Optics and Photonics Winter School and Workshop (WSWS 2021)

University of Arizona

Wyant College of Optical Sciences

Tucson, Arizona

January 5, 2021 – January 7, 2021

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Optics and Photonics Winter School & Workshop 2021

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Home Page

https://wp.optics.arizona.edu/winter-school-workshop/

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Important Information for the 100% Digital WSWS Event

This year, we will run the event 100% virtually using the Zoom platform due to COVID-19 safety circumstances. The online Zoom access information is as below.

Zoom Meeting Link:
https://arizona.zoom.us/j/85824440977

Zoom Password: optics
(Note: This password will be used for all WSWS Zoom sessions.)

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Meeting ID: 858 2444 0977
Phone Access Password (if necessary): 566243

All event schedules are in Mountain Standard Time (MST).
https://www.timeanddate.com/time/zones/mst
Please, check your local time and mark your calendar accordingly.

6th Annual Optics Winter School & Workshop

Wyant College of Optical Sciences, University of Arizona

Day-1 Program

Tuesday, January 5

All times MST (AZ Time)

9:30	**Group Chats and Free-Talk with OptSci Students (on-going academic program Q&A session)**	
10:00	*Welcome*	Dean Thomas Koch
10:30	Invited Talk: *Wait! Who says we don't make eyeglasses!?*	Prof. Michael Hart
11:00	Lecture 1: *Joe Cool Introduces Optical Engineering*	Prof. Tom Milster
12:00	**Social Networking & Coffee/Tea Break Time**	
12:30	Lecture 2: *Radiation Pressure in Modern Physics*	Prof. Dalziel Wilson
1:30	**Brunch/Late-lunch/Dinner at your own**	
2:00	*The Tissue Optics Lab Tour*	Prof. Jennifer Barton
2:30	Invited Talk: *Measurement of Coherent Fields*	Prof. David Brady
3:00	Lecture 3: *Sources of Light & Color*	Prof. Euan McLeod
3:30	Lecture 3 tech demo using the pre-delivered care package kit	Prof. Euan McLeod
4:00	**End of Day for Official Programs** (on-going academic program Q&A session)	
5:00	Social Event (with Current Optical Sciences Students)	WSWS student Committee

6th Annual Optics Winter School & Workshop

Wyant College of Optical Sciences, University of Arizona

Day-2 Program

Wednesday, January 6

All times MST (AZ Time)

9:30	**Group Chats and Free-Talk with OptSci Students (on-going academic program Q&A session)**	
10:00	*UA Alumni Talk #1: from* Ball Aerospace	Dr. Benjamin Cromey
10:30	*UA Alumni Talk #2: from* Facebook	Dr. Garam Yun
11:00	*UA Alumni Panel Discussion: Careers in Optics*	Benjamin Cromey, Garam Yun, Khanh Kieu, Dae Wook Kim, Jhen Lumbres
12:00	**PhD Admission Opportunities Discussion & Coffee/Tea Break Time**	
		Prof. Brian Anderson
12:30	Lecture 4: *The Cellphone Polariscope*	Prof. Meredith Kupinski
1:00	Lecture 4 tech demo using the pre-delivered care package kit	Prof. Meredith Kupinski
1:30	**Brunch/Late-lunch/Dinner at your own**	
2:00	*Intro. To University of Rochester Program*	Prof. Scott Carney
2:30	*Intro. To University of Central Florida (CREOL) Program*	Prof. Ayman Abouraddy
3:00	Virtual Lab Tours at Wyant College of Optical Sciences	Various lab researchers
4:00	**End of Day for Official Programs** (on-going academic program Q&A session)	
5:00	Social Event (Student Only Panel Q&A)	WSWS student Committee

6th Annual Optics Winter School & Workshop

Wyant College of Optical Sciences, University of Arizona

Day-3 Program

Thursday, January 7

All times MST (AZ Time)

9:30	**Group Chats and Free-Talk with OptSci Students (on-going academic program Q&A session)**	
10:00	***Keynote Talk: Fourier Transforms and Fourier Optics Using Mathematica***	Prof. Joseph W. Goodman
11:00	*Subaru Telescope Virtual Tour and live* Q&A session with the Adaptive Optics team *(Hawaii site)*	Prof. Olivier Guyon
12:00	**Women in Optics (WiO) Spotlight & Coffee/Tea Break Time**	WSWS student Committee
12:30	*Sub-group Q&A with faculty*	*WSWS faculty committee*
1:30	**Brunch/Late-lunch/Dinner at your own**	
2:00	*Richard F. Caris Mirror Lab Tour*	Prof. Dae Wook Kim
2:30	Student Talks Competition	Participating students
4:30	Happy Hour (Bring your own food and drink)	
5:00	**Announcement of Student Talks Competition Winners & End of Winter School and Workshop**	

Abstracts – Oral Presentations

Tuesday, January 5 (Day-1)

10:00 **Prof. Thomas Koch, Dean of the Wyant College of Optical Sciences, University of Arizona**

Welcome Remarks and Introduction to the UA Program

Biography: Thomas Koch is the dean of the University of Arizona Wyant College of Optical Sciences. His research interests have focused on semiconductor optoelectronics and optical fiber communications, including photonic integrated circuits and silicon photonics. He holds 36 patents and has authored more than 335 papers and presentations, including at several SPIE conferences. Koch has nearly three decades of experience in academia and industry, having worked for Bell Labs, Lucent Technologies, and Agere Systems as well as for Lehigh University.

10:30 **Prof. Michael Hart, University of Arizona**

Title: Wait! Who says we don't make eyeglasses?!"

Abstract: You're chatting with a stranger riding on the local Tucson streetcar, back in pre-COVID days when we could do that kind of thing. They ask where you work and you tell them the University's College of Optical Sciences. "Oh," they say, "So you make eyeglasses?" Well… no. Except that, among many amazing technologies being pioneered here, some of us sort of actually do. At least, we make glasses for giant telescopes (also made here!) that help them to see through our atmosphere much more clearly than they otherwise would. I will describe some of the research that's being carried out to render the sharpest images ever made of the Universe, to look for, characterize (and maybe even visit!) possibly habitable planets orbiting other stars, and touch on other broader applications of the technology.

Biography: Michael Hart studied physics at Oxford University before taking a PhD in Astronomy at the University of Arizona, with an emphasis on optical instrumentation for high resolution imaging. His scientific specialties include adaptive optics for the dynamic compensation of optical image blur, numerical image restoration, and optical remote

sensing methods. Michael joined the University of Arizona's College of Optical Sciences in 2015. He holds several patents in the fields of remote sensing and adaptive optics. Michael is a licensed private pilot and also occasionally finds time to squeeze in some camping, woodworking, and Scottish pipe band drumming.

11:00 **Prof. Tom Milster, University of Arizona**

Title: Joe Cool Introduces Optical Engineering

Abstract: The historic figure, Joe Cool, explains what Optical Engineering is and will discuss some very cool projects in which Optical Engineering play critical roles, including searching for life in the universe, superresolution, and the amazing cell phone camera.

Biography: Dr. Milster is Professor of Optical Sciences and Electrical and Computer Engineering at the University of Arizona and has over 36 years of research experience in academia with applications in diffractive optics, spectroscopy, microscopy, lithography and data storage. His current work involves developing ultralight lenses for large space telescopes, developing adaptive optics for data storage systems, and applying vacuum ultraviolet Raman spectroscopy to the detection of pathogens, like SARS-CoV-2 (COVID-19). He has around 100 refereed publications and holds 14 patents. He is a Fellow of the Optical Society of America (OSA) and the Society of Photo-Optical Instrumentation Engineers (SPIE), and he is a Senior Member of the National Academy of Inventors.

12:30 **Prof. Dalziel Wilson, University of Arizona**

Title: Radiation Pressure in Modern Physics

Abstract: What is a weak force that everyone knows, was discovered long ago, has no practical use whatsoever, and is ubiquitous in modern physics research from quantum computing to space travel? I'll answer this question and highlight some connections to the OSC.

Biography: Dr. Wilson is an Assistant Professor of Optical Sciences and Physics at the University of Arizona. His work in cavity optomechanics, spanning a decade, includes seminal demonstrations of radiation pressure feedback cooling, quantum-limited interferometric measurement, ponderomotive light squeezing, and ultra-high-Q

nanomechanics. Previously, he was a scientist at IBM Research–Zurich, a Marie Curie Postdoctoral Fellow at EPFL, and a Ph.D. student at Caltech.

2:00 **Prof. Jennifer Barton, University of Arizona, Director of BIO5 Institute**

Title: The Tissue Optics Lab Tour

Biography: Jennifer Barton received the BS and MS degrees in electrical engineering from the University of Texas at Austin and University of California Irvine, respectively. She worked for McDonnell Douglas (now Boeing) on the Space Station program before returning to The University of Texas at Austin to obtain the Ph.D. in Biomedical Engineering. She is currently the Thomas R. Brown Distinguished Professor of Biomedical Engineering at the University of Arizona, in Tucson, Arizona, USA. She has served as Department Head of Biomedical Engineering, Associate and Interim Vice President for Research, and is currently Director of the BIO5 Institute, a collaborative research institute dedicated to solving complex biology-based problems affecting humanity.

Barton develops miniature endoscopes that combine multiple optical imaging techniques, particularly optical coherence tomography and fluorescence spectroscopy. She evaluates the suitability of these endoscopic techniques for detecting early cancer development in patients and pre-clinical models. She has a particular interest in the early detection of ovarian cancer, the most deadly gynecological malignancy. Additionally, her research into light-tissue interaction and dynamic optical properties of blood laid the groundwork for a novel therapeutic laser to treat disorders of the skin's blood vessels. She has published over 120 peer-reviewed journal papers in these research areas. She is a fellow of SPIE- the International Optics Society, and a fellow of the American Institute for Medical and Biological Engineering.

2:30 **Prof. David Brady, University of Arizona**

Title: Measurement of Coherent Fields

Abstract: Since the invention of the laser, holography has been the primary mechanism for measurement of coherent fields. Where holography is not possible, phase retrieval has been attempted. This talk presents recent work showing that both holography and phase retrieval can achieve quantum limited measurement fidelity on fields of arbitrary size. We also review recent computational algorithms for processing coherent optical signals and consider novel applications laser imaging.

Biography: Brady's research focuses on computational optical imaging. Brady led the team that built the world's first terrestrial gigapixel camera. His current research focuses on "smart cameras," using artificial intelligence to improve image data capture and formation and compressive holography. Brady' interest in neural processing extents from his Ph. D. thesis on artificial networks to his recent work on deep learning for array camera image processing. Brady is also Chief Scientist of Aqueti, which manufactures gigapixel cameras.

Biography: Professor Brady is the holder of the J.W. and H.M. Goodman Endowed Chair in Optical Sciences. He received his Bachelors degree from Macalester College in St. Paul, MN in 1984. He went on to earn Masters and PhD Degrees from the California Institute of Technology in 1986 and 1990, respectively. He was on the faculty of the Department of Electrical & computer Engineering at Duke University since 2001, before joining the University of Arizona's College of Optical Sciences in 2020. He has founded multiple companies and was recognized with the Dennis Gabor Award by the SPIE in 2013 in recognition of "his development of compressive holographic and tomographic imaging systems and for advances in the physical and information science of imaging and spectroscopy."

3:00 **Prof. Euan Mcleod, University of Arizona**

Title: <u>Sources of Light and Color</u>

Abstract: The colors of different objects can result from a wide variety of different physical mechanisms. For example, if you illuminate a white object with red and green light simultaneously, the object will look yellow, whereas if you mix red and green paint, you get a brown color. At a quantum level, color is due to the interplay of absorption, spontaneous emission, and stimulated emission of photons. These processes give rise to fluorescence, phosphorescence, and lasing, which have applications in biomedical microscopy, lighting, and laser research. At microscopic and nanoscopic scales, the composition and structure of materials can generate color due to the coherent interference of light, rather than absorption and emission processes. These concepts underpin diffractive optics, photonic crystals, and nanophotonics, which have applications in sensing, quantum optics, and tagging of biological samples. In exploring these topics, this lecture will make extensive use of the hands-on demo items that have been shipped to you.

Biography: Euan McLeod is an Assistant Professor in the College of Optical Sciences at the University of Arizona (UA) since 2015. He is also an Assistant Professor of the UA BIO5 Institute and an Affiliate Member of the UA Cancer Center. He was previously a postdoc in Electrical Engineering and Bioengineering at UCLA, as well as a postdoc in Applied Physics at Caltech. He received his Ph.D. from Princeton University and his B.S. from Caltech. Euan's background

and interests lie at the intersection of optics, nanoscience, and soft bio-materials science. He has published more than 30 papers on these topics in peer-reviewed journals, with major contributions in the areas of high-speed varifocal lenses based on acoustic modulation; lensfree holographic imaging of nanoparticles, viruses, and biomarkers; and the use of optical tweezers in fabricating micro- and nano-structured materials.

Wednesday, January 6 (Day-2)

10:00 **Dr. Benjamin Cromey, Ball Aerospace**

Title: So far so good!

Abstract: Dr. Benjamin Cromey will present on his story in the field of optics, from his padawan days first learning about optics at a week-long summer camp as a high schooler, to working at Ball Aerospace designing and analyzing optics on NASA programs as a Jedi Knight of Optics. He completed his PhD from the University of Arizona in May of 2020, where he worked for Professor Khanh Kieu on the design and applications of multiphoton microscopes. Dr. Cromey will share about his work experiences (both in industry and in research) and his volunteering efforts, and how they each helped him prepare for his future career. He will share some tips for new graduate students from his experience, as well as tips for being successful in the field of optics in general.

Biography: Benjamin Cromey is an optical engineer at Ball Aerospace in Boulder, CO, where he works in optical design and analysis for contracts on several NASA programs, as well as supporting internal research and development. He completed his PhD from the University of Arizona in May of 2020, where he worked for Professor Khanh Kieu on the design and applications of multiphoton microscopes. Dr. Cromey was very involved with SPIE and OSA as a member of SOCk, and he remains involved with the professional societies in various capacities as an early career professional. He helped teach two different courses during his time as a grad student, and was an optics ambassador for the college.

10:30 **Dr. Garam Yun, Facebook**

Title: Optical System Modeling & How Optics Education Helped My Career So Far

Abstract: Garam is going to share her career journey so far focusing on what optical system modeling is and how it connects with other engineering disciplines. She will also share briefly Optics projects currently going on at AR/VR FRL (Facebook Research Lab).

Biography: Garam is an optical engineer at Facebook's FRL, leading a team of experts who provide illumination design, stray light analysis, and AR/VR system modeling. Her team brings optical designs and system designs one step closer to reality by adding cross-talks between sub-modules and

providing system level performance predictions. Garam grew up in South Korea and received her B.S. in Physics from Seoul National University and Ph.D. in optics from the University of Arizona. She co-authored an undergraduate / graduate-level textbook titled "Polarized Light and Optical Systems" (CRC press) with Professor Russell Chipman and Wai Sze Tiffany Lam based on her Ph.D. research. Prior to Facebook, Garam worked as a LightTools developer where she learned programming while adding her optical expertise to the codebase. At Apple, she contributed to illumination designs and established an optical model of the FaceID system in LightTools

12:30 **Prof. Meredith Kupinski, University of Arizona**

Title: <u>Winter School Lecture – 4: Polarization</u>

Abstract: This interactive workshop will introduce you to your new cellphone polariscope. This gift from OSC will allow you to continue testing polarization properties after the winter school concludes. During the workshop fundamental principles of anisotropic materials will be demonstrated so that you'll be ready to conduct your own tests. Cellphone polariscope videos from current students will be shared for further inspiration.

Biography: Dr. Kupinski is Research Professor in the College of Optical Sciences, working with Professor Russell Chipman in the Polarization Laboratory at the University of Arizona. She began her education in optics at the Rochester Institute of Technology, earning her B.S. degree in 2001. She earned her Masters and Ph.D. degrees in Optical Sciences at the University of Arizona in the area of medical imaging before joining the College of Optical Sciences as a faculty member in 2008.

2:00 **Prof. Scott Carney, Director of the Institute of Optics, University of Rochester**

Title: <u>Introduction to University of Rochester Program</u>

Biography: P. Scott Carney has served as the Director of The Institute of Optics, since July 2017. He holds a PhD in Physics (1999) from the University of Rochester and a bachelor's degree in Engineering Physics (1994) from the University of Illinois Urbana-Champaign. He was faculty at ECE Illinois 2001-2017. Scott has a strong commitment to teaching excellence. He is active in the optics community primarily through the OSA as a journal editor and meeting organizer. He is an entrepreneur and co-founder of Diagnostic Photonics, Inc. Scott is primarily an applied theorist, but will

do experiments in a pinch. He considers himself a generalist, but is lately focused on problems in computed imaging, spectroscopy, and coherence theory. His major career accomplishments include modeling of tip-sample interactions in near-field microscopy and the solution of related inverse problems, solution of the inverse problem for optical coherence tomography (OCT) and the subsequent invention of interferometric synthetic aperture microscopy (ISAM) and the recent development of synthetic optical holography (SOH). He has made contributions to spectroscopy and the correction of spectroscopic data to account for the effects of scattering and propagation. In addition to ongoing interest in all of these areas, he also maintains focus on problems in nonlinear enhanced spectroscopy.

2:30 **Prof. Ayman Abouraddy, University of Central Florida (CREOL)**

Title: <u>Space-time optics and photonics: A new frontier for structured light</u>

Biography: Ayman F. Abouraddy received the B.S. and M.S. degrees from Alexandria University, Alexandria, Egypt, in 1994 and 1997, respectively, and the Ph.D. degree from Boston University, Boston, MA, in 2003, all in electrical engineering. In 2003 he joined the Massachusetts Institute of Technology (MIT), Cambridge, as a postdoctoral fellow working with Prof. Yoel Fink (Materials Science & Engineering) and Prof. John D. Joannopoulos (Physics), and then became a Research Scientist at the Research Laboratory of Electronics in 2005. At MIT he pursued research on novel multi-material optical fiber structures, photonic bandgap fibers, nanophotonics, fiber-based optoelectronic devices, and mid-infrared nonlinear fiber optics. He has also been engaged in investigating techniques that lead to sub-diffraction-limited resolution in optical microscopy and lithography. He is the coauthor of more than 65 journal publications, 130 conference presentations, and 55 invited talks; he holds seven patents, and has three patents pending. His research also encompasses quantum optics and quantum information processing. He joined CREOL, The College of Optics & Photonics, at the University of Central Florida as an assistant professor in September 2008 where he has since established facilities for fabricating new classes of polymer and soft-glass fibers for applications ranging from mid-infrared optics to solar energy concentration. He also continues to pursue his research testing the foundations of quantum mechanics and implementing optical realizations of quantum computation. He was awarded tenure and promoted to associate professor in August 2014.

3:00 **Various Lab Researchers, University of Arizona**

Title: <u>Virtual Lab Tours at Wyant College of Optical Sciences</u>

Participating Labs:
- Prof. Dongkyun Kang Lab
- Prof. Poul Jessen Lab
- Prof. Jason Jones Lab
- Prof. Hong Hua Lab (by Xuan Wang and Elliot Kwan)
- Prof. Khanh Kieu Lab "Ultrafast Fiber Lasers and Nonlinear Optics Laboratory" (by Orkhongua Batjargal)

Orkhongua Batjargal works with Prof. Khanh Kieu on the research of developing ultrashort pulse fiber lasers for several different applications. In this lab tour, she will discuss ultrashort pulse fiber lasers, why it is important, its working mechanism and some of its applications while going through a live demo on my current research projects in the lab.

Thursday, January 7 (Day-3)

10:00 **Prof. Joseph W. Goodman, Stanford University**

Title: <u>Fourier Transforms and Fourier Optics Using Mathematica</u>

Abstract: In a time of COVID-19, many laboratories are closed and access to experimental facilities is quite limited. Likewise, classrooms remain unoccupied due to limitations on crowd gathering. Classroom lab demos are gone. In the absence of laboratories, the savior for research is SIMULATION. Home computers are fast enough to provide rapid tools for teaching and research. While most students choose to use Matlab, my preferences lead me to Mathematica, due to its seamless ability to mingle continuous and discrete math. Here I will first consider illustrations drawn from the theory of Fourier transforms. Then I will turn to illustrations drawn from the field of Fourier optics.

Biography: Joseph W. Goodman received the A.B. Degree in Engineering and Applied Physics from Harvard University in 1958, and the M.S. and Ph.D. degrees in Electrical Engineering from Stanford University in 1960 and 1963, respectively. Goodman joined the faculty of the Department of Electrical Engineering at Stanford University in 1967. He chaired the department from 1989 to 1996, and then served as senior associate dean of engineering until 2000. He retired from Stanford in 2001. He is the author of the Introduction to Fourier Optics (now in its 4th edition), Statistical Optics (now in its 2nd edition), Speckle Phenomena in Optics (now in its 2nd edition), and co-author of Fourier Transforms: An Introduction for Engineers. His most recent book Fourier Transforms Using Mathematica was published in late 2020. Goodman has received numerous awards from the IEEE, the ASEE, OSA, and SPIE, including the highest awards given by the latter two societies. He was elected a member of the National Academy of Engineering and the American Academy of Arts and Sciences. He was a co-founder of Optivision, Inc., ONI Systems, Nanoprecision Products, Inc., and Roberts & Company Publishers, and served as a member of the Board of Directors of Optivision, ONI Systems, E-TEK Dynamics, and Ondax Inc. Goodman and his wife Honmai are active in philanthropy, including donation of the naming gifts for the Goodman Surgical Simulation Center, the Goodman Immersive Learning Center in the Stanford School of Medicine and Graduate fellowships and named professorships at both Stanford and the University of Arizona.

11:00 **Prof. Olivier Guyon with Adaptive Optics Team, Subaru Observatory & University of Arizona**

Title: <u>Subaru Telescope virtual tour, Q&A with the Adaptive Optics team</u>

Abstract: The Subaru Telescope, at 8.2m diameter, is one of the largest telescopes currently in operation. Thanks to its location in Hawaii atop Maunakea (elevation 4200m) and its adaptive optics system, it delivers sharp diffraction-limited images from in visible and near-infrared. Subaru's adaptive optics team will provide a virtual tour of the telescope and its instruments, and describe latest developments in adaptive optics.

Adaptive Optics Team Biography:

Olivier Guyon: Dr Guyon is an astronomer at the Subaru Telescope and the University of Arizona. He develops new techniques for imaging exoplanets (planets around other stars) from telescopes on Earth and also future telescopes in space. With these new techniques, astronomers will soon be able to observe planets like ours orbiting nearby stars and search for signs of biological activity in their atmospheres and on their surfaces.

Sebastien Vievard: Dr Vievard is an instrument scientist at the Subaru Telescope. He works on instrumentation to study circumstellar environments (search/characterization of exoplanets, stellar binaries or protoplanets). He also develops new methods to improve the image quality on ground-based and/or future space-based telescopes.

Vincent Deo: Dr Deo is a postdoc who joined the Subaru Telescope Extreme Adaptive Optics System (SCExAO) project from March 2020. His main area of interest is adaptive optics, with a strong focus on novel wavefront sensing and control techniques. He works on improving the image sharpness and contrast depth delivered by SCExAO.

Julien Lozi: Dr. Lozi is a senior scientist at the Subaru Telescope. He joined the SCExAO project in October 2014. He is in charge of maintaining and upgrading the hardware inside the instrument, as well as Python interfaces aimed at optimizing observations and collaborations. His area of interest is wavefront sensing, vibration corrections and instrumental characterizations.

Kyohoon Ahn: Dr Ahn is a postdoc who joined the Subaru Telescope Extreme Adaptive Optics System (SCExAO) project from January 2021. His main area of interest is adaptive optics. To find the planets like Earth, he supports adaptive optics wavefront sensing and control technology prototyping and validation in close coordination with internal collaborators. He also develops and implements real-time wavefront control on the SCExAO instrument.

2:00 **Prof. Dae Wook Kim, University of Arizona**

Title: Richard F. Caris Mirror Lab virtual tour and Q&A session

Abstract: Next generation space and ground based astronomical optics are bringing about exciting developments in our scientific understanding of the Universe in which we live. Over 1,000 tons giant astronomical telescope systems coupling diffraction-limited spatial resolution with unprecedented photon collection power will be one of the most powerful scientific investigation tools. Their primary optics, 25m Giant Magellan Telescope, 8.4m Large Synoptic Survey Telescope, and 4.2m Daniel K. Inouye Solar Telescope, have been nano-manufactured at the University of Arizona. Those precision optics were efficiently fabricated using a computer controlled optical surfacing (CCOS) technology. Also, to build the next generation of large optics, new freeform design/metrology methods and tools have been developed. Various new approaches advancing the current CCOS processes have been developed and implemented to manufacture highly aspheric or free-form optics at the Richard F. Caris Mirror Lab (RFCML), Optical Engineering and Fabrication Facility (OEFF) and the Large Optics Fabrication and Testing (LOFT) group at the University of Arizona. Various exciting technologies including Silly-Putty lap using non-Newtonian fluid, visible deflectometry (a.k.a. SCOTS), IR deflectometry using a hot wire, and precision freeform metrology using an iPhone are presented with some actual data demonstrating the exceptional performance of the precision optics manufacturing process. Finally, we can "time-travel" using the priceless mirrors.

Biography: Dae Wook Kim is an assistant professor of optical sciences and astronomy at the University of Arizona. He has been working in the field of optical engineering for more than 10 years, mainly focusing on very large precision optics, such as the 25 m diameter Giant Magellan Telescope primary mirrors. His research area spans precision freeform optics fabrication and various metrology options, such as interferometric test systems using computer-generated holograms, direct curvature measurements, and dynamic deflectometry systems. He is the chair of SPIE's Optical Manufacturing and Testing conference, SPIE's

Astronomical Optics: Design, Manufacture, and Test of Space and Ground Systems conference, and OSA's Optical Fabrication and Testing conference. He has published over 130 journals/conference papers. He is a SPIE fellow and a senior member of OSA, and served as an associate editor of OSA's Optics Express journal.

Student Talks Competition (2:30 – 4:30 pm MST, 1/7)

Important note: This session includes 15 pre-recorded student presentations. There will be a live Q&A time with the presenting student after each presentation. All presenting speakers must be online during the Zoom session in order to answer the Q&A session after their own presentations.

After the Student Talks Competition session, the best presentation will be selected with an Apple iPad award. Also, the best student's question during the Q&A session will be selected with an Optical Sciences hat award.

Talk 1 - "Recovery of Removed Text on Palimpsests," Zoe LaLena, Rochester Institute of Technology

Talk 2 - "Protected Mirrors and Miniature Spectrometers for Space," Gabriel Richardson, Brigham Young University

Talk 3 - "Optical Metrology Laboratory," Andy Bradfield, Northern Arizona University

Talk 4 - "Digital Plasmonic Holography with Iterative Phase Retrieval for Sensing," Grace Cole and Nathan Lindquist, Bethel University

Talk 5 - "A Fourier Processor for Partially Coherent Fields," Benjamin Nussbaum, S. A. Wadood, and A. N. Vamivakas, University of Rochester

Talk 6 - "Single-Shot Digital Phase-Shifting Moiré Patterns for 3D Topography," Haiyun Guo and Partha Banerjee, University of Dayton

Talk 7 - "Classifying Laguerre-Gaussian Optical Modes," Sofia Brown, College of William and Mary

Talk 8 - "Carrier Frequency Interferometer for Stress Measurements in Optical Coatings," Skylar Dannhoff, Ela Jankowska, and Carmen Menoni, Case Western Reserve University

Talk 9 - "Quantitative Image Processing," Valeria Viteri-Pflucker, Xiaotian Fang, Tae-Hoon Kim, and Lin Zhou, Illinois Wesleyan University

Talk 10 - "Continuum Percolation of Disks with Correlated Positions," Diego Garcia, California State Polytechnic University, Pomona

Talk 11 - "Investigating Magnetic Nanocolloids Using Shadowgraphy," David Dorf, Patrick Simonson, Sorinel Oprison, and Ana Oprison, College of Charleston

Talk 12 - "High-Speed Single Molecule Surface-Enhanced Raman Spectroscopy," Britta Nordberg, Bethel University

Talk 13 - “Momentum-Resolved Photoluminescence,” Jaclyn John and John Schaibley, University of Arizona

Talk 14 - “Automated Laser Tuning for Magneto-Optical Trap,” Jake Mandel, Jordan Churi, Anya Houk, and Kat Gillen California State Polytechnic University, San Luis Obispo

Talk 15 - “Trapping Lanthanum Ions,” Rahul Shrestha, Denison University

Talk 16 - “Optical Atomic Clock: Two-Photon Transition in Rubidium,” River Beard and Nathan Lemke, Bethel University

Academic Program Q&A sessions over Zoom: Graduate Studies at the Wyant College of Optical Sciences

Note: All of these meetings will be held at https://arizona.zoom.us/j/9670089691, password: optics. Note that this is not the same zoom channel as for the regular Winter School events.

Please feel free to join Optical Sciences Prof. Brian Anderson, Associate Dean for Graduate Academic Affairs, for informal discussions about graduate studies at the Wyant College of Optical Sciences and about applying to our PhD and MS programs. We can discuss

- Application fee waivers for Winter School attendees (your application fee will be waived!)

- Extended PhD application deadline for Winter School attendees (you may take an extra week to complete your application!)

- Application requirements

- PhD and MS program requirements

- Anything else that is on your mind regarding graduate school at the Wyant College of Optical Sciences!

The following times are set aside for these informal Q&A sessions. You are welcome to join and leave as best suits your schedule and needs.

Tuesday, Jan 5

* 1:30-2pm
* 4-5pm

Wednesday, Jan 6

* 1:30-2pm
* 4-5pm

Thursday, Jan 7

* 8:30-10am
* 12:30-2pm

Also, one-on-one meetings outside of these times or after the conclusion of the Winter School are also possible! Schedule a time to talk by sending email to Brian at: bpa@optics.arizona.edu