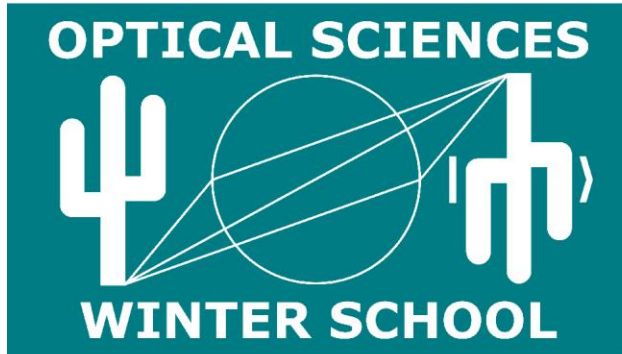
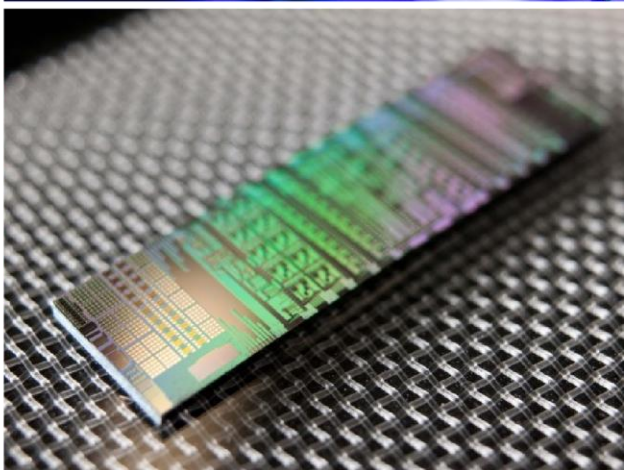
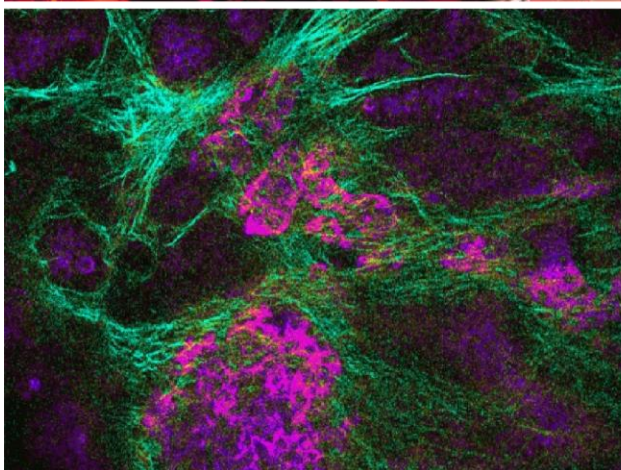
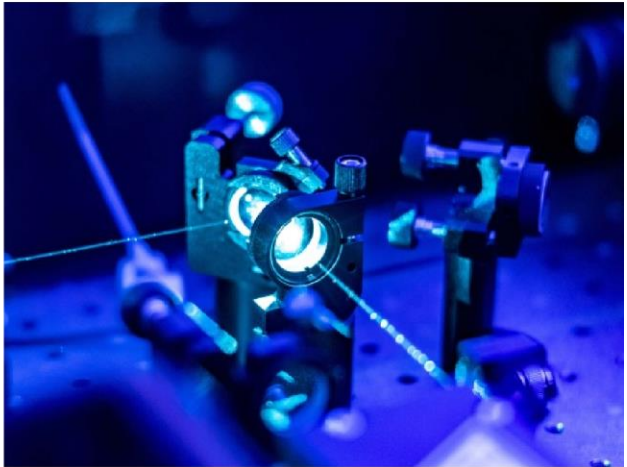
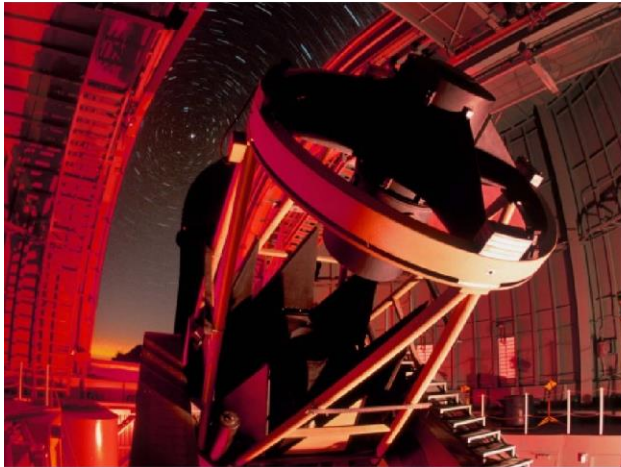


# OPTICAL SCIENCES WINTER SCHOOL



Wyant College of Optical Sciences  
University of Arizona  
Tucson, Arizona  
Jan. 4 - Jan. 7, 2023



# **Optical Sciences Winter School 2023**

## **College of Optical Sciences Organizing Committee**

Brandon Chalifoux  
Lars Furenlid  
Poul Jessen  
Jason Jones  
Daewook Kim  
John Koshel  
Channel Lemon  
Masud Mansuripur  
Euan McLeod

### **Special Thanks to Our Sponsors:**

DeMund Foundation  
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# Schedule – Optical Sciences Winter School 2023

## Wednesday, Jan. 4, 2023

(All sessions at Optical Sciences 307)

8:00	Breakfast	
8:50	Welcome	Prof. Jason Jones
9:00	<i>Introduction to Image Science</i>	Prof. Lars Furenlid
10:00	Break	
10:20	<i>Low-cost, in vivo microscopy</i>	Prof. Dongkyun Kang
11:00	<i>Real-Time Modeling of Imaging Systems: The role of Modern Gaming Architectures in System Development, Analysis, and Optimization</i>	Prof. Matthew Kupinski
11:40	Lunch (Optical Sciences)	
1:00	<i>Introduction to Optical Physics</i>	Prof. Jason Jones
2:00	Lab tours	
3:30	<i>Radiation Pressure in Modern Physics</i>	Prof. Dalziel Wilson
4:10	Break	
4:30	<i>Quantum Optics</i>	Prof. Poul Jessen
5:10	Break	
6:30	Dinner (Gentle Ben's)	

## Thursday, Jan. 5, 2023

(All sessions at Optical Sciences 307)

8:00	Breakfast	
9:00	<i>Introduction to Photonics</i>	Dean Thomas Koch
10:00	Break	
10:20	<i>Compact ultrafast fiber lasers and applications</i>	Prof. Khanh Kieu
11:00	<i>Nanophotonics</i>	Prof. Euan McLeod
11:40	Lunch (Optical Sciences)	
1:00	<i>Introduction to Optical Engineering</i>	Prof. Meredith Kupinski
2:00	Lab tours (including the Richard F. Caris Mirror Lab)	
3:40	<i>Ultrafast lasers as tools for optical fabrication and alignment</i>	Prof. Brandon Chalifoux
4:20	Break	
4:40	<i>Adventures during the Pandemic: Engineering a Remote Imaging Telescope</i>	Prof. John Hayes
5:20	Break	
6:30	Dinner and Poster Session (The Graduate Hotel)	

## **Friday, Jan. 6, 2023**

(All sessions at Optical Sciences 307)

- 8:00 Breakfast
- 8:45 Euan McLeod, University of Arizona  
*Welcome, Introduction to Optical Sciences at the UA*
- 9:00 Keynote: Marcia Rieke and George Rieke, University of Arizona  
*JWST - triumph of engineering and science*
- 9:50 Break
- 10:20 Session Chair: Euan McLeod  
Katie Schwertz, Edmund Optics (UA Optics Alumna)  
*Forging a Career in the Optics & Photonics Industry*
- 10:40 Kyle Myers, Former U.S. Food and Drug Administration Official (UA Optics Alumna)  
*How an Optical Sciences grad can impact medical device evaluation and regulation*
- 11:00 Panel discussion: K. Schwertz, K. Myers, N. Lima, T. Sawyer
- 12:00 Lunch (Optical Sciences)
- 1:10 Session Chair: Masud Mansuripur  
Arash Mafi, University of New Mexico  
*Laser Cooling of Yb-Doped Silica Glass*
- 1:35 Thomas Brown, University of Rochester  
*East and West: How Rochester and Tucson Together Led the World in Defining Optics*
- 2:00 Lab tours (including the Richard F. Caris Mirror Lab)
- 3:40 Session Chair: Brandon Chalifoux  
Maxim Sukharev, Arizona State University  
*Computational nano-optics*
- 4:05 Selim Unlu, Boston University  
*Commercialization of Interferometric Reflectance Imaging Sensor – A journey of innovation and entrepreneurship in and academic laboratory*
- 4:30 Break
- 4:50 Session Chair: Brandon Chalifoux  
Hong Hua, University of Arizona  
*Optics in Virtual and Augmented Reality Displays*
- 5:15 Joe Shaw, Montana State University  
*Advancing the Optics and Photonics Frontier in Montana*
- 5:40 Break
- 6:30 Banquet (Bear Down Gymnasium)
- 8:30 (or earlier) Session Chair: Lars Furenlid. After-dinner talk, Center for Creative Photography  
John Schaefer, University of Arizona  
*Putting Optics to Use*

## **Saturday, Jan. 7, 2023**

(All sessions except for 9am Keynote at Optical Sciences 307)

- 8:00 Breakfast
- 9:00 Session Chair: Euan McLeod  
Keynote: Donna Strickland, Nobel Laureate, University of Waterloo  
*From Nonlinear Optics to High-Intensity Laser Physics*  
**Room: Manuel Pacheco Integrated Learning Center (ILC) 120 (below ground level)**
- 10:00 Break, return to Optical Sciences (Meinel 307)
- 10:30 Session Chair: Jason Jones  
David Hagan, University of Central Florida  
*Fun with short pulses of light*
- 10:55 Brian Monacelli, NASA Jet Propulsion Laboratory & Pasadena City College  
*Optical Engineering of SHERLOC: Deep UV Raman from Earth to Mars*
- 11:20 Svenja Fleischer, Western Washington University  
*Icy optics - studying ice films on cold mirrors for cryogenic gravitational wave detectors*
- 11:45 Lunch (Optical Sciences)
- 1:10 Session Chair: Jason Jones  
Juan Merlo, Vassar College  
*Asymmetric generation of surface plasmons polaritons using apertured probes*
- 1:35 David Jones, University of British Columbia  
*Measuring quantum materials in the time domain*
- 2:00 Lab Tours
- 3:30 Session Chair: Masud Mansuripur  
Matthew Eichenfield, University of Arizona  
*Ultra-Scalable and Reconfigurable Photonic Integrated Circuits for Quantum Information Processing Applications*
- 3:55 Achuta Kadambi, University of California, Los Angeles  
*Equitable Optics: Engineering Solutions to Make Light-based Medical Devices More Inclusive and Accurate*
- 4:20 Break
- 4:40 Keynote: Enrique Galvez, Colgate University  
*Einstein beams and the optics of gravitationally-lensed light*
- 5:30 Break
- 6:00 Transportation to Dinner at Pinnacle Peak in Trail Dust Town.

# Keynote Abstracts—Optical Sciences Winter School 2023

## James Webb Space Telescope - Triumph of engineering and science

Drs. Marcia Rieke and George Rieke

Regents' Professors of Astronomy and Planetary Sciences, University of Arizona

Friday, Jan. 6, 9:00 am

JWST is a triumph of high technology, engineering and management. The University of Arizona had central roles in two of its four instruments, as a continuation of our central role in infrared astronomy. We will review this history briefly, and show the importance of JWST in the context of astronomy overall. Some of the technical features of NIRCam and MIRI will be described in more depth, and we will finish by showing off a few of the science results.

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## From Nonlinear Optics to High-Intensity Laser Physics

Dr. Donna Strickland

Professor, Department of Physics & Astronomy, University of Waterloo

Nobel Laureate, Physics 2018

Saturday, Jan. 7, 9:00 am

The laser increased the intensity of light that can be generated by orders of magnitude and thus brought about nonlinear optical interactions with matter. Chirped pulse amplification, also known as CPA, changed the intensity level by a few more orders of magnitude and helped usher in a new type of laser-matter interaction that is referred to as high-intensity laser physics. In this talk, I will discuss the differences between nonlinear optics and high-intensity laser physics. The development of CPA and why short, intense laser pulses can cut transparent material will also be included. I will also discuss future applications.

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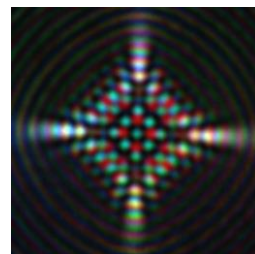
## Einstein Beams and the Optics of Gravitationally Lensed Light

Dr. Enrique J. (Kiko) Galvez

Professor, Department of Physics & Astronomy, Colgate University

Saturday, Jan. 7, 4:40 pm

One of the most interesting and puzzling features of deep sky images are the arcs and rings that appear alongside stars and galaxies. They are caused by the deflection of light from a luminous object far away, such as a quasar or galaxy, by the gravity of a foreground massive object, such as a black hole, galaxy or cluster. However, Earth observations only capture a small fraction of the deflected light. We investigated this phenomenon in the laboratory using electro-optical devices, allowing us to observe the full light beams of gravitational lensing: Einstein beams. These beams show the interference of the gravitationally deflected light, probing the wave aspect of gravitational lensing. These beams are a class in themselves, as they expand slower than Gaussian beams, exhibit self-healing and contain patterns of optical singularities that are imparted by asymmetries in the lensing mass.



## Lab Tours – Wed-Sat 2:00-3:30 pm each day

<b>Wednesday, January 4th, 2:00-3:30pm</b>		
<b>Lab name</b>	<b>Room number</b>	<b>Principal Investigator</b>
Translational optical imaging lab	664	DK Kang
Infrared Systems Group	106F	Ron Driggers
Lightweight Optics Lab	106J	Brandon Chalifoux
Polarization Lab	765, 767	Meredith Kupinski
Photonic Integrated Circuit Testing lab	207	Bob Norwood
Quantum Information and Control	568, 570	Poul Jessen
Quantum Optomechanics Lab	676	Dalziel Wilson
High contrast astronomy	584 (Steward Observatory)	Ewan Douglas
<b>Thursday, January 5th, 2:00-3:30pm</b>		
Translational optical imaging lab	664	DK Kang
Lightweight Optics Lab	106J	Brandon Chalifoux
Infrared Systems Group	106F	Ron Driggers
Polarization Lab	765, 767	Meredith Kupinski
Photonic Integrated Circuit Testing lab	207	Bob Norwood
Quantum Information and Control	568, 570	Poul Jessen
Quantum Optomechanics Lab	676	Dalziel Wilson
Theoretical Solid State Optics Group	632 (2-2:45pm)	Rolf Binder
High contrast astronomy	584 (Steward Observatory)	Ewan Douglas
<b>Friday, January 6th, 2:00-3:30pm</b>		
Translational optical imaging lab	664	DK Kang
Computational Optics	538	Miroslav Kolesik
Lightweight Optics Lab	106J	Brandon Chalifoux
Polarization Lab	765, 767	Meredith Kupinski
Soft Nano-Photonic Systems Lab	667	Euan McLeod
Photonic Integrated Circuit Testing lab	207	Bob Norwood
Quantum Information and Control	568, 570	Poul Jessen
Theoretical Solid State Optics Group	632 (2-2:45pm)	Rolf Binder
High contrast astronomy	584 (Steward Observatory)	Ewan Douglas
<b>Saturday, January 7th, 2:00-3:30pm</b>		
Translational optical imaging lab	664	DK Kang
Lightweight Optics Lab	106J	Brandon Chalifoux
Soft Nano-Photonic Systems Lab	667	Euan McLeod
Quantum Information and Control	568, 570	Poul Jessen
High contrast astronomy	584 (Steward Observatory)	Ewan Douglas

## Poster Session – Thursday, Jan. 5, 6:30 pm, The Graduate Hotel

Lily McKenna, Rochester Institute of Technology  
*Integrated Photonic Imaging with Phased Arrays*

Alexander Bartenev, University of Puerto Rico Mayaguez  
*Photoinduced dynamics of unconventional superconductor  $FeSe_{0.8}Te_{0.2}$*

Florence Binny, Vassar College  
*Picosecond Laser Ultrasonic Measurements on the Acoustic Properties of  $Bi_2Te_2Se$*

Sam Carlson, Bethel University  
*Digital Laser Locking of a Robust Optical Frequency Standard*

Zachary Erickson, Bethel University  
*Constructing an Optical Based Controls Systems Lab*

Nhi Doan, Pomona College  
*Developing an Automated Observing and Photometry System for the Table Mountain 1-Meter Telescope*

Nathan Killough, Illinois Wesleyan University  
*Light Modulating Capabilities of a Low-Cost LCD Device*

Ikumi Ellis, Arizona State University  
*Mass Distribution of neutral metal clusters recoded with Ultrafast ionization*

Tarik Cigeroglu, Colgate University  
*Rotating Optical Beams for Free-Space Communications*

Xiangqin (Wayne) Wang, Colgate University  
*Generating the polarization-entangled photon state with the highest fidelity*

Bhavana Panchumarthi, Reed College  
*Excitation of a Quantum Dot for Emission of Indistinguishable Single Photons*

Lawrence Taylor, Delaware State University  
*Synchronous Optical Pumping of Rubidium 87 Vapor for Magnetic Field Measurement*

Katie Canavan, Vassar College  
*Dynamic Optical Diffraction of *C. Elegans* Locomotion*

Zaha Shadad, Delaware State University  
*Quantum Entanglement and Violation of Bell's Inequality*



## Poster Session (continued)

Siddharth Nandanwar, University of Iowa

*Measuring Temperature-dependent Polarized Exciton-Polaritons in 1T-ReSe<sub>2</sub> flakes*

Koray Menteshoglu, UCLA

*Deep Learning Enabled Virtual Histological Staining*

Yurii Potsiluienko, University of Waterloo

*Modeling the effect of corneal birefringence on polarimetry imaging of retinal amyloid*

Francisco Hernandez, University of Central Florida

*Plasmonic Biosensor for Brain Monitoring*

Clara Hung, University of California – Berkeley

*Discretization-free, Machine Learning-Accelerated Light Simulation for Computational Imaging*

Kamal Rudra, University of Michigan

*Characterization of low-bandgap MnV<sub>2</sub>O<sub>4</sub> thin films and photodetection in IR*

Eren Ergene, Boston University

*Bulk Effect Elimination in IRIS (Interferometric Reflectance Imaging Sensor) Using Multicolor Imaging*

Justin Pijanowski, College of the Holy Cross

*Development of a Population of Digital Anthropomorphic Phantoms with Simulated Acquisitions for use in Deep Learning Improvement of DMSA Quantification and Estimation of Attenuation Maps from Emission Reconstructions in DMSA Pediatric SPECT Imaging*

# Optional Activities for Sunday, Jan. 8

Note that no meals or food will be provided by the organizers on this day.

## Option 1: 4th Avenue Adventures!

Historic 4th Avenue in Tucson is rich with history, art, and food! Join OSC students on an adventure from late morning to early afternoon!

10:00am – Meet @ Time Market (444 E University Blvd, Tucson, AZ 85705)

12:00pm – Lunch along 4th Avenue, Martins Comida Chingona (557 N 4th Ave, Tucson, AZ 85705)

1:00pm – Walking Tour of Mural Artwork in Tucson (Take off from Martins Comida Chingona)

## Option 2: Sabino Canyon Hike

Sabino Canyon Recreation Area is part of the Coronado National Forest. It is approximately 25 minutes away from the university campus, and hosts many trails:

<https://www.fs.usda.gov/recarea/coronado/recreation/recarea/?recid=75425>

Meet in the hotel lobbies at 9:45 am. A private shuttle bus will come to collect people. Estimated return time is 2:00 pm.