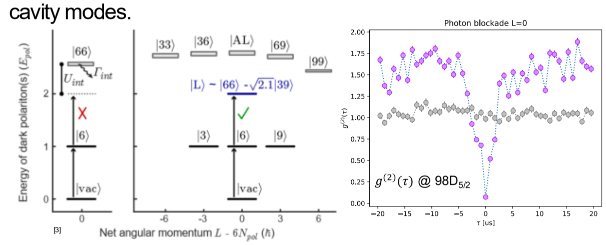
The interaction between atoms and cavity photons makes polaritons the eigenstates of the system. By leveraging EIT, we have dark polaritons as superposition of Rydberg excitations and cavity photons. These polaritons have strong inherent mutual interactions due to their Rydberg components.





We load ^{87}Rb atoms from a MOT into the waist of the cavity using a vertical transport lattice, and cool to ~1μK using degenerate Raman sideband cooling. Using an elliptical lattice (ELAT), we enforce two-dimensionality.

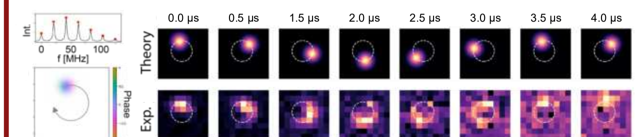
While Rydberg blockade forbids double mode occupation, scattering into degenerate spatial modes is possible. Assuming contact interactions, the lowest energy states are Laughlin states with a maximum size limited by the number of degenerate optical cavity modes.



Projects

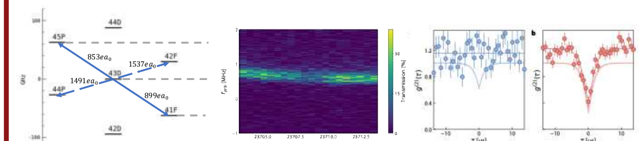
Magnetron Rotation

In the presence of a harmonic confinement potential, the LG modes are linearly spaced. A displaced Gaussian will then rotate and perform a magnetron rotation. We use dark polaritons to decelerate the rotation so that we can directly observe this rotation on an EMCCD camera with 2 MHz frame rate.



Förster resonances between Rydberg states

Interaction between Rydberg atoms can be enhanced by cancelling out the pair-state defect using AC stark shifts leading to a dipole-dipole interaction instead of Van-der-Waals interaction. Using microwave shifts we observe a Förster interaction at n=44 that decreases $g^{(2)}(0)$ from 1.0(1) to 0.38(1) [6].



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6 – Notes

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