Máté Ádámkovics

Education

Ph.D.	Chemistry	UC Berkeley
M.S.	Chemistry	UC Berkeley
B.S.	Chemistry, Astronomy	University of Chicago



Lockheed Martin Space Expertise:

LM Fellow



- Vis-IR Instrumentation, Test & Development
- Photochemical Kinetics of Circumstellar Disks
- Photonic Sensor Development for Remote Sensing

Share an Emerging Technology You're Working on that may Address a NASA Astrophysics Need

- Application: Photonic Integrated Circuit instrumentation
- **Benefit:** PIC component development, fabrication & test, e.g., for metrology
- **Emerging Technology**: free-space coupling into PICs with novel micro-optics



Single baseline IR interferometer on silicon nitride PIC with micro-optic coupling. Wafer is edge-coupled to lithium niobate MZM (not shown) for phase and amplitude measurement.

- Visible/IR spectropolarimeter and high resolution spectrometer development with free-form optics
- Instrument models and data analysis pipelines for observing system simulation experiments (OSSEs)
- Instrument integration and test



Amit Ashok

Education

University of Arizona
University of Cape Town
University of Swaziland
University of Cape To University of Swazilar



Professor, Optical Sciences and ECE Wyant College of Optical Sciences, U of Arizona Expertise:

- Quantum/Classical Information Theory
- Information-optimal measurement design
- Computational/Compressive Imaging/Sensing
- Bayesian Inference and algorithms



Share an Emerging Technology You are Working on that may Address a NASA Astrophysics Need

- Application: Quantum-limited wavefront sensing, optical-super-resolution and coronagraphs
- Benefit: Improved wavefront sensing and correction for high-contrast imaging and subdiffraction for application such as coronagraphs
- Emerging technology: spatial-spectral modal sensing to enable host of astrophysics applications (AO, Coronagraphs)



Share Something Else that You are Working on that might be Interesting to this Workshop

- We are working on event-based sensors (EBS) for low SWAPC surveillance and tracking applications ranging from SSA, directed energy and drone swarm detection
- Discovering fundamental limit of wavefront sensing with quantum-sources and developing quantum-optimal metrology measurements and algorithms
- Commercializing next generation X-ray multi-modal (Transmission + Diffraction) tomography for defense, security and medical application using a start-up

ashoka@arizona.edu

Tania Bedrax-Weiss

Education

Ph.D	Artificial Intelligence	University of Oregon
B.S.	Math & Computer Science	Catholic University of Chile



Sr. Director, Research Engineering Google DeepMind

Expertise:



 Formerly worked at NASA Ames Intelligent Systems division, on Autonomous Systems and Robotics, Planning and Scheduling.

Share an Emerging Technology You're Working on that may Address a NASA Astrophysics Need

- Application: Large Multimodal Models (Gemini)
- **Benefit**: AI models can help understand, explain, and optimize complex problems given the right data, feedback, and verification.
- Emerging Technology: The technology is capable of interleaving understanding and generation and reasoning of images and text and voice. Other types of data are underexplored.

Share Something Else that You're Working on that Might be Interesting to this Workshop

- **Application**: Enabling data flywheels under multiple constraints.
- Benefit: Building systems that self-learn.
- Emerging Technology: Building models that sense, reason and act to acquire increasingly more knowledge.

Story and

Story and illustration generation with Gemini



Johannes Borregaard

Education

Ph.D.	Quantum physics	University of Copenhagen
MSc	Physics	University of Copenhagen
BSc.	Astronomy	University of Copenhagen



Research Associate/ Chief Scientific Officer Harvard University/Lightsynq Technologies inc

Expertise:

Light-to-gubit

- Theoretical quantum optics
- Quantum computing, sensing, and networking
- Quantum information theory
- Diamond defect centers

Share an Emerging Technology You're Working on that may address a NASA Astrophysics Need

- Application: Exoplanet/weak source imaging
- Benefit: Unprecedented resolution and SNR in imaging of weak sources such as exoplanets.
- Emerging Technology: Quantum processing enhanced optical imaging. Using broadband photon-qubit interfaces, the amplitude information of the incoming light is stored in a quantum processor for enhanced signal filtering and imaging.

Quantum processing



(top) Schematic of quantum processing enhanced detection system. (bottom) light-to-qubit system (L) and atomic quantum processor (R)

Share Something Else that You're Working on that Might be Interesting to this Workshop

- Application: New tests of the interplay between gravity and quantum mechanics
- Benefit: Allows to perform tests of the validity of fundamental principles such as Born's rule in the presence of curved space time.
- Emerging Technology: Quantum networked atomic clocks. Non-local quantum clocks can be distributed between local atomic clock nodes by means of photon-mediated entanglement distribution.



LIGHTSYNQ



User ID: johannes-borregaard

Danielle A. Braje

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Education

Ph.D.	Applied Physics	Stanford
M.S.	Applied Physics	Stanford
B.S.	Physics/Math	University of Arizona



Group Leader, Advanced Quantum Technologies MIT Lincoln Laboratory, Space Systems

Expertise:

- Quantum sensing/metrology & quantum computing
- Application-driven quantum sensors
 - Magnetometry
 - High-spatial resolution magnetic Imaging
 - Precision timing & next generation ion optical clocks
- Nitrogen vacancy diamond, ion / integrated photonics, YIG

Quantum Magnetometers

- Application: Precision magnetometry for navigation
- Benefit: Quantum stable vector magnetometer
- Emerging Technology: Quantum-grade diamond for bulk magnetometry, high spatial resolution imaging and ferrimagnetic AC magnetometry



Ion Optical Clocks

- **Application:** Precision, scalable optical clocks for holdover of GPS for month long duration
- **Benefit:** High stability timing not achievable with microwave clocks
- Emerging Technology: Ion optical clocks



Megan Eckart

Education

Ph.D.	Physics	Caltech
M.S.	Physics	Caltech
A.B.	Astrophysics, Physics	UC Berkeley

Share an Emerging Technology You're Working on that may Address a NASA Astrophysics Need

- Application is x-ray astrophysics space missions
- Benefit is x-ray spectroscopy with unparalleled combination of resolution, field of view, waveband, and calibration accuracy
- **Emerging technology** is transition-edge sensor (TES) microcalorimeters coupled with new calibration techniques and instrumentation





Calibrating the XRISM Resolve spectrometer, a precursor to the emerging technology

Director, Space Science Institute Lawrence Livermore National Laboratory (LLNL) Expertise:

- Low-temperature detector development
- X-ray microcalorimeters
- Non-dispersive X-ray imaging spectroscopy, instrument testing and calibration



X-ray astrophysics, incl. studies of active galaxies

- We are adapting these x-ray detector systems developed for astrophysics as diagnostics for magnetic fusion energy research
- Instead of launching novel spectrometers to measure astrophysical plasmas in space, we aim to diagnose plasmas in magnetically confined fusion devices (on Earth)
- A long-term goal is to provide diagnostic instrumentation for fusion pilot plants



Madeleine Eggers

Education

B.Arch Architecture

Cornell University



Senior Computational Designer (Architecture) Kohn Pedersen Fox Associates, PC

Expertise:

• Architectural design of highly customized megaprojects

Share Something Else that You're Working on that

Computational design at scale is becoming more critical as project

schedules accelerate and demand for early-project accuracy grows.

In AEC, computational design teams are often small and specialized,

project-specific tasks from repeatable core processes, standardizing

complexity of large projects by ensuring adaptability, scalability, and

the foundational functions that underpin higher-order design and

consistency across diverse conditions and edge cases. Once core

address unique geometric challenges, exponentially increasing a

logics are established, bespoke solutions can be layered on to

so scaling impact across diverse megaprojects is essential to meet

This can be achieved through creating methods that decouple

analytical tools. These core methods address the increasing

 Parametric & computational design for architectural megaproject delivery

Might be Interesting to this Workshop

Visual programming for 3D NURBS modeling

these growing demands.



Share an Emerging Technology You're Working on that may Address a NASA Astrophysics Need

- Application: computationally optimized design and fabrication of constructed spacecraft elements
- Benefit: identifying and packaging fundamental computational design methods to generate detailed geometry without building fully custom computational form generation algorithms every time
- **Emerging Technology:** adaptable, reusable computational processes to enable high-performance, mass-customized design at scale.



Encoding fabrication & construction data into 6,300 unique glass panels, updating automatically as design changed. One person can generate 6,300 detailed drawings in several hours.





small computational design team's capacity.

.

Connect on LinkedIn

Stephen Eikenberry

Education

Astronomy	Harvard University
Astronomy	Harvard University
Physics	MIT
	Astronomy Astronomy Physics



Share an Emerging Technology You're Working on that may Address a NASA Astrophysics Need

- Application: Habitable Worlds Observatory
- Benefit: Simultaneous post-coronagraph focal plane wavefront sensing and imaging spectroscopy of exoplanets. The focal plane sensing eliminates non-common-path aberrations and also provides science-quality spectra of the exoplanet candidates and host star.
- **Emerging Technology:** PEEPSS employs photonic lanterns to efficiently couple light from the inner dark hole in the coronagraph focal plane into single-mode optical fibers that feed a separate science-grade spectrograph.



Schematic layout of a PEEPSS module for one coronagraphic channel in an HWO exoplanet imager.

Professor of Optics; Professor of Physics CREOL – University of Central Florida

Expertise:

- Astrophotonics; Photonic Lanterns
- Specialty optical fibers
- Laser Frequency Combs
 - IR/Optical Astronomical Instrumentation



- **Application:** Quantum-inspired modal imaging with photonic lanterns
- Benefit: Sub-diffraction (~0.1 λ/D) hyperspectral imaging
- Emerging Technology: Our team has developed a Photonic Quantum-Inspired Imager (PQI2) capable of providing source reconstruction below the optical/NIR diffraction limit. This passive imaging system is based on innovations including photonic lantern spatial mode sorters with spatial and spectral diversity, and quantum-inspired image reconstruction techniques.





Jonathan Fan

Education

Ph.D.	Applied Physics	Harvard
M.S.	Applied Physics	Harvard
A.B.	Electrical Engineering	Princeton



Associate Professor, Stanford University Expertise:

- Electromagnetics and photonics
- Metamaterials
- EM scientific computing and AI
- Nanofabrication and manufacturing



Share an Emerging Technology You're Working on that may Address a NASA Astrophysics Need

- **Application** is automated design of nanophotonic technologies using AI-driven concepts.
- **Benefit** is ability to prototype concepts in nearreal time by users who have interests in optics but not necessarily are nanophotonic specialists.
- **Emerging technology** is Al-enhanced, human int the loop modeling and automated design.



Freeform photonic metasurface designed using topology optimization and fabricated in silicon.

- We have been using our computational platforms to design and implement metasurfaces and metamaterials with new physical capabilities.
- We have been collaborating with staff scientists at LLNL to develop new platform technologies for high throughput nanoscale additive manufacturing.
- We are developing an understanding of how to electrical thermochemical conversion processes using wireless power transfer. The concepts are motivated by applications in sustainability but generally extend to temperature-based chemical transformation, including in space-based environments.

Jared Fell



Jes M)

CubeSat chassis using topology optimization and built using LPBF Engineering Directorate Advanced Manufacturing Lead NASA Langley Research Center

Expertise:

- Desing and analysis of additive manufactured parts
- Design of systems for wind tunnels, aircraft, and UAS



Share Something Else that You're Working on that Might be Interesting to this Workshop

We are working to implement various advanced manufacturing technologies and capabilities to adapt to the evolving requirements and demands of the industry.

Education

BS

Mechanical Engineer Idaho State University

Share an Emerging Technology You're Working on that may Address a NASA Astrophysics Need

- Application: Advanced manufacturing techniques
 - Laser Powder Bed Fusion (LPBF)
 - Direct Energy Deposition (DED)
 - Friction stir additive manufacturing (FSAM)
- **Benefit:** Provide alternate manufacturing capabilities to provide benefits not available using conventual manufacturing techniques
- Emerging Technology: Engineering material properties to meet system needs

Jared.s.fell@nasa.gov

Mike Fitzgerald

Education

Ph.D.	Astrophysics	UC Berkeley
M.A.	Astrophysics	UC Berkeley
B.S.	Engineering and Applied Science	Caltech



Professor

Director, Infrared Laboratory Expertise:

- Circumstellar debris disks, direct exoplanet characterization (imaging and spectroscopy)
- Infrared instrumentation & adaptive optics
- High-contrast and high-angular-resolution techniques
- Astrophotonics

Share an Emerging Technology You're Working on that may Address a NASA Astrophysics Need

- Application: OIR high-resolution/contrast imaging spectroscopy
- Benefit: Efficient mode conversion and stable single-moded systems enables a range of measurements that push the limits of angular resolution and contrast
- Emerging Technology: Photonic lanterns with dispersed backends



A closed-loop system with an Adaptive Optics system feeding a Photonic Lantern with dispersed outputs



- Application: OIR high-resolution/contrast imaging spectroscopy
- Benefit: Achieving high contrast through by nulling in a highly stabilized platform
- Emerging Technology: Photonic integrated circuits with Mach-Zehnder meshes and nulling beam combination

Neil Gershenfeld

Education

Junior Fellow	Society of Fellows	Harvard
PhD	Applied Physics	Cornell
BA	Physics	Swarthmore

Share an Emerging Technology You're Working on that may Address a NASA Astrophysics Need

- **Application**: Exoplanet, early universe studies
- **Emerging Technology**: Swarm robotic assembly of functional voxels in material-robot systems
- **Benefit**: Flat-pack launch, incremental scalable assembly, elimination of deployment single points of failure and wiring harnesses, lifecycle repair and reconfiguration





Incremental robotic assembly of large-scale space structures with functional voxels

Director, MIT Center for Bits and Atoms Expertise:

- Digital fabrication
- Device physics
- Metamaterials
- Embedded and high-performance computing



Share Something Else that You're Working on that Might be Interesting to this Workshop

Self-reproducing robots



- Physically-reconfigurable 3D electronics
- Zeptojoule superconducting electronics



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(b) He-C	(c)	• 2 2 °	(d) -	150 µm

https://lexfridman.com/neil-gershenfeld/

gersh@cba.mit.edu

https://ng.cba.mit.edu

Chris Helmerich

Education

Ph.D.	Physics	UAH
M.S.	Physics	UAH
B.S.	Astrophysics, Physics	UAH



CTO Celedon Solutions Expertise:

- AI/ML
- General Relativity
- Gamma-ray Instrumentation
- Scientific Ballooning

Share an Emerging Technology You're Working on that may Address a NASA Astrophysics Need

- **Application** is concept design, mission planning, systems engineering, simulation, flight software, manufacturing, integration, and operations
- **Benefit** is engineering up to 100x cheaper and faster
- Emerging technology is a fully automated and collaborative engineering design platform powered by agentic generative artificial intelligence: Davinci

Share Something Else that You're Working on that Might be Interesting to this Workshop

- General relativity simulations
- Gamma-ray detector design for multi-messenger astronomy
- Atmospheric lensing

chris@celedon.solutions

celedon.solutions

linkedin.com/in/christopher-helmerich

Interesting to this V

Davinci



Nemanja Jovanovic

Education

Ph.D.	Laser physics	Macquarie University
Honors	Laser physics	Macquarie University
B. Tech	Optoelectronics	Macquarie University



Lead Instrument Scientist Caltech

Expertise:

- Astrophotonics
- Astronomical instrument design, build and commissioning.
- Exoplanet instrumentation.
- High contrast imaging.

Share an Emerging Technology You're Working on that may Address a NASA Astrophysics Need

- Application is photonic nulling & wavefront control.
- **Benefit** is that photonic nullers can achieve better inner working angles than coronagraphs.
- **Emerging Technologies** are mode selective photonic lanterns and integrated photonic beam combiners.



Taken during the service mission for the KPIC instrument at Keck.

- We are developing spectral shapers on a chip.
- You can arbitrarily shape a spectrum as needed. This is useful for flattening the output of a laser frequency comb for example.





Caroline Kilbourne

Education

PhD	MSE	Stanford University
MS	MSE	Stanford University
BSE	EECS (+ Eng. Phys.)	Princeton University



Senior Research Astrophysicist NASA Goddard Space Flight Center Expertise:

- Low-temperature (<0.1 K) detectors
 - Quantum calorimeters
- Quantum-calorimeter instrumentation
- Astrophysical x-ray spectroscopy
- Particle radiation interactions with quantum calorimeters

Share an Emerging Technology You're Working on that may Address a NASA Astrophysics Need

- **Application:** x-ray astrophysics space missions
- **Benefit:** x-ray spectroscopy with unparalleled combination of spectral resolution, angular resolution, field of view, energy band, and low background
- Emerging technology: quantum-calorimeter x-ray spectrometers consisting of exquisite sensors and commensurate cutting-edge enabling supporting technologies



high-resolution imaging spectroscopy enables study of distant galaxy despite bright Milkyway foreground

Share Something Else that You're Working on that Might be Interesting to this Workshop

- Different permutations of elements of a quantum-calorimeter spectrometer
 - optimized to answer different questions
- Synergies with other wave bands and applications
- Advances in signal processing, spectral analysis needed to handle data cubes of the future
- Moving quantum-calorimeter spectrometers from "niche" to "work horse"



https://pcos.gsfc.nasa.gov/physpag/meetings/EarlyCareerWorkshop_Nov2024/presentations/Day3/3_Caroline_Kilbourne_early-career-forum.pdf



John Lawson

Education

PhD	Physics	Brown University
M.Sc.	Physics	Brown University
B.Sc.	Physics	Clemson University



Computational Materials Group Leader NASA Ames Research Center



Expertise:

- Multiscale modeling of materials, structures and biosystems
- Physics and chemistry-based modeling from first principles
- Process, systems and device modeling

Share an Emerging Technology You're Working on that may Address a NASA Astrophysics Need

- **Application**: Computational materials design for aerospace and astrophysics applications
- **Benefit**: Broad spectrum of astrophysics materials from structures to optical to thermal materials, etc. can be designed and optimized for targeted application, e.g., telescopes, detectors, etc.
- Emerging Technology: Computational materials engineering is rapidly maturing discipline for tailored made materials for extreme and highperformance applications with specialized, targeted properties, e.g., semiconductors, optical materials, ultra-light weight, ultra-strong, thermal, cryogenics, liquid mirrors, etc.



A. Molecular protein model B. Atomic ice-surface interface

Share Something Else that You're Working on that Might be Interesting to this Workshop

- Application: Liquid telescopes
- Benefit: Ultra-smooth surfaces
- **Emerging Technology**: Liquids telescopes offer many benefits including high resolution imaging, portability and easy of assembly. Many issues regarding choice and composition of the liquids and possible additives including nanoparticles suspensions remain.

Optimization of these systems with assistance from advanced computational methods will be crucial to enable high performance telescopes.



John.W.Lawson@nasa.gov

https://www.nasa.gov/intelligent-systems-division/discovery-and-systems-health/computational-materials-group/

Jonathan Lin

Education

B.S.

PhD (in progress)

UCLA

Engineering UC Berkeley Physics



Graduate student UCLA

Expertise:

- wavefront sensing
- photonic lanterns
- photonics simulations



Share an Emerging Technology You're Working on that may Address a NASA Astrophysics Need

- Application: focal-plane wavefront sensors for high-contrast imaging
- **Benefit**: sense & correct wavefront errors (noncommon-path & petal aberrations) which limit coronagraphic contrast
- Emerging Technology: photonic lanterns & integrated circuits for focal-plane wavefront sensing and active control



On-sky demo of photonic lantern wavefront sensor @ Subaru/SCExAO



- **Application**: nonlinear phase retrieval techniques for wavefront sensors
- **Benefit**: improve the dynamic range of very sensitive but very nonlinear wavefront sensors and understand fundamental limits
- Emerging Technology: numerical continuation techniques from nonlinear dynamics, sparse interpolation

Philip Mauskopf

Education

Physics	U. C. Berkeley
Physics	U. C. Berkeley
Physics	Harvard University
	Physics Physics Physics



Array of 4000 superconducting kinetic inductance detectors (KIDs) in the ground-based Toltec instrument - a precursor to arrays being developed for upcoming FIR and X-ray missions.

Professor Arizona State University

Expertise:

- Quantum sensing
- Superconducting devices
- **Metamaterials**
- Microwave and DSP



Share Something Else that You're Working on that Might be Interesting to this Workshop

- Application: High speed deep space optical communications
- Benefit: High data rates from deep space (cis-lunar, ٠ L2, Mars)
- Emerging Technology: Superconducting single photon linear detectors. Existing superconducting nanowire detectors have a speed limited by reset time to about 1 GHz. Linear mode superconducting nanowire detectors coupled to guantum limited superconducting amplifiers can enable faster data rates up to 100 GHz.

Share an Emerging Technology You're Working on that may Address a NASA **Astrophysics Need**

- Application: X-ray, FIR and optical single photon spectroscopic imaging
- Benefit: Improved astrophysics data capability
- **Emerging Technology: Superconducting** microwave multiplexing components based on non-linear kinetic inductance







yourname@domain.com



User ID

Ryan McClelland

Text-to-Spaceship

- Application:
 - Accelerate Mission development 10x using AI
- Benefits:
 - Shorten development timelines
 - Increase mission frequency and ambition
 - Maintain NASA leadership
 - Inspire innovators
- Emerging Technology:
 - LLMs
 - Al Agents
 - Computational Design
 - Surrogate Models



ALICE Evolved Optical Bench as seen in the New York Times

Research Engineer NASA Goddard Space Flight Center

Expertise:

- Al for Hardware
- Systems Engineering
- Spaceflight Structures
- Opto-mechanical Engineering

Evolved Structures

- Application:
 - Automate development of spaceflight structures using AI
- Benefit:
 - 10x faster development
 - 3x improved performance
 - Science enabling
- Emerging Technology:
 - Generative Design
 - Topology Optimization
 - LLMs



BS

Education



Mechanical

Engineering





University of Maryland



yourname@domain.com





Brittany McClinton

Education

B.S.	Physics	Yale University
Ph.D.	Electrical Engineering and Computer Science	UC Berkeley



Proposal Manager NSF NOIRLab



Expertise:

- Resolution enhancement techniques for lithography
- Imaging and materials at EUV and SXR
- Physical and statistical optics, coherence theory, and speckle
- Quantum sensing based on precision timing, simultaneity and entanglement

Share an Emerging Technology You're Working on that may Address a NASA Astrophysics Need

- Application: optical interferometry in astronomy
- Benefit: possible microarcsecond resolution / superior sensitivity
- Emerging Technologies:
 - Quantum memory protocols for optical delay and non-local beam combination in interferometric arrays optimized for probability, fidelity, broadband, and generalized photon states
 - Ultra-precision non-local timing based on integrated technology: atomic clocks, optical frequency combs, entanglement distribution over a quantum network, and photonic integrated circuits for local time-gating



Entanglement-based technologies may replace optical delay lines such as these at the CHARA Array

NOIRLab is a CHARA consortium member



- Novel quantum imaging protocols and architectures based on non-locality of quantum waves, imaging with undetected photons, principles of complementarity
- QND single photon imaging techniques well characterized by wavefront collapse
- Quantum tomography applications to non-local stellar photon characterization

David Miller

Education

Ph.D.	Physics	Heriot-Watt University
B.Sc	Physics	St. Andrews University



An interferometer mesh silicon

photonic chip giving a fully

programmable and self-

configuring arbitrary linear

optical component

Arbitrary programmable and self-configuring photonic integrated circuits (PICs) for spatial and spectral analysis and filtering

- Application: optimal spatial and spectral sensing at physical limits for, e.g., exoplanet detection, ...
- Benefit: full and rapid re-programmability and optimization, e.g. for different objects and spectra
- Emerging Technology:
 - growing understanding of algorithms and architectures for optimal and self configuration
 - new invention of programmable spectral response
 - various physical chip foundry platforms now available – e.g., silicon photonics – and being developed – e.g., silicon nitride photonics for wider wavelength ranges; improved component designs for higher performance

Prof. of Electrical Engineering & Applied Physics

Expertise:

- fundamentals of optics in communicating, processing and sensing information
- programmable and self-configuring optics
- optoelectronic physics and applications of quantum-confined structures, such as semiconductor quantum wells





Fundamental description of waves connecting sources and receivers: "communication modes"

Waves, modes, communications, and optics Adv. Opt. Photon. – general introduction Leads to fundamental physical results and limits for arbitrary optical systems, including PICs. E.g., Why optics needs thickness Science - limits how compact optics can be

Tunneling escape of waves Nat. Photon. - the fundamental reason for diffraction limits for any optics Measuring, processing, and generating partially coherent light with self-configuring optics Light Sci. Appl. – optimal measurement and separation of natural light sources



https://dabm.stanford.edu/

Austin Minnich

Education

PhD	Mechanical Engineering	MIT
SM	Mechanical Engineering	MIT
B.S.	Engineering Science	UC Berkeley



Share an Emerging Technology You're Working on that may Address a NASA Astrophysics Need

- Application: Black hole imaging using spacebased radio observatories
- Benefit: High-resolution images of black holes beyond what is possible with ground-based observatories
- Emerging Technology: Superconducting mixers operating above 4 K based on high-Tc superconductor MgB₂.



Schematic of thermal laser epitaxy system which has potential for growing high quality MgB₂ thin films



austin-minnich-652b7513 Professor of Mechanical Engineering and Applied Physics Caltech

Expertise:

- Low-noise microwave transistors
- Vacuum deposition, epitaxy of thin films
- Caltech

• Atomic layer processing

Share Something Else that You're Working on that Might be Interesting to this Workshop

- Application: Exoplanet spectroscopy using superconducting microwave kinetic inductance detectors (MKIDs)
- Benefit: Single-photon energy resolution of MKIDs allows for spectroscopy of very faint sources.
- Emerging Technology: Atomic layer etching to engineer film surfaces at the Angstrom scale, decreasing surface microwave loss and jitter and thereby improving energy resolution.

aminnich@caltech.edu

minnich.caltech.edu

Kelsey Morgan

Education

Ph.D.	Physics	University of Wisconsin- Madison
M.S.	Physics	University of Wisconsin- Madison
B.A.	Physics	University of Chicago

Share an Emerging Technology You're Working on that may Address a NASA Astrophysics Need

- Application: x-ray and gamma ray astrophysics space missions
- Benefit: high-resolution x-ray and gamma ray spectroscopy with large FOV/high efficiency
- Emerging Technology: large arrays of transitionedge sensor (TES) microcalorimeters read out by microwave SQUID multiplexing





A 244-pixel array of TESs optimized for soft x-ray spectroscopy packaged with microwave SQUID mux readout Physicist, Quantum Sensors Division, National Institute of Standards and Technology

Expertise:

Superconducting detectors for X-ray and gamma ray spectroscopy



 Multiplexing techniques for large arrays of superconducting detectors National Institute of Standards and Technology U.S. Department of Commerce

Precision spectroscopy for metrology

Share Something Else that You're Working on that Might be Interesting to this Workshop

- Application: optical/x-ray/gamma ray spectroscopy for space missions
- Benefit: massively multiplexed arrays of lowtemperature microcalorimeters with improved fabrication simplicity and focal plane density
- Emerging Technology: Kinetic Inductance Current
 Sensor (KICS) readout provides the advantages of
 multiplexing at microwave frequencies, but eliminates
 the need for a SQUID to sense current



kelsey.morgan@nist.gov

https://www.nist.gov/people/kelsey-morgan

Shouleh Nikzad

Education

PhD	Applied Physics/Physics	Caltech
MS	Electrical Eng.	Caltech
Degree	Electrical Eng/Electrophysics	USC

Share an Emerging Technology You're Working on that may Address a NASA Astrophysics Need

- Application: Astrophysics through UV/Optical Observations from CubeSats to flagship scale missions
- **Benefit**: high SNR, scalable, stable response, enabling higher performance instruments
- Emerging Technology: Single Photon Counting Detectors, skippers, QIS





Nanoscale interface engineering via MBE and ALD

Shouleh.Nikzad@jpl.nasa.gov

Science Division Head, JPL Fellow, Senior Research Scientist Jet Propulsion Laboratory (JPL)

JPL

Expertise:

- UV/Optical instruments and technologies for astrophysics
- Silicon detectors, coatings
 - Silicon devices, materials, nanoscale engineering (MBE, ALD)

- We are developing techniques and processes that are applicable to a variety of silicon and other materials devices
- We are developing coatings for mirrors and gratings to allow high reflectivity and stability across UV and optical ranges
- We are developing compact, high throughput UV and UV/Visible imaging spectrometers taking advantage of high efficiency detectors, high reflectivity coatings, and low scatter, high efficiency gratings

Jayson "Luc" Peterson

Education

Ph.D.	Astrophysical Sciences - Plasma Physics	Princeton
M.S.	Astrophysical Sciences - Plasma Physics	Princeton
A.B.	Physics; Science, Technology & Society	Vassar College



El Capitan, the world's fastest supercomputer, where we are prototyping an Al-driven automated design system, capable of millions of high-fidelity physics simulations

Associate Program Leader for Data Science Space Science and Security Program Lawrence Livermore National Laboratory (LLNL) Expertise:

- High Performance Computing
- Computational Physics
- AI/ML
- Digital Design and Engineering
- Nuclear Fusion



Share Something Else that You're Working on that Might be Interesting to this Workshop

- The use of large language models to sift through large document stores, open source, and deployable on stand-alone systems
- Scientists and engineers can ask in natural language questions about a large trove of documents and get not only an answer but also specific paragraphs from the documents that led to that answer
- This could help with everything from regulatory questions to keeping up on latest S&T developments.
 A spacecraft engineer was able to use this to answer a highly technical question in one morning what another SME did in 3 weeks.

Share an Emerging Technology You're Working on that may Address a NASA Astrophysics Need

- Application is automated design of nuclear fusion experiments on SOTA supercomputers
- Benefit is ability to prototype new designs using exascale computing and "design for manufacturability"
- Emerging technology is AI-enhanced high fidelity modeling and automated design

Laurent Pueyo

Education

PhD	Aerospace Engineering	Princeton
Agregation	Electrical Engineering	Ministere de l'Education Nationale de France
Maitrise	Applied Physics	University d'Orsay & ENS Cachan



Project Scientist Advanced Technologies STScI

Expertise:

- High-contrast imaging of exoplanets techniques
- Coronagraphs, wavefront sensing and control
- Interferometry
- Giant planet formation



Share an Emerging Technology You're Working on that may Address a NASA Astrophysics Need

- **Application**: high-contrast imaging of exoplanets, search for earth twins around other stars.
- Benefit: ability to observe earth twins with a shorter exposure time (throughput), ability to observe earth twins at all in the IR (resolution), ability to observe earth twins at higher spectral resolution.
- Emerging Technology: hybrid bulk optics + photonics coronagraph.



The coronagraph does most of the work and the PIC helps reach the final contrast

- Application: contrast stability of coronagraph images, figuring out how stable the telescope needs to be.
 Can we build a telescope that wiggles but the images that do no wiggle?
- **Benefit**: Better sensitivity to fainter planets, or easier to build telescope as a whole.
- **Emerging Technology**: Al inspired mechanical and thermal design.





Eleanor Rieffel

Education

PhD	Math (Geometric Group Theory)	UCLA
A.B.	Math	Harvard

An Emerging Technology I'm Working on that may Address a NASA Astrophysics Need

- Application: Protocols for the generation of entangled states for use in quantum sensing or computing; Modeling of quantum processing under realistic errors; Quantum and quantumclassical hybrid algorithms
- Benefit: More sensitive sensing, fewer samples needed from low light sources; support for verylong baseline telescopy; faster processing of astrophysics data
- Emerging Technology: Quantum Information Processing Hardware, from small special purpose devices to full quantum computers



$\rho(\epsilon)^{\otimes n} \xrightarrow{\vdots} U \xrightarrow{\varsigma} \rho(\epsilon' < \epsilon)$

Quantum circuit for an n-photon distillation scheme



NASA Senior Researcher For Advanced Computing & Data Analytics Lead, Quantum Artificial Intelligence Laboratory (QualL)

NASA Ames Research Center Expertise:

Quantum Technologies, particularly Quantum Information Processing

Something else that I'm working on that might be Interesting to people attending this workshop

- Quantum Inspired Classical Computing, both quantum-inspired hardware and quantum-inspired algorithms
- Potential benefits in processing of astrophysics data, including fast ML/AI processing for astrophysics
- Emerging Technology:

Digital Annealers; Coherent Ising Machines De-quantized quantum algorithms; quantum-ready classical algorithms; quantum-spurred algorithms

<first>.<last>@nasa.gov

Noah Rubin

Education

в.А.	Physics	University of Pennsylvania
	Dhusias	
Ph.D.	Applied Physics	Harvard University



Assistant Professor of Electrical Engineering University of California San Diego (UCSD)

Expertise:

- Optics
- Polarization optics
- Diffractive optics, nanophotonics



JACOBS SCHOOL OF ENGINEERING

Share an Emerging Technology You're Working on that may Address a NASA Astrophysics Need

- In the last few years, we have developed metasurface polarization grating technology for improved polarimetry and polarization sensing
- Under NASA support, we have demonstrated the use of this technology for solar astronomy.
- We built an instrument around this new technology which was deployed to an observatory solar telescope (see image at right), and have worked to space-qualify the technology.



Image of a sunspot near the solar limb taken through our metasurface based polarimetric telescope. Each image is one polarization channel.

Share Something Else that You're Working on that Might be Interesting to this Workshop

- My group's research considers the role of polarization in optics generally
- I have worked extensively the theory and design of polarization-sensitive diffractive optics (sometimes called "metasurfaces") which allow for the simplification of optical systems with components not possible by any other means
- I am interested in the application of these to astronomical and other sensing systems.



noahrubin@ucsd.edu

Dan Sirbu

Education

Mechanical &	Princeton University
Aerospace Engineering	
Electrical	University of Alberta
Lingineering	
	Mechanical & Aerospace Engineering Electrical Engineering



17 mm

AstroPIC

Prototype

Share an Emerging Technology You're Working on that may Address a NASA Astrophysics Need

- AstroPIC is a photonic integrated circuit (PIC) device that performs photonic nulling to enable high-contrast imaging
- Astrophotonics has the potential to miniaturize a coronagraph onto a small-form factor device
- Can incorporate additional functionality including more bands, programmable phase shifters to reconfigure the Mach-Zehnder Interferometric (MZI) mesh and an integrated spectrometer

Astrophysicist NASA Ames Research Center

Expertise:

- Astrophotonics
- Coronagraph design & modeling
- Wavefront sensing & control
- Technology development



- Novel wavefront sensing & control algorithms and coronagraph designs for NASA's Habitable Worlds Observatory flagship mission to find Earth-like planets
- Multi-Star Wavefront Control (MSWC) uses a Deformable Mirror and a mask on the Roman Coronograph instrument to look for exoplanets around binary stars
- Technology development including in-air and invacuum validation of astrophysics instrumentation for infusion to flight instruments



Eric Smith

Education

PhDElementaryUniversitParticle Physics(researchBSEngineeringUniversitPhysics EE focus(research

University of Oklahoma (research at Fermilab) University of Oklahoma



Sr Principal, Al Strategy Lockheed Martin Space Expertise:

- Al Application for multi-domain missions
- Systems Engineering for ISR
- Systems Engineering for autonomous driving
- Optical modeling and simulation

hat Might be Interesting to this Workshop

- Application: Al at the edge
- Benefit: Move advanced processing and discovery to the edge for deep space applications - more science from smaller, less expensive probes that have limited bandwidth given link to Earth
- Emerging Technology: Single-bit implementations of attention-based transformers, neuromorphic processors

Share an Emerging Technology You're Working with that may Address a NASA Astrophysics Need

- Application: GenAl for exploration
- **Benefit:** Anything not specifically forbidden by the laws of physics is allowed. Generative AI is remarkably innovative and useful when properly constrained Nobel prize in Chemistry 2024
- Emerging Technology: attention-based transformers coupled with reinforcement learning, constrained by physics.





User ID



LOCKHEED MARTIN

User ID

Olav Solgaard

Educat	lion	
Ph.D.	EE	Stanford University
MS	EE	Stanford University
BS	EE	University



Professor of Electrical Engineering Stanford University

Expertise:

- Photonic Micro and Nano Systems
- Silicon Photonics
- Optical sensors
- Microscopy
- Dielectric Laser Accelerators



Share an Emerging Technology You're Working on that may Address a NASA Astrophysics Need

- Application: Spatial and spectral identification of exo-planets
- Benefit: Tunable, compact, and mechanically robust instrumentation
- Emerging Technology: High Contrast Silicon Photonics



Comparison of standard Mach-Zehnder and tunable Double Mach-Zehnder that enables high contrast

Share Something Else that You're Working on that Might be Interesting to this Workshop

- Application: Optical sensors for remote environmental monitoring
- Benefit: Tunable, compact, and mechanically robust sensors that be can be interrogated from base stations, drones, and satellites
- Emerging Technology: Tunable Silicon Photonics Spectrometers that can be optimized for specific applications



https://solgaardlab.stanford.edu/

Tayyab Suratwala

Education

B.S.

Ph.D. Materials Science U. of AZ

Ceramic U. of IL Urbana-Champaign Engineering

Share an Emerging Technology You're Working on that may Address a NASA Astrophysics Need

- Application: Optic technologies used in high energy and power lasers (such as the National Ignition Facility (NIF))
- **Benefit:** Enable such lasers to perform at high energies and powers (such as fusion ignition on NIF)
- Emerging Technology: Stockpile Stewardship and Nuclear Fusion

work performed under the auspices of the US Department of Energy by Lawrence Livermore National Laboratory (LLNL) under Contract DE-AC52-07NA27344



Program Director: Optics & Materials Science & Technology Lawrence Livermore National Laboratory Expertise:

- Optical fabrication
- Fracture behavior in glasses
- Glass & crystal chemistry
- Laser damage initiation and growth
- Optical properties of glasses





NIF optics being refurbished for reuse with the Optics Recycle Loop

suratwala1@llnl.gov

- Application: Freeform optics fabrication
- **Benefit:** Enable novel uses of optics in imaging and laser systems
- Emerging Technology: Multiple

Hayden Taylor

Education

in

B.A. & M.Eng	Electrical and Electronic Engineering	Cambridge University
Ph.D.	FFCS	MIT

Computed Axial Lithography (CAL)

- Rapid, layer-less printing of glass and polymers
- Intricate geometries and smooth (as low as ~ 6 nm rms) surfaces
- Potential applications in custom optics
- 'Overprinting' of electronics and metals
- Features from ~20 µm to centimeters





Computed axial lithography of silica glass

Associate Professor, Mechanical Engineering U.C. Berkeley

Berkelev

Expertise:

- Volumetric additive manufacturing
- Semiconductor process modeling
 - Nanoimprint lithography
- Mechanical processing of 2D materials

Nanoimprint lithography for emerging applications

- Potential rapid prototyping of metasurfaces for custom optical systems – faster manufacturing than scanning-beam methods and lower-cost than **DUV/EUV** lithography
- Ability to apply texture to components for engineering, e.g., thermal properties





hkt@berkeley.edu

Sylvain Veilleux

Education

Ph.D.	Astronomy	UC Santa Cruz
M.S.	Astronomy	UC Santa Cruz
B.S.	Physics	Université de Montréal

Share an Emerging Technology You're Working on that may Address a NASA Astrophysics Need

- Application is UVOIR astrophysics space missions
- **Benefit** is UVOIR filters, spectrometers, and interferometers with superior throughput, sensitivity, stability, and capabilities that can only be achieved with photonics
- Emerging technology is photonic filters, spectrometers, and interferometers that address the need to reduce the size, weight, and power (SWaP) of instruments used in space missions



A typical photonic spectrometer produced in our lab (on the left) is smaller than a penny

Professor, Optical Director University of Maryland, College Park Expertise:



- Astrophotonics
- Photonic devices on Si₃N₄ + SiO₂ platform
- Multi-wavelength astrophysics, incl. studies of starburst and active galaxies and distant transient events

- We are about to commission a new near-infrared imager-spectrometer, called RIMAS, for the groundbased 4.3-meter Lowell Discovery Telescope
- This instrument will eventually be equipped with photonic fiber Bragg gratings to suppress the strongest 100 telluric OH lines produced in the Earth's atmosphere and provide a huge gain in sensitivity
- A long-term goal is to equip the upcoming generation of ground-based Extremely Large Telescopes (ELTs) with these OH suppression filters and study the first galaxies, black holes, and stars in the early universe

Alan Wang

Education

Ph.D.	Electrical & Computer engineering	University of Texas at Austin
M.S.	Solid State Electronics	Chinese Academy of Science
B.S.	Materials Science and Engineering	Tsinghua University



Share an Emerging Technology You're Working on that may Address a NASA Astrophysics Need

- Application is astro-photonics for spectroscopy, remote sensing and hyperspectral sensing.
- Benefit is the ultra-compact size and electrical tunability with fast speed.
- Emerging Technology is the design and implementation of electrically tunable photonic integrated circuits (PICs) and meta-surfaces enabled by epsilon-near-zero (ENZ) high mobility transparent conductive oxide(HMTCO)



Concept of an electrically tunable MOSCAP structure by a HMTCO/HfO₂/p-Si and images of on-chip microring optical filters

Professor & Mearse Endowed Chair Baylor University

Expertise:

- Photonic integrated circuits
- Nanophotonic devices
- Optical sensing and spectroscopy
- Optical materials



- We are developing a high-mobility transparent conductive oxide, hydrogen-doped indium oxide (IHO) with mobility above 100 cm²/(V•s), that can offer large electro-optic tunability from near-infrared to mid-infrared wavelength
- We aim to demonstrate an electrically tunable PIC and meta-surface structure for on-chip spectroscopy
- Our long-term goal is to develop new spectroscopy devices for astrophysics with unprecedented SWaP reduction







Ryan T Watkins

Education

PhD	Aerospace Eng.	University of Michigan
MS	Aerospace Eng.	University of Michigan
BS	Aeronautical Eng.	Clarkson University

Share an Emerging Technology You're Working on that may Address a NASA Astrophysics Need

- Application: Telescope structural design
- Benefit: Rapid design cycles producing lighter, yet more performant structures to support telescope systems
- Emerging Technology: Integrating the computation design tool Topology Optimization with Machine Learning has the ability to merge physics-based design tools with large data to rapidly generate optimal structural designs of telescope systems.





Topology optimized backing structure for a telescope mirror

Technologist Jet Propulsion Laboratory

Expertise:

- Computational Design
- Advanced Manufacturing
- Advanced Materials



- Application: Telescope reflectors
- **Benefit**: Reduce cost and lead time of large meter scale monolithic telescope reflectors from years to months.
- Emerging Technology: Conventional large aluminum reflector manufacturing requires costly (on the order of \$1M) and long lead time forgings (on the order of a year). Friction Stir Additive Manufacturing has to potential to rapidly and cheaply manufacture these large metallic reflectors for astrophysics telescopes (such as those used on NEO Surveyor and the proposed mirror on PRIMA).







Please email me for anything: Xia7@llnl.gov XiaOXing Xia My son really wants me to send something to space!

Education

Ph.D.	Materials Science	Caltech
B.A.	Physics & Economics	University of Chicago

Metalens-based Parallel 3D Nanolithography 1000X speed → 100nm feature over 3cm area





Work at LLNL was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344.



Staff scientist, Materials Engineering Division Lawrence Livermore National Laboratory

- Additive Manufacturing, esp. two-photon AM
- Target fabrication for inertial confinement fusion
- Responsive and architected materials
- Functional devices: electrochemical cells, microelectronics, microfluidics, ion traps



Dynamically responsive architected materials



On-chip ion trap for quantum computing/sensing

Wetted-foam capsules for fusion



Education

Ph.D.	EE	Pennsylvania State University
MS	Opt Eng	Chinese Academy of Sciences
BS	Opt Eng	Zhejiang University

Share an Emerging Technology You're Working on that may Address a NASA Astrophysics Need

- Application picometer metrology.
- **Benefit** Wavefront sensing and control to picometer level.
- Emerging Technologies integrated photonics



Feng Zhao





Engineering Fellow

Expertise:

- Optical instruments
- Interferometry
- Laser metrology
- Wavefront sensing and control
- High contrast imaging

Share Something Else that You're Working on that Might be Interesting to this Workshop

• High contrast imaging (Roman Coronagraph Instrument, Habitable Worlds Observatory)



JPL