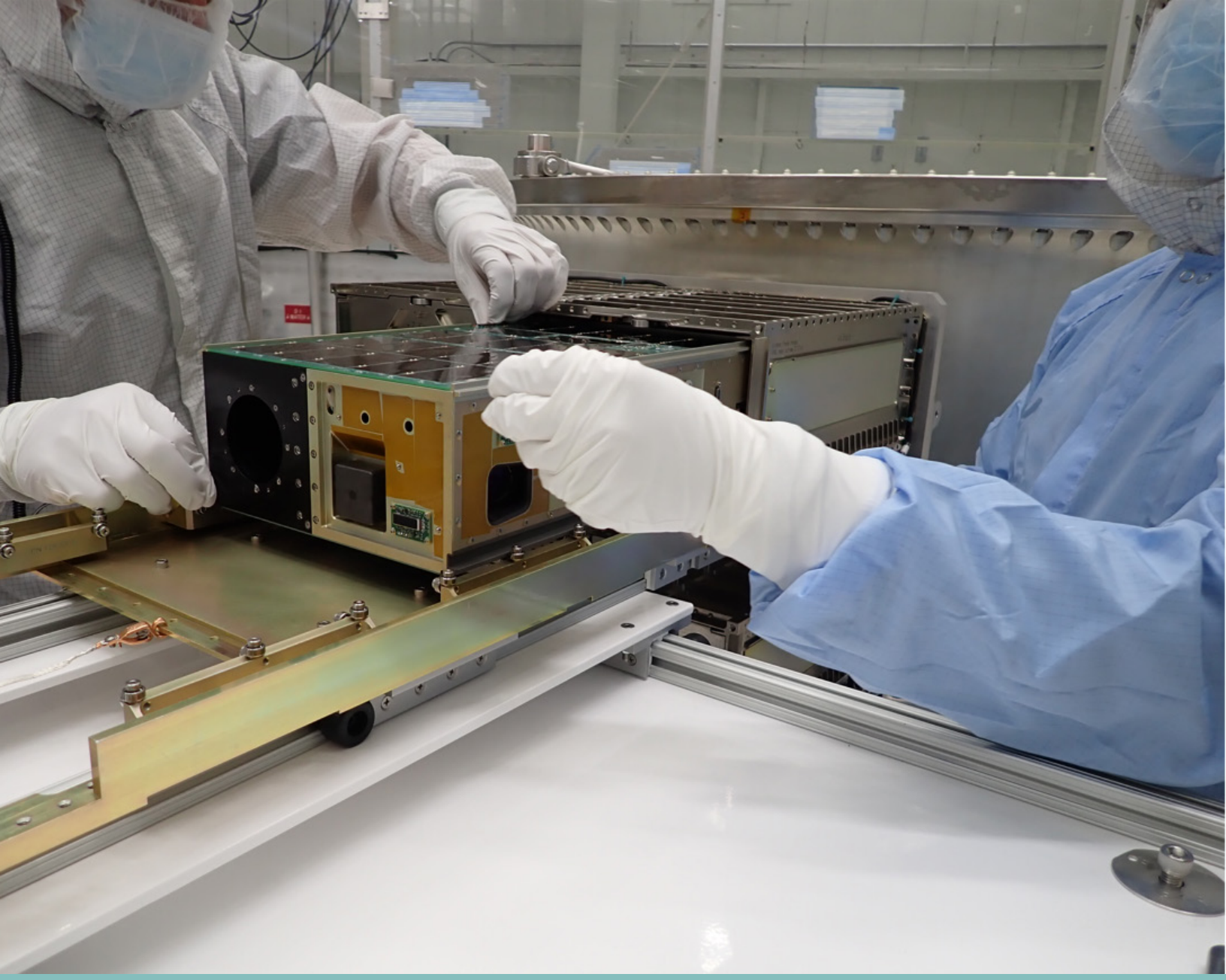
Boston University Photonics Center

Annual Report | 2021

BOSTON UNIVERSITY



Rousseau Nutter (MS '20) and Emil Atz (PhD '22) install the CuPID Cubesat into the deployer for launch in September 2021. (Photo Courtesy of Assistant Professor Brian Walsh)

(Front Cover: A photo of the BU Photonics Center. Photo Credit: Christopher Mcintosh)

LETTER FROM THE DIRECTOR

AS THE PHOTONICS CENTER marked its twenty-fifth year of operation in 2021, **its prominence as a pillar of academic strength at Boston University was never more evident**. Our cohesive community continues to excel in the pursuit of interdisciplinary research, serving as a university model for creative scholarly achievement, external grant support, business innovation, and training of students at all levels.

This annual report summarizes activities of the Photonics Center for the 2020-2021 academic year. In it, you will find quantitative and descriptive information regarding our photonics programs in research, education, and technology development. Over the past year the income from grants that were awarded to Photonics Center faculty **totaled more than $37M for the second year in a row, more than doubling that metric from six years ago**. This sustained increase is due in large measure to the leadership of an extraordinary cohort of **distinguished and collaborative faculty**. We are fortunate to count among them the pioneering neurophotonics scientist **David Boas**, the prolific microsystems physicist **David Bishop**, the innovative optical biosensing chemist **Ji-Xin Cheng**, the creative computational optoelectronics modeler **Enrico Bellotti**, the unparalleled engineering designer **Xin Zhang**, and too many other leading academic scholars to list here.

Located at the heart of Boston University's urban campus, the Photonics Center is an interdisciplinary hub for education, research, scholarship, innovation, and technology development associated with practical uses of light. Our nine-story building houses world-class research facilities and shared laboratories dedicated to photonics research and sustains the work of 53 active (and 7 emeritus) faculty members, 15 staff members, and more than 100 graduate students and postdoctoral fellows.

As a leading Boston University institution, the Photonics Center has adopted a mission to help to establish and support newer research centers and university initiatives in allied fields. **We routinely provide critical resources, infrastructure, and support for the creation of new units** such as the Neurophotonics Center and the Materials Science and Engineering Division, and **we help win and manage a portfolio of major research and training grants** that have catalyzed transformative growth in prominent allied research programs such as the Biological Design Center, the Precision Diagnostics Center, and the Center for Systems Neuroscience. Our Business Innovation Center, which has always been a hub for industry engagement at Boston University, currently houses an all-time high of sixteen tenants, including many BU spinouts and strategic optics/photonics industry partners.

This year, the Photonics Center has continued to help win and administer a portfolio of large, complex, multi-university interdisciplinary grants that leverage our substantial potential for societal impact through optics and photonics innovation. We have also launched several new programs that will lay the foundation for our next strategic plan. These include enhancements to our programs for graduate student recruitment, research and training grant support, doctoral student professional development, promotion of diversity, K-12 outreach, technology development, and shared facilities.

As I end my 15th year as Director, I could not be prouder of the achievements of the Photonics Center's faculty, staff, and students, nor could I be more optimistic about their promise for the future.

Thomas Bifano, Director

As the Photonics Center marked its 25th year of operation in 2021, its prominence as a pillar of academic strength at Boston University was never more evident.

3 | By the Numbers

5 | Highlights of FY21

9 | Researcher Spotlight

10 | Faculty Journal and Photonics Articles

11 | Mission Statement

17 | Major Research Projects

21 | Business Innovation Center & Industry Engagement

27 | Events and Programs

29 | Shared Facilities for Research

32 | Strategic Goals

33 | Scholarly Work of the Photonics Center Faculty

46 | Faculty List

50 | Faculty Committees

51 | Ph.D. Graduates and Their Dissertation Titles

52 | Leadership and Staff

55 | List of Awarded Grants

Boston University Photonics Center Annual Report 2021

BU Innovator of the Year: Professor Jerome Mertz

11

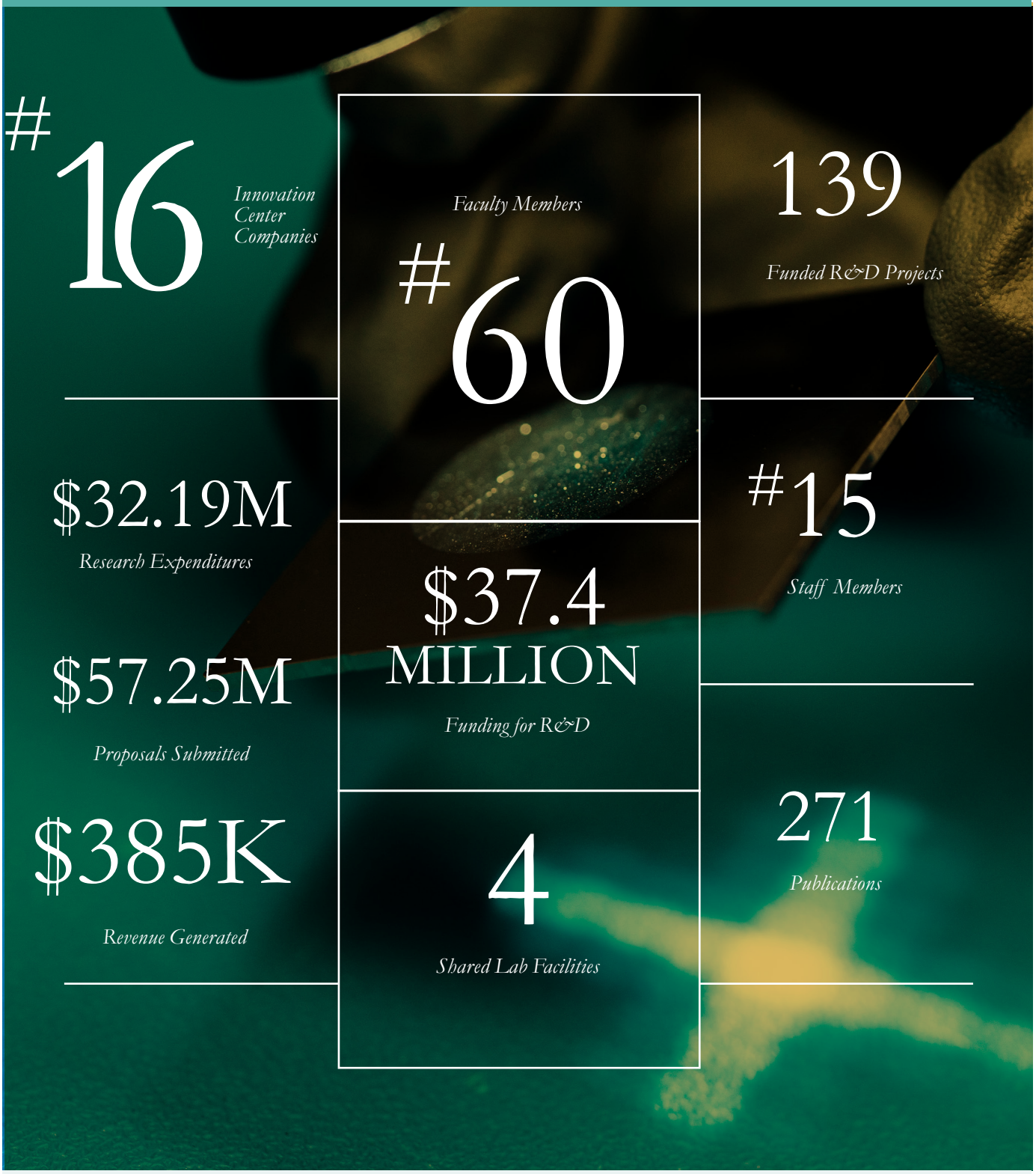
Professor Andre Sharon Develops and Donates Thousands of Masks

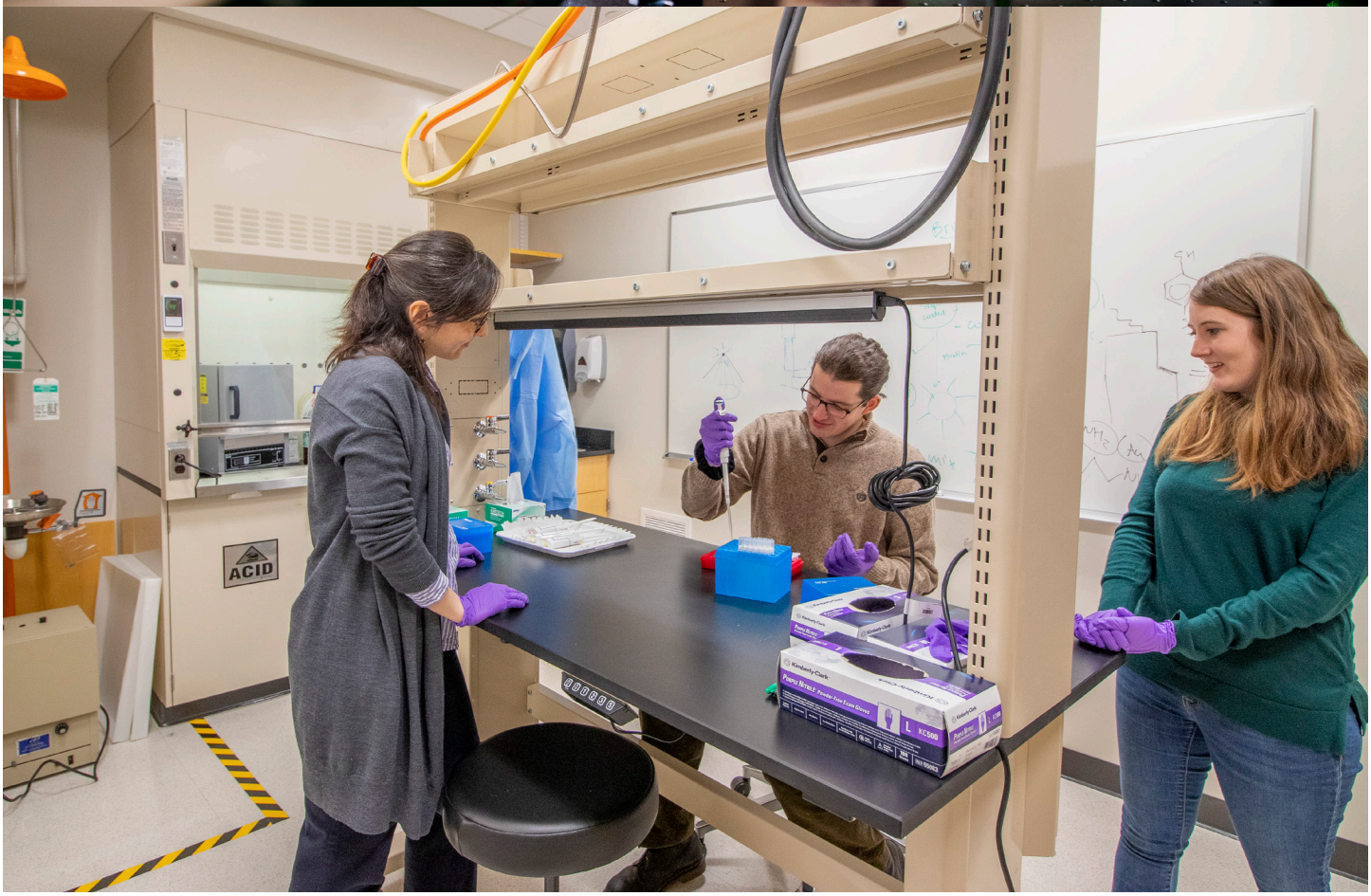
14

Major Photonics Center Research Projects

17

PHOTONICS CENTER BY THE NUMBERS FY21





These photos were taken in the labs of Assistant Professors Xi Ling and Maria Kamenetska. (Photo Credit: Christopher Mcintosh.)

HIGHLIGHTS OF FY2021

CELL-MET Engineering Research Center

Our prominent interdisciplinary research project on cellular metamaterials (CELL-MET) supported by the National Science Foundation (NSF) and administered by the Photonics Center has advanced markedly toward its ten-year goal of creating functional heart tissue for cardiac repair. Recent technical achievements include substantial progress in tissue maturation, scaffold engineering, action-potential imaging, and image-based contractility control. In addition to technical activity, CELL-MET has catalyzed a transformation in the Photonics Center's programs for promoting broader impacts that include initiatives in workforce development, diversity and inclusion, and innovation.

Photonics Center faculty and staff continue to play a prominent role in all aspects of the ERC, led by Professor David Bishop. Thomas Bifano, Photonics Center Director, leads the Imaging Thrust; Cara Ellis McCarthy, Director for Finance, Administration & Personnel Management, serves as Administrative Director. Thomas Dudley, Director of Technical & Industry Programs, leads the Innovation Thrust. Helen Fawcett, Director of Operations and Program Management, is the Director of Student Engagement, and manages ERC safety training. Cynthia Kowal is Team Associate and manages budgets, compliance, and supplemental programs for the ERC. Photonics Center staff members Nozomi Ito, Administrative Manager, and Akeem Chambers, Administrative Coordinator, are fully dedicated to the ERC. Partners in CELL-MET include University of Michigan (UM), Florida International University (FIU), Harvard University, Harvard/Wyss Institute, Columbia University, North Carolina State University, Fort Valley State University, and Nueta Hidatsa Sahnish College.

Doctoral Training Program in Neurophotonics

The Photonics Center's prestigious NSF Research Traineeship Program: Understanding the Brain: Neurophotonics (NRT) for doctoral students in neurophotonics entered its final year of operation this year. This program has supported 21 doctoral fellowships and an additional 77 trainees with $3M in support from NSF. The program is notable for having exceeded all proposed targets for support of fellowship awardee diversity.

Led by Thomas Bifano (PI) and Helen Fawcett (Program Coordinator), the NRT's thriving student-centered focus on skills development, student-led symposia, career planning, interdisciplinary research, and active mentoring and sponsorship have become a model for interdisciplinary graduate community building at BU. The program will be sustained in a joint venture between the Photonics Center and the Neurophotonics Center, led by Professor David Boas.

Photonics Center Grant Support

In yet another excellent year for new external grant support, the Photonics Center faculty were awarded more than $37M in new funding. Photonics Center faculty annual grant income has risen steadily to a level that is more than double what it was six years ago. Highlights among this year's new awards include:

- *Nanosystems Engineering Research Center for Directed Multiscale Assembly of Cellular Metamaterials with Nanoscale Precision: CELL-MET*, a five year, $20M NSF ERC award ($5.15M funding this year) led by Professor David Bishop.
- *The Neuroscience of Everyday World – A Novel Wearable System for Continuous*

Measurement of Brain Function, a five year, $5.9M NIH U01 award ($1.24M funding this year) led by Professor David Boas.

- *Computationally-guided Design of Energy Efficient Electronic Materials*, a five year, $4.3M DoD award ($506K funding this year), led by Professor Enrico Bellotti.
- *CuPID Cubesat Observatory*, a NASA satellite program, $2.2M ($593K funding this year), led by Assistant Professor Brian Walsh.
- *Multidimensional Optimization of Voltage Indicators for In Vivo Neural Activity Imaging*, a five-year, $3.4M NIH award ($707K funding this year), led by Associate Professor Xue Han.
- *Local Neuronal Drive and Neuromodulatory Control*, a five year, $13.9M NIH U19 award ($2.7M in its first year), led by Associate Professor Anna Devor.

Research Summer Programs

Boston University Photonics Center's on-site summer research experience program in 2021 was far and away the largest, most successful, and most diverse that we have ever hosted. Our 2021 cohort consisted of 46 participants, including 11 Teachers in our NSF-sponsored *Research Experiences for Teachers* (RET) program, 11 undergraduates in our NSF-sponsored *Research Experiences for Undergraduates* (REU) program, 12 undergraduates in our *CELL-MET REU* program, 9 undergraduates in our NSF-sponsored *Research Experiences and Mentoring* (REM) program, and 3 undergraduates from leading undergraduate optics and photonics programs in our self-funded *Photonics Center Undergraduate Research Summer Experience* (PURSUE).

The Photonics Center's primary aim for all our summer programs is to provide immersive interdisciplinary research experiences that promote graduate study in our field by talented students from diverse backgrounds, filling an important graduate recruitment pipeline. This year's cohort included 28% Black participants, 22% Asian participants, 22% White participants, 15% Native American participants, and 13% Hispanic participants. Women made up 57% of the participants, and people with disabilities made up 7% of the participants.

Four New Faculty Members

The Photonics Center welcomed four new faculty members: Associate Professor *Ian Davison*, Biology, whose work focuses on neural circuits underlying perception and behavior in olfaction; Assistant Professor *Michael Economo*, Biomedical Engineering, whose work focuses on systems neuroscience, motor control, long-range neural circuits, computational neuroscience, and neurotechnology; Assistant Professor *Abdoulaye Ndao*, Electrical and Computer Engineering, whose work focuses on science, nanomaterial/structure design, and prototype device development in both passive and active photonic devices; and Assistant Professor *Michael Albro,* Mechanical

Photonics Center Professor Catherine Klapperich Leads BU COVID Testing

In a year that was dominated by the COVID-19 pandemic, Boston University was fortunate to have an extraordinarily effective virus testing program. This program, created and led by Photonics Center Professor Catherine Klapperich, distinguished BU from many of its peers and was a key factor in the University's capacity to remain open and active. Professor Klapperich's work included designing and building a robot-assisted testing lab and implementing technical programs to manage more than a million COVID-19 tests for the BU community. As a long-time academic leader in the field of point-of-care diagnostics Professor Klapperich managed this challenging problem with remarkable skill, professionalism, and success. In one of many acknowledgements of her achievements in this arena, the *Boston Business Journal* named Professor Klapperich one of Boston's *50 most extraordinary people*, "whose influence, innovation, commitment, and courage are making a difference in the community during an extraordinary time."

Faculty Awards and Distinctions

Among many distinctions and honors bestowed upon Photonics Center faculty for their scholarly and academic achievements some highlights include:

- Assistant Professor *Xi Ling* was awarded an NSF Career Award to support her work on chemical sensing techniques using interactions between light and matter.
- Emeritus Professor *Ted Moustakas* was elected a Fellow Member of the OSA. Professor Moustakas was honored for his seminal, sustained contributions to optical materials and devices, particularly in nitride semiconductors.
- Professor *Catherine Klapperich* was named a Fellow of the AAAS for extraordinary achievements in her field.
- Professor *Jerome Mertz* Named Boston University's 2020 Innovator of the Year.
- Assistant Professor *Lei Tian* received the 2021 Early Career Excellence in Research Award from the BU College of Engineering, which celebrates junior faculty with exceptional research accomplishments.
- Assistant Professor *Steve Ramirez* received the 2021 BU Metcalf Cup and Prize, which is the University's highest teaching award.
- Professor *Irving Bigio* was awarded the 2020 Joseph W. Goodman Book Writing Award from OSA & SPIE.
- Associate Professor *Keith Brown* was awarded the Frontiers of Materials Award from the TMS The Minerals Metals and Materials Society.
- Professor *Ji-Xin Cheng* was awarded the 2-2 Microscopy Today Innovation Award from Microscopy Today; he also received the 2020 Pittsburg Spectroscopy Award from the Spectroscopy Society of Pittsburgh; and he received the 2020 MIRA award from NIGMS/NIH.
- Assistant Professor *Allison Dennis* was named the 2020 SPIE Community Champion.
- Assistant Professor *Xi Ling* received the 2020 BU Ignition Award and the 2020 NSF Career Award.
- Professor *Anna Swan* received the 2020 Nottingham Prize from the 78th Physical Electronics Conference at Lawrence Berkeley National Laboratory in Berkley, CA.
- Professor *Selim Unlu* was named AIMBE Fellow from the American Institute for Medical and Biological Engineering.

Faculty Scholarly Works

Scholarship by Photonics Center faculty included 271 publications of prominent articles in high-impact journals. Some highlights of this body of work include the following articles:

- Sengupta, P., & **Bellotti, E.** (2020). Anomalous Lorenz Number in Massive and Tilted Dirac Systems. *Applied Physics Letters*, 117(22), 223103.
- Beaulieu, D., **Davison, I.**, Kılıç, K, **Bifano, T.**, **Mertz, J.**, (2020). Simultaneous Multiplane Imaging with Reverberation Multiphoton Microscopy. *Nature Methods*, 17(3), 283-286.
- Barrett, L., Lally, R., Fuhr, N., Stange, A., & **Bishop, D.** (2020). A Chip-Scale, Low Cost PVD System. *Journal of Microelectromechanical Systems*, 29(6), 1547-1555.
- Yang, J., Chen, I. A., Chang, S., Tang, J., Lee, B., Kılıç, K., . . . **Boas, D.** (2020). Improving the Characterization of ex vivo Human Brain Optical Properties Using High Numerical Aperture Optical Coherence Tomography by Spatially Constraining the Confocal Parameters. *Neurophotonics*, 7(4), 045005.
- Jiang, Y., Lee, H. J., Lan, L., Tseng, H., Yang, C., Man, H., **Han, X**.. . . *Cheng, J.* (2020). Optoacoustic Brain Stimulation at Submillimeter Spatial Precision. *Nature Communications*, 11(1), 881.
- Chen, Y., Britton, W., & **Dal Negro, L.** (2020). Design of Infrared Microspectrometer Based on Phase-modulated Axilenses. *Applied Optics*, 59(18), 5532.
- Piatkevich, K., Bensussen, S., Tseng, H.., Shroff, S., Lopez-Huerta, V., Park, D., **Han, X.** (2019). Population Imaging of Neural Activity in Awake Behaving Mice. *Nature*, 574(7778), 413-417.
- Kogos, L. C., Li, Y., Liu, J., Li, Y., **Tian, L.**, & **Paiella, R.** (2020). Plasmonic Ommatidia for Lensless Compound-eye Vision. *Nature Communications*, 11, 1-9.
- Dostart, N., Zhang, B., Khilo, A., Brand, M., Al Qubaisi, K., Onural, D., **Popović, M.** (2020). Serpentine

Optical Phased Arrays for Scalable Integrated Photonic Lidar Beam Steering. *Optica*, 7(6), 726.

- Greenberg, A., Prabhakar, G., & **Ramachandran, S.** (2020). High Resolution Spectral Metrology Leveraging Topologically Enhanced Optical Activity in Fibers. *Nat Commun*, 11(1), 5257.
- Leblanc, H., & **Ramirez, S.** (2020). Linking Social Cognition to Learning and Memory. *J Neurosci*, 40(46), 8782-8798.
- Gramolin, A., Aybas, D., Johnson, D., Adam, J., & **Sushkov, A.** (2021). Search for Xxion-like Dark Matter with Ferromagnets. *Nature Physics*, 17(1), 79-84.
- Zhao, X., Chen, C., Kaj, K., Hammock, I., Huang, Y., Averitt, R., & **Zhang, X.** (2020). Terahertz Investigation of Bound States in the Continuum of Metallic Metasurfaces. *Optica*, 7(11), 1548.

Assistant Professor Abdoulaye Ndao

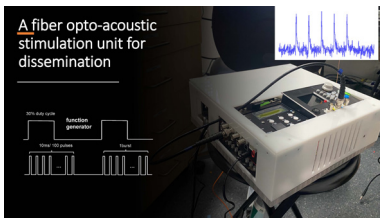
Assistant Professor Abdoulaye Ndao has an appointment in the Electrical and Computer Engineering department and received his Master's and Ph.D. degrees in Physics from the University of Franche Comte. He was subsequently a postdoctoral researcher at UC San Diego and UC Berkeley. His research interests span wide-ranging topics in photonics, material sciences, and physics.

Professor Abdoulaye Ndao's group focuses on interdisciplinary research in physics, engineering, optics, applied physics and quantum optics. Their research involves fundamental science, nanomaterial/structure design, and prototype device development in passive and active devices.

His team includes the postdoctoral researcher Liyi Hsu, and three graduate students, Joengho Ha, Guang Yang, and Purva Bhumkar. To collaborate or for further information, please contact Assistant Professor Ndao at: andao@bu.edu.

(Photo Credit: Christopher Mcintosh)

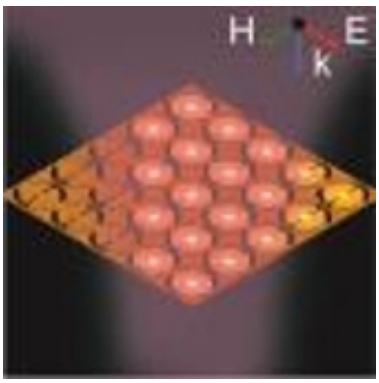
Faculty Journal Articles



- Jiang, Y., Lee, H. J., Lan, L., Tseng, H., **Yang, C.**, Man, H., **Han, X.**. . . **Cheng, J.** (2020). Optoacoustic Brain Stimulation at Submillimeter Spatial Precision. *Nature Communnications*, 11(1), 881.

  Funded by a Brain Initiative R01 grant to Boston University.

Low-intensity ultrasound is an emerging modality for neuromodulation. Yet, transcranial neuromodulation using low-frequency piezo-based transducers offers poor spatial confinement of excitation volume, often bigger than a few millimeters in diameter. In addition, the bulky size limits their implementation in a wearable setting and prevents integration with other experimental modalities. In this work, the authors report spatially confined optoacoustic neural stimulation through a miniaturized Fiber-Optoacoustic Converter (FOC). The FOC has a diameter of 600 μm and generates omnidirectional ultrasound wave locally at the fiber tip through the optoacoustic effect. The authors show that the acoustic wave generated by FOC can directly activate individual cultured neurons and generate intracellular Ca2+ transients. The FOC activates neurons within a radius of 500 μm around the fiber tip, delivering superior spatial resolution over conventional piezo-based low-frequency transducers. Finally, they demonstrate direct and spatially confined neural stimulation of mouse brain and modulation of motor activity in vivo.



- Zhao, X., Chen, C., Kaj, K., Hammock, I., Huang, Y., Averitt, R., & **Zhang, X.** (2020). Terahertz Investigation of Bound States in the Continuum of Metallic Metasurfaces. *Optica*, 7(11), 1548.

The concept of "bound states in the continuum" (BIC) describes an idealized physical system exhibiting zero radiative loss composed, for example, of an infinitely extended array of resonators. In principle, vanishing of radiative losses enables an infinitely high-quality factor and corresponding infinite lifetime of the resonance. As such, BIC inspired metasurfaces and photonic designs aim to achieve superior performance in various applications including sensing and lasing. The authors describe an analytical model based on temporal coupled mode theory to realize an "accidental" (i.e., parameter-tuned) Friedrich–Wintgen BIC. Further, we experimentally verify this model with measurements of quasi-BICs in a metallic terahertz metasurface (MS) and the corresponding complementary metasurface (CMS) using terahertz time domain spectroscopy. For the MS and CMS structures, quality factors of 20 are achieved, limited by non-radiative intrinsic loss in the materials. Their results reveal that Babinet's principle qualitatively holds for the MS and CMS quasi-BIC structures. In addition, ultra-high electric and magnetic field enhancement MS and CMS structures, respectively, are presented.

BU OPTICAL PIONEER JEROME MERTZ IS BU'S 2020 INNOVATOR OF THE YEAR

ENG professor is a prolific inventor whose innovations have made leaps and bounds in microscopy

by Kat J. McAlpine

Photo by Zalman Zabarsky

Jerome Mertz, a Boston University College of Engineering professor of biomedical engineering and of electrical and computer engineering and a BU College of Arts & Sciences professor of physics, holds six issued patents for technologies that have greatly advanced microscopic imaging quality and capabilities. Some of his inventions—he's disclosed 22 new ones during his time so far at BU—have made it easier and faster to get better images of thick breast, heart, and brain tissue, more clearly illuminating for clinicians what is happening inside the human body. Other technologies invented by Mertz have sped up microscopic imaging processes of tissues or other materials by up to 16 or 20 times faster. For his pioneering work, he's been named BU's 2020 Innovator of the Year, an honor bestowed annually by BU's Office of Technology Development. The Brink reached out to Mertz to learn more about his passion for microscopy and how he gets ideas for his inventions.

Q&A WITH JEROME MERTZ

The Brink: How did you first get so interested in optics and microscopy? What drew you to the world of technology that allows humans to see what the naked eye cannot?

Mertz: Both my parents were trained in optics, and so there were optics books all over the house when I grew up. It was pretty inevitable. As for why microscopy in particular, my dad was an astronomer and liked to look at small things through a telescope. I just settled with looking at small things through a microscope.

Can you describe your innovation process? Where do you get inspiration for designing new optical technologies?

Honestly, it's pretty random. It usually comes from following up on something I don't understand, meaning there's a lot to follow up on.

Is there an invention that you're particularly proud of? If so, why? What problem did it solve and how did solving that problem improve our understanding of biology (or something else)?

I can't say I'm more proud of any one invention over another. In fact, the invention itself is usually a letdown, and I rarely think about it when it's over. It's the process of getting there that's interesting to me.

As for improving our understanding of biology, most of what I've worked on is the development of [better imaging] tools. For example, biologists no longer settle for simple 2D images of their samples. They want 3D volumetric images, in thick tissue and at high speeds. These are some of the tools my lab has been developing.

What challenges in optics or microscopy are you currently working on solving?

Right now, my favorite challenge is translating what I know in optics into ultrasound imaging, which I've never worked on before. It's great. I feel like a kid in a toy store. I have to thank Tom Bifano and the BU Photonics Center for that possibility.

For early career scientists with dreams of translating new technologies out of the lab, what advice do you have for them? What is the key to

staying creative and identifying solutions that will attract commercial interest?

I could say something trite about following your dream, but I won't. The truth is much more prosaic. The key to being creative is to have a deep understanding of what you're working on to the point that it becomes intuitive. Without intuition, there can be no creativity. And unfortunately, at least for me, the intuition comes only after a lot of hard work. There's no cutting corners.

When you aren't in the lab, how do you enjoy spending your time? What are some of your favorite pastimes, hobbies, or interests?

Well, there's before and after COVID. Before COVID, it was the usual stuff—reading, hiking, swimming, rollerblading, etc. Since COVID, it's been a lot of working with my wife to keep the kids sane.

■ ENG NEUROSCIENTIST STEVE RAMIREZ AWARDED BU'S 2021 METCALF CUP AND PRIZE

STUDENTS: HE'S "HUMBLE," "ENGAGING," THE "EMBODIMENT OF A GREAT TEACHER"

by Doug Most

Steve Ramirez (CAS'10), a CAS assistant professor of psychological and brain sciences, is commended by students for his listen-first approach. In awarding him this year's top teaching award, the judges wrote that he "presents information in a way that students say is impossible to forget, using personal stories, videos, and pop-culture references they can relate to." Photo by Cydney Scott

His students may think that when they come to a Steve Ramirez class, they are the ones learning, he is the one teaching. After all, the College of Arts & Sciences assistant professor of psychological and brain sciences is a renowned neuroscience researcher and a leading expert on the science of memory. But what his students don't realize is that just as Ramirez is teaching them, they are teaching him.

"Wisdom is a two-way street when it comes to age. We have to learn from our students as well," Ramirez (CAS'10) says. "When we remind ourselves that students are people too, we listen. What we can do as adults is grow down a little bit."

By growing down, rather than looking down, at his students, he says, he is reminded of all the nuggets of wisdom students can offer. "If you listen and are kind to your classroom, the walls break down for communicating anything."

That listen-first approach is what helped earn Ramirez this year's top BU teaching award, the Metcalf Cup and Prize for Excellence in Teaching.

"Members of the Faculty Teaching Awards Committee were blown away by their visits to Steve's class," the award letter said, citing Ramirez's "masterful organization" in structuring his 50-minute class into defined blocks, while conducting a Zoom chat that was both professional and easily accessible. "Steve presents information in a way that students say is impossible to forget, using personal stories, videos, and pop-culture references they can relate to."

His students echoed the committee's opinion: "It is rare in life to meet someone so willing to help others, and who, despite their incredible academic success, is still extremely humble," one former student wrote in a letter to the committee. "Having the opportunity to discuss neuroscience, and the phenomenon of human memory, with a person who has already contributed substantially to the field, has been incredible. Professor Ramirez is not only a wonderful, engaging lecturer: he is truly the embodiment of what it means to be a great teacher."

Ramirez, at 33 one of the youngest winners of the top Metcalf award, says that after his initial disbelief on learning he was this year's award winner, there was no hesitation about who he'd share the news with first. He

calls his parents every day, sometimes twice.

Pedro Ramirez and Delmy Moreno came to the United States illegally, escaping with their son and daughter from a long and deadly civil war in El Salvador and settling in Everett, Mass. (they would later become citizens and have a second son). Seeing his father work 100-hour weeks, from waiting tables to custodial work to eventually managing a lab at Harvard, pushed Ramirez to stay on top of his own schoolwork and become the first in his family to go to college.

"The first thing I thought of was my parents," he says. "Most first-gen students say the same thing. I thought this award was a reflection of my parents' ideals for me. In addition to paying it forward, I wanted to teach it forward. This award recognizes what I want to embody. I want to pay it forward, everything I know and have learned around science literacy."

He's learned a lot. Ramirez's initial interest in neuroscience came as a teenager, when one of his cousins fell into a coma after being anesthetized for a Caesarian section delivery and never completely recovered. As a BU undergraduate, he found purpose in the lab of the late Howard Eichenbaum, a hugely important figure in the study of memory and director of BU's Center for Memory and Brain.

"Wisdom, feedback, and advice"

Today, as principal investigator of his own lab, the Ramirez Group, he is a leading figure in understanding the science of memory, how memory works, and how one day science might be able to help people minimize negative feelings and reactivate older, positive memories. If he's successful in his goal (and he's done it with mice), Ramirez hopes that one day his techniques could help people manage or overcome issues from depression to anxiety to post-traumatic stress disorder, and maybe even the memory loss associated with Alzheimer's disease. A 2015 TED talk he gave on the subject with his research partner Xu Liu, who died in 2015, has garnered over a million views.

"Although Professor Ramirez has not taught for as long as many Metcalf Prize nominees may have, his mastery of the material and his ability to connect with students while helping them both intellectually and personally clearly make him a top candidate for a Metcalf Award," wrote David Somers (GRS'93), a CAS professor and chair of psychological and brain sciences.

As with so many faculty members and researchers, the coronavirus pandemic forced Ramirez to pivot his priorities, his teaching, and even his research in some unexpected ways. "There has always been camaraderie in science," he says, but the pandemic "tied us together closer even while we've been spaced apart."

He has focused his energy on the mental health of his students, arguing that wellness needs to be recognized more than sporadically. "We need wellness forever, not wellness days," he says. He has paid special attention to the stressors on himself and on his students, who appreciate how much he cares about them.

"He presents information in a way that students say is impossible to forget, using personal stories, videos, and pop-culture references."

"Rather than staring at the clock waiting for class to end, I found myself wanting to delve deeper into the material and ask as many questions as possible," another former student told the awards committee. "He's a naturally engaging and fascinating person—so much so that it lends extra credence to the wisdom, feedback, and advice that he altruistically shares with his students."

Ramirez says it's important for him to see the world through their eyes, not his, which is why he is active on social media, watches TED talks, and keeps up with what sort of messaging is on TikTok. "I consider myself a student still. I try to put myself in their shoes as much as possible and lean into what they are doing in their free time. Instead of rolling my eyes, I see those things not as distractions, but as opportunities for teaching students in a more organic language."

And even though people all over joke nowadays about how "time doesn't matter anymore" and we forget if it's Monday, Wednesday, or Saturday, Ramirez says, those feelings will have a real impact on his own lab's research.

"We are so used to having memories have a beginning, middle, and end," he says. "But in the last year that was completely turned upside down. We all entered our own heads more."

Unlike other tragedies, like 9/11 or the Space Shuttle Challenger explosion, which had very defined periods of time and grieving, the pandemic has been one gradual, prolonged tragedy. "Something deeper is happening here," he says.

"An award like this is a collective validation of the risks I take in the classroom," Ramirez says. "And I think that has resonated with students. Every time you see a professor do something human, like trip or come to a class late because they were stuck in traffic, students are reminded that professors are human. And I try to remember that students are human too."

A gift from the late Arthur G. B. Metcalf (Wheelock'35, Hon.'74), a Board of Trustees chair emeritus and former professor, funds the Metcalf Cup and Prize and the Metcalf Awards for Excellence in Teaching, created in 1973 as the University's highest teaching awards. The Cup and Prize winner receives $10,000; the Award winners $5,000 each. A University committee selects winners based on statements describing nominees' teaching philosophy, supporting letters from colleagues and students, and classroom observation of the nominees.

SHARON DONATES THOUSANDS OF MASKS MADE AT ENG

by ME Department

Andre Sharon (right), director of the Fraunhofer USA Center for Manufacturing Innovation at BU chats with Matt Ferrer, volunteer coordinator at The Pine Street Inn, after handing over a box of 1,000 masks on March 19. Photo by Cydney Scott for Boston University Photography

When spring 2020 sprung a sudden need for face masks worldwide, suppliers were caught flat-footed. Professor Andre Sharon (MSE, ME) asked himself, "Who's in the best position to solve this shortage? Engineers!"

Director of the Fraunhofer USA Center for Manufacturing Engineering, Sharon got to work building a machine that could produce 2,000 masks an hour. If replicated and made widely available in hospitals and other institutions, the compact machine could reduce the need for shipping masks from overseas plants.

For now, Sharon is donating thousands of masks to homeless shelters and other organizations in the Boston area. "There's a whole lot of people who cannot afford to buy masks, and you see a lot of them on the streets, wearing just a scarf over their mouth, or a bandana or a turtleneck pulled up," says Sharon. "It occurred to me that these were the people who really needed the masks."

Sharon has personally boxed up and delivered 4,000 masks to homeless shelters Rosie's Place, St. Francis House and the Pine Street Inn.

"I never did get involved in volunteering at food pantries or anything like that previously," says Sharon, "but now

that I'm donating the masks, I get a real satisfaction out of it. Homeless shelters and organizations that serve low-income people have been extremely grateful. At this point, they're the ones that benefit the most from these masks, because the people they serve really need them."

"Donations such as the masks from BU Engineering have allowed us to keep guests and staff safe through the COVID pandemic," says Matt Ferrer, volunteer coordinator at the Pine Street Inn. "And they help to defray costs the organization would otherwise incur, as masks are an essential item in our fight against COVID. We appreciate the ongoing support of the BU community."

In addition, Sharon has donated thousands of masks to first responders and essential workers at BU Facilities, BU School of Medicine, the Boston Police Department, and the Holtzman Medical Group vaccination site in Newton.

That's how the Societal Engineer rises to meet a challenge, Sharon says. "Whenever there's any real problem in the world, whether it's a pandemic or a lack of clean water after a hurricane, in the end it's engineers and scientists who need to step up and come up with solutions."

Mission Statement

THE BOSTON UNIVERSITY PHOTONICS CENTER generates fundamental knowledge and develops innovative technology in the field of photonics. We work on challenging problems that are important to society, translate enabling research discoveries into useful prototypes, and we educate future leaders in the field.

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This mission is executed through:

- Basic research and scholarship in photonics
- Training and initiatives for students
- Business innovation and photonics technology development

Listed below are some of the ways in which the Photonics Center community pursues each of these mission-specific themes.

Basic Research and Scholarship in Photonics

Photonics Center research is distributed broadly across all areas of optics and photonics; however, areas of particularly cohesive research strength and national prominence include:

- Biophotonics
- Lasers, Nonlinear Optics, and Quantum Photonics
- Nanophotonics
- Neurophotonics
- Photonic Metamaterials & Devices

In addition to its core faculty-led research program, the Photonics Center is also a closely associated with two distinct scholarly units within BU: the Neurophotonics Center (NPC) and the Materials Science and Engineering Division (MSE). Our affiliation with NPC is the direct result of the Photonics Center's previous strategic plan, through which we deliberately and successfully built a neurophotonics program at BU in collaboration with the Center for Systems Neuroscience. Now led by David Boas and housed in BU's Kilachand Center for Integrated Life Sciences and Engineering, NPC continues to receive technical, financial, and doctoral training support from the Photonics Center and shares substantial overlap with our mission. Our strong collaborative relationship with the MSE derives in part from the fact that MSE's facilities and core faculty research labs are housed in the Photonics Center, and in part from MSE's scholarly focus on photonic-related materials research. The Photonics Center also maintains, staffs, and shares costs related to a large complement of MSE shared laboratory facilities.

Training and Student Initiatives

While the Photonics Center does not offer academic degrees, its faculty teach a broad array of graduate and undergraduate courses that cut across traditional departmental curricula, and the foundation of its research program is interdisciplinary doctoral education. Our most direct programs for training and student-focused initiative are associated with Photonics Center led, externally supported, photonics-themed training programs. The four main operational programs for training, all funded by NSF, include our NRT doctoral training program that has supported ~100 PhD trainees (21 with full fellowships) in the past five years and our combined REU, RET, and REM immersive summer experience programs that have supported ~100 undergraduate and HS teacher participants in the past five years.

This past summer, the BU Photonics Center added a new research experience opportunity to our programs. The Photonics Undergraduate Research Summer Experience (PURSUE) aims to recruit academically talented undergraduates from leading photonics and optics programs at peer institutions (e.g., Rochester, Stanford, and Duke) for immersive summer experiences in the labs of our leading researchers, with the goal of attracting those students to the doctoral programs of our cognate departments.

The Center also participates in professional development for its graduate students, sponsoring student chapters of the leading optics and photonics societies (SPIE and OSA) and paying student fees for memberships; providing travel awards to doctoral students who have a paper accepted for presentation at a national optics or photonics symposium; and hosting student-led booths at conferences.

Students also organize and run the Photonics Center's Distinguished Seminar Series, through which they select and invite nationally and internationally renowned speakers to BU for a day-long visit that includes a plenary talk and multiple small group meetings with students and faculty. Finally, the Center supports a series of Journal Club Lunches in which faculty and students within relatively narrow thematic areas (e.g., microscopy) meet regularly for student-led discussion of recent seminal publications.

Business Innovation and Photonics Technology Development

The Photonics Center is a leader in the commercialization of photonics technology, an activity that is anchored by the Business Innovation Center (BIC). The BIC ended last year with a record 16 member companies. BIC is anchored by three multi-national leaders in opto-electronics, micro-electromechanical devices, and imaging. The year also saw a doubling to a total of six companies that are spin-outs of BU research. While the member companies exhibited good fiscal management policies, harnessed opportunities created during the pandemic and had supportive investors, they also credited the support of the Photonics Center with helping them thrive in a difficult year. The BIC companies continue to be valued participants in the Photonics Center community, collaborating with faculty, training students, and creating a career option for engineering graduates. Preferential selection of prospective tenants that work in areas aligned with the research and scholarship activities of Photonic Center faculty supports this environment of collaboration and fosters potential for growth in sponsored research.

Strategic Goals

In support of its mission, the Photonics Center operational plan is driven by five major strategic goals:

1) Support and catalyze major research projects
2) Lead training and educational enrichment programs
3) Promote technology development through the Business Innovation Center
4) Foster a cohesive community through events and programming
5) Provide an enabling infrastructure of shared facilities for research

Major Research Projects

The Photonics Center continues serve the University as a leader in helping to propose, win, administer, and manage large research grants. Currently supported major awards include the NSF-sponsored *CELL-MET Engineering Research Center*, led by Professor David Bishop, that aims to engineer heart tissue for cardiac repair; and a US-Ireland R&D Partnership Collaboration, led by Professor David Bishop, Alice White, and Chris Chen to study *Cardiac Organoid Systems*. In the coming year, the Photonics Center will begin administering and managing two new awards: a large NIH-sponsored $14M U19 multi-university program, led by Professor Anna Devor, to study *Local Neuronal Drive and Neuromodulatory Control*; and an internal $1.5M award from the Boston University Kilachand Fund for Integrated Life Science and Engineering, led by Professors Xin Zhang, Stefan Anderson, and Ioannis Paschalidis, entitled *Metamaterial and AI-Enabled Ultra-Low Field MRI for Low-Cost, Portable Brian Imaging*.

NSF ERC: Directed Multiscale Assembly of Cellular Metamaterials with Nanoscale Precision (CELL-MET)

The CELL-MET ERC has a vision to develop cell and tissue engineering technologies with the goal of delivering therapeutics to restore normal function to diseased or damage hearts. This is a comprehensive program that involves research in biomaterials, nano-engineering, imaging, optogenetics and fundamental research in cell and tissue engineering. CELL-MET will drive these technologies to the clinical environment by building an innovation ecosystem of industry, medical and regulatory stakeholders, and training a pipeline of skilled engineers and scientist. This workforce will be diverse and inclusive, and engagement of future leaders will begin at the K-12 and continue through postdoctoral levels. Photonics Center staff play significant leadership roles in the research, inclusiveness, training, administration, and technology transfer efforts of CELL-MET.

The CELL-MET ERC now faces an exciting transition. Work to date has emphasized research innovations in the fields of nano-manufacturing, nanomaterials, cell and tissue engineering, and imaging. In the fifth year of the award, these thematic advances will be integrated to become the framework for the ERC renewal: a five-year research program to demonstrate and implement cardiac repair with engineered tissue.

In May of 2020, CELL-MET developed an action plan for strengthening its commitment to diversity and inclusion. As part of that plan, CELL-MET and the content aligned with MA-Adapted Next Generation Science Standards (NGSS) was developed by Photonics Center staff, undergraduates from

BU's College of Communications, CELL-MET faculty, and East Boston High School's (EBHS) AP Biology class. The program is aimed toward building clear pathways to STEM engagement. In addition, as part of its enhanced commitment to fostering a culture of inclusion, CELL-MET established two pilot programs last year. The first was a BU-led summer program for Research Experiences and Mentoring (REM) in affiliation with Fort Valley State University, a historically Black institution in GA. The second was a teacher-in-residence research partnership with Nueta Hidatsa Sahnish College, a Tribal college chartered by the Three Affiliated Tribes of the Fort Berthold Reservation in ND. More information about the NSF CELL-MET ERC can be found on the program website: https://www.bu.edu/cell-met/

NSF Center to Center (C2C) Funding Mechanism: Cardiac Organoid Systems Partnership (COSP)

COSP is a collaboration between CELL-MET, the SFI Research Center for Medical Devices (CURAM) out of the National University of Ireland, Galway and the Wellcome-Wolfson Institute for Experimental Medicine (WWIEM) out of Queens University Belfast. These Centers have a common goal to cure heart disease and the complementary skills of this C2C collaboration provide a force multiplier that enhances the opportunity for success. The COSP intends to pursue development of high throughput techniques for fabrication of nanoscale scaffolds and functionalization of those scaffolds with cardio biosystems. Partnerships like this are possible due to the Photonics Center's reputation and leadership position in the biophotonics sector and established corporate partnerships. The NSF and their counterparts in Ireland awarded funding to BU CELL-MET and Irish partners for this international collaboration during the 3rd quarter of FY21, and the program has ramped up.

Training Programs and Initiatives

In training and education, the Photonics Center administers and manages and the NSF *NRT in Neurophotonics*; the NSF *RET* Site *in Integrated Nanomanufacturing*; and the NSF *REU* Site *in Integrated Nanomanufacturing* and the NSF REM programs for CELL-MET ERC. Last year, the Photonics Center also developed a pilot K-12 outreach program in partnership with East Boston High School as part of CELL-MET ERC Activities. Supported in part by a grant from the Brown Rudnick Charitable Foundation, that program engaged hundreds of students at high-school, middle school, and elementary school levels in university-mentored, multi-level peer-peer learning at sites in Detroit, Miami, and Boston.

NSF NRT: Understanding the Brain (UtB): Neurophotonics

The NSF NRT Program - Understanding the Brain (UtB): Neurophotonics was BU's first NSF NRT award. Traineeships form the essential core of the NRT student community, and all trainees have access to the many benefits and opportunities afforded by the grant. Our program's emphasis is on community building, interdisciplinary research and collaboration, and professional development opportunities for trainees. A subset of the trainees is supported on fellowships that provide stipend, tuition, and fees from NSF for two years. Ninety-three trainees have been accepted into the training program and twenty-one fellowships have been awarded. Due to complications related to the pandemic, the last two cohorts of the NRT program were launched simultaneously in 2021. Training for nearly 40 participants was adapted to a hybrid approach that included an active program combining in-person lectures and remote content led by faculty and trainees.

More information about the NSF NRT UtB: Neurophotonics can be found on the program website: http://www.bu.edu/neurophotonics-nrt/.

REU/RET/REM Summer Programs

Despite the worldwide pandemic, Boston University Photonics Center's on-site summer research experience program in 2021 was far and away the largest, most successful, and most diverse that we have ever hosted. Our 2021 cohort consisted of 46 participants.

This participant group included:

- 11 Teachers in our *NSF RET* site Program, in which we host STEM instructors from elementary, middle, and high schools that predominantly serve minority students and community college faculty members.
- 11 undergraduates in our *NSF REU* site Program on the topic of Integrated Nanomanufacturing.
- 12 undergraduates in our *NSF ERC* REU Program distributed among our three active sites (BU, UM, and FIU).
- 9 undergraduates in our NSF Research Experiences and Mentoring (REM) supplemental program, all from Fort Valley State College for the ERC, a top ranked public Historically Black College and University (HBCU) in Georgia.
- 3 undergraduates from leading undergraduate optics and photonics programs in our self-funded *Photonics Center Undergraduate Research Summer Experience* (PURSUE).

The Photonics Center's aim for all our summer programs is to engage underrepresented groups in engineering. Demographics of the cohort included (self-identified) race/ethnicity 13 (28%) Black participants, 10 (22%) Asian participants, 10 (22%) White participants,

7 (15%) Native American participants, and 6 (13%) Hispanic participants. Twenty-six (57%) of the participants self-identified as women, and three (7%) of the participants self-identified as people with disabilities.

A culmination of the program was the final poster session, hosted at the Photonics Center. More information can be found at the respective summer program websites:
https://www.bu.edu/photonics-reu/meet-the-participants/2021-participants/
https://www.bu.edu/cell-met/research/opportunities/meet-the-participants/
https://www.bu.edu/photonics-ret/meet-the-participants/

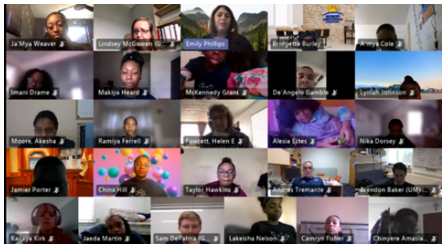
Photonics Center K-12 Engineering Engagement Curriculum Outreach Initiative

In support of its mission to promote photonics-themed educational pathways and careers, particularly for students from racial and ethnic minority groups, the Photonics Center leads a robust outreach program with K-12 schools. Our closest and longest-lasting affiliation is with East Boston High School (EBHS), where we have partnered with STEM program leaders and teachers to engage in spirited multi-level interactions with students from that primarily Hispanic-serving institution. This year, the Photonics Center piloted an ambitious new program – **Engineering Engagement Curriculum Outreach Initiative** – in partnership with EBHS to strengthen that pipeline that was inspired by the tissue-engineering-themed CELL-MET NSF ERC that the Photonics Center leads. We established a formal partnership between the Photonics Center and EBHS that included as its pilot commitment a "near-peer mentoring model" in which *EBHS students* would be mentored by their teachers and Photonics Center faculty and staff to *become mentors* for 3rd and 6th grade students at partner schools in the Boston area, inspiring their younger peers with hands-on learning in areas of science, engineering, and math.

The content for this multi-level mentoring activity was adapted from the highly successful Engineering Engagement Kits (EEK!) that were developed as part of CELL-MET. We developed a comprehensive plan to deliver the proposed new multi-level mentoring not only in Boston, but also at allied sites at our CELL-MET partner sites at FIU in Miami and at UM in Ann Arbor. Each of those sites also partnered with regional high schools and elementary schools in Miami and Detroit serving underrepresented populations.

Under joint leadership by Photonics Center Director of Operations and Program Management Helen Fawcett and EBHS Dean and Program Director of Science Amanda Dillingham, and supported by many other participants from BU and EBHS, we assembled 300 hands-on training kits and distributed them to the participating sites. Kits included a mix of engaging hardware and well-crafted graphical and written content aimed at inspiring dialog about STEM career pathways, scientific insight, engineering design, and life sciences. The culminating exercise was a design challenge directly related to tissue engineering.

Thank you so much for coming to our classroom this year. The kids have looked forward to it each week. You truly have inspired them to learn much more about science. All of you have done an awesome job!
Mr. Prince and Ms. Rosher's class
James Otis School



Snapshots from the Outreach Initiative, piloted last year by the Photonics Center in partnership with East Boston High School, brought together BU faculty, staff, and students in an ambitious program to support peer-to-peer mentoring in STEM, using a pathway spanning from elementary and middle school to high school and college. Clockwise from upper left: The CELL-MET EEK! museum kit that inspired the content for this translation to K-12 curricular outreach; Brenda Hugot assembling some of the 300 kits distributed to schools in Boston, Miami, and Detroit for mentored engagement and hands-on learning at high-schools, middle schools, and elementary schools serving underrepresented communities; A Zoom classroom snapshot from Emily Phillips' classroom at Renaissance High School in Detroit, where student mentors prepared for delivery of tissue-engineering-themed content to younger peers at a partner elementary school; A thank you note from the class of 3rd grade teacher Mr. Prince of Boston's James Otis School, acknowledging the Outreach Initiative and its impact on his students.

These photos were taken in the labs of Assistant Professors Abdoulaye Ndao and Michael Albro. (Photo credit: Christopher Mcintosh)

Business Innovation Center & Industry Engagement

The BIC is a facility located in the Photonics Center that houses industry tenants engaged in commercial activities that are complementary to the Center's mission. Currently, the BIC is comprised of about 6000sf of space that includes large and small office suites, multi-company shared office spaces, common areas, and dedicated shared laboratory spaces including a biosafety level 2 (BSL2) space built with funding from the Massachusetts Life Sciences Center. The BIC now hosts a record 16 companies.

The goal of the BIC is to accelerate innovation by encouraging industry collaboration with BU faculty and to provide educational opportunities for graduate and undergraduate students. Innovation occurs at large companies as well as at start-ups, so the BIC is comprised of start-up and mid to large-size business enterprises in life sciences, biotechnology, photonics, and materials technologies. The Center is anchored by three strategic partners: **Thorlabs**, **Analog Devices (ADI)**, and **AEMtec**. These international companies are leaders in optoelectronics, MEMS, and imaging, which are core competencies of Photonics Center researchers. More importantly, these strategic partners support the education and innovation pillars of the Photonics Center's mission statement.

AEMtec GmbH is a German company specializing in the development of complex optoelectronic and microelectronic devices for the medical technologies, automation, and data/telecommunications markets. AEMtec expects to establish a rapid prototyping capability in the BIC, and the company operates at the "sweet spot" of the Photonic Center capabilities. It is expected that collaborations with faculty will produce value for both the company and BU researchers, and create many opportunities for student internships. As of this writing, AEMtec has sorted out the pandemic restricted visa issues, staffed their operation, and are waiting on the final delivery of equipment. The next fiscal year is expected to be AEMtec's breakout year, and the Photonics Center is looking forward to a multi-year collaboration.

ADI gives their engineers a high degree of autonomy in working on advanced projects with their Analog Garage organization. The Analog Garage teams not only focus on technology, but they also have complete latitude to look for innovative ways to organize and collaborate with other companies and universities. The Photonics Center BIC provides ADI with access to top-tier researchers and allows the company to tap into a pipeline of enthusiastic and qualified engineering students and graduates. COVID-19 has not slowed ADI's work in advancing MEMS based sensors for medical diagnostics and monitoring, and in-fact efforts were expanded in the past year to develop COVID-19 diagnostics.

Thorlabs, a long-time supporter of the Photonics Center, made BIC the hub of their outreach to other universities and businesses in the Boston area tech community. Although COVID-19 restrictions delayed the staffing and build-out of the BIC-based lab, this is now fully staffed and ready to launch. In the past year, Thorlabs has taken advantage of BU researchers' expertise in writing galvanometer algorithms for optical scanners and laser controllers, and the proximity to BU researchers is expected to result in additional sponsored research opportunities. The relationship with Photonics has also enabled wider Thorlabs support at BU. For example, Thorlabs is a Sustaining Member of the CELL-MET ERC and the Thorlabs representative has served as the Chair of the CELL-MET Industry Advisory Board.

ClearIt was the only company leaving BIC in the past year, departing concurrent with a round of financing. ClearIt has confirmed safety in use and first-level efficacy of their plasma-based single treatment ERASER tattoo removal system and commenced human clinical trials with FDA approval and MDR clearances expected in 2022. ClearIt and their staff have been great tenants in BIC, and the Center wishes them the best of luck as they launch their product.

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In FY21, BIC has seen the doubling of the companies spun-out from BU with three of the four new companies having BU faculty as founders. These companies are **Virex Health** (Scott Schaus and Mark Grinstaff), focusing on medical diagnostics; **K2 Biotechnologies** (Mo Khalil), which is working on antibody therapies; and **Acoulent** (Stephan Anderson and Xin Zhang) working on a metamaterial-based noise cancellation product. Overall, the companies with BU founders have seen substantial success in the past year. **149Medical** was awarded a Phase II STTR and received a $250K grant from the Massachusetts Life Sciences Center (MLSC). Virex addresses medical diagnostics broadly, but opportunistically their technology also led to a MLSC award in the amount of $510K for low-cost SARS-CoV-2 diagnostics. Virex is off to a great business launch and in addition to the MLSC award, raised $750K in seed financing in February. Another BU founded company, **NXTEC**, has

demonstrated steady revenue growth and expects positive EBITDA and cash flow in the current year.

Other BIC companies have also done quite well in the past year. The accomplishments discussed here are on top of the strong leadership skills and sound cash management practices they have exhibited, and the support they have received from investors. **Bitome** doubled their headcount, signed a contract with a synthetic biology company, added high-profile Board of Director members, received $500K in Angel funding, and landed a $225K NSF Phase I SBIR award. **Leuko Labs** received a $2M NIH Phase II SBIR award, and an NIH CAPCaT award and funding from MassVentures. Leuko has expanded their IP portfolio, completed FDA pre-submissions for their PointCheck device, which is used for non-invasive white cell monitoring, and despite COVID-19 has tested over 200 patients in five new clinical trial sites. **PlenOptika** has seen a doubling of year over year revenue with their handheld autorefractor product now used on over three million patients across 30+ countries in the past two and a half years. In addition to follow-on investment from existing investors, PlenOptika was awarded a NIH Phase II SBIR (Commercial Readiness Program), a MassVentures grant and the EU Industrial PhD grant. The company's leadership team was recognized by the International Agency for the Prevention of Blindness, and had a major clinical study accepted in the high impact journal Ophthalmology. **Neural Dynamics Technologies** (NDT) also wrote a compelling proposal and received notice of a NIH Phase II SBIR award in the amount of $2.5M. As is the case with many SBIR awardees, NDT expects to collaborate and provide a sub-award to BU researchers. **JanaCare** was presented with unique challenges during COVID-19 as the company has substantial operations in India in addition to being located at BU. JanaCare still delivered on the milestones of their existing agreements with big pharma, received an additional $1M in research contracts, and were highlighted in a press announcement by Astra Zeneca on remote monitoring of biomarkers. Jana Care will graduate from BIC later this calendar year, and the company will be greatly missed as they have been a full participant in many Photonics Center initiatives.

A highlight of all the BIC companies, particularly JanaCare, has been their contributions to the educational mission of the Photonics Center. During their tenure at BIC, JanaCare has consistently participated in networking events and senior design projects, presented during classroom guest lectures, participated in the NSF REU and RET sites in INM, and offered multiple internships as well as employment opportunities to BU graduates. FY21 has been no different with JanaCare providing a research project for both an undergraduate Community College student in the REU INM and a high school teacher from East Boston High School in the companion RET program. The fall holds expectations that JanaCare will continue to cultivate their outreach relationship with Bradley LePak's AP Biology class during Academic Year 2021-2022. JanaCare makes a point to develop the students they take under their tutelage and in the past year the company added two students (1 undergrad and 1 graduate) as co-authors on a paper appearing in *Analytical Chemistry*.

The number of internships offered by BIC companies totaled 12 for the fiscal year, about one-third of a typical non-COVID-19 year. The BIC companies participated in several university-wide events including participating in the BU Medical Innovation & Technology Panel, offering mentorship in career opportunities and entrepreneurship, mentoring in the BU Neurobiology program, giving guest lecturers in the BME Senior Design class, and mentoring students on design projects. The BIC exited the fiscal year, fully occupied with a waiting list of companies seeking to join. BIC offers an environment that enables innovation and the demand for the space is high, allowing the Photonics Center to be selective in bringing new companies in. The Center places a priority on choosing companies that can collaborate with Photonics Center faculty and other BU faculty researchers. In general, this results in companies with photonics and materials as the core technology enablers, however there are opportunities for companies that are spun-out of BU or could support other BU programs such as the CELL-MET ERC.

The full list of FY21 tenants can be found in the nearby table. These companies made full use of BU facilities to continue product development, solicit investment, and cultivate their initial customers. This year has been a challenge for the economy at the macro level and at individual businesses including the BIC companies. The BU support for cultivating innovation can be best summarized by the following comment from Daniel Lookadoo at JanaCare: "COVID-19 has presented some significant and unique challenges for the company, both in Boston and in India. We have been very fortunate in our ability to maintain operations in the Photonics Center and meet major milestones associated with sponsored research programs. We would like to acknowledge support from the Photonics Center and Boston University at large for help making this possible."

List of FY21 Photonics Center Innovation Center Tenants					
Company Name	**Origin**	**Status Change**	**Technology**	**Market Sector**	**Funding**
Acoulent	Boston University	New	Metamaterials	Noise Cancellation	Grants
AEMtec	Corporate Spin-out	Existing	Optoelectronic Circuits	Medical Technology, Telecomm	Corporate
Analog Devices Inc.	Corporate Spin-out	Existing	MEMS	Healthcare	Corporate
Bitome	MIT	Existing	Nuclear Magnetic Resonance (NMR) Spectroscopy	Healthcare	Grants/Angel Funding
ClearIt	De Nova Start-up	Departed	Pain-Free Tattoo Removal	Healthcare	Self-Funded and Private Equity
Coalesenz	Wellman Center	New	Optical Sensor	Healthcare	Grants
JanaCare	Harvard University	Existing	Diagnostics for Chronic Diseases	Healthcare	Grants and Venture
Leuko Labs	MIT	Existing	Non-Invasive White Blood Cell Monitor	Healthcare	Grants and Venture
K2 Biotechnologies	Boston University	New	Anti-body Therapies	Healthcare	Grants
Neural Dynamics Technologies	MIT	Existing	Micro-Electrodes and Implantable Devices	Healthcare	Grants
NXTEC Corporation	Boston University	Existing	Software as a Service (SaaS)	Healthcare	Grants and Venture
PlenOptika	MIT	Existing	Autorefractor Using Wavefront Aberrometry	Healthcare	Grants and Angel
Primetaz	Boston University	Existing	Metamaterials	Healthcare	Grants
Thorlabs	Corporate	Existing	Optical Tools	Multiple	Corporate
Virex Health	Boston University	New	Medical Diagnostics	Healthcare	Grants
149Medical	Boston University	Existing	Imaging	Healthcare	Grants and Strategic Partners

Faculty Entrepreneurship Highlight: Professor Ji-Xin Cheng

Entrepreneurial success is not accidental; it is shaped by personal values and follows a defined process that establishes the venture and drives its ultimate growth. Dr. Ji-Xin Cheng, who joined BU in 2017 as the inaugural Moustakas Professor in Photonics and Optoelectronics and with appointments in ECE and BME, is a textbook example of the values and processes that lead to successful entrepreneurship.

His name Ji-Xin, in English "Continue New" provides more than a signature and appears to drive his personal ambitions for innovations and business success. Many researchers think of ideas, but few act on those ideas. In the short time since arriving at Boston University, Professor Cheng has disclosed twenty-eight (28) inventions to the Technology Development office with the first patent issuing earlier this year. In terms of commercializing the innovations, Professor Cheng has the philosophy to be "as flexible as water", in other words just as water takes the shape of its container, innovations have many paths to market and the inventor should look at all considerations before choosing the best path.

Michael Pratt, the Managing Director of BU's Technology Development office (OTD), indicates that when Professor Cheng visits his office, "he is not just making disclosures for disclosure sake, but rather he has a practical application in mind and many times has a research sponsor and business in-mind." Mr. Pratt sums up Professor Cheng's approach as "I invent, here is what the invention is useful for and here is who would be interested." As examples of his engagements, Mr. Pratt cites a license and options for additional licenses to Photothermal, a Professor Cheng founded company and three additional licensing opportunities with Vibronix, another Cheng company. True to his philosophy on flexibility, Professor Cheng feels the best path often may be to license to a company that has the resources to exploit the invention, and he has also brought these opportunities to OTD.

Whether it comes naturally or is a planned strategy, his path to commercial success follows a textbook approach, starting in the lab with basic research funded by sources such as federal agencies, private foundations, and corporate sponsored research. After consideration for protection of patentable inventions, his lab has published in high profile journals. His team follows with engaging OTD and following the process through filing for patent protection and licensing. The license may be to a large company with resources or to a spin-out that can leverage the expertise of the Cheng Lab to exploit the invention. If a spin-out company, the next step involves setting the company up and pursuing non-dilutive funding such as SBIR grants. And finally, the company enters the growth stage. Vibronix, launched from his lab and devoted to developing advanced imaging and sensing technologies for disease diagnosis and treatment, is now at this stage with the recent FDA clearance on its AcuSee surgical guidance system.

Every great entrepreneur believes in their people and Professor Cheng is not the exception. He indicates that of the thirty-four students that he has mentored, half have gone into academia, a quarter are working at major corporations (e.g. Samsung, Genetech, ThermoFisher, Pfizer) some have gone to start-ups including two start-up founders and others have become MDs or lawyers. Professor Cheng credits this diverse team, as well as family and friends, for much of his success.

BIC Company Spotlight: Analog Devices Inc.

Lockheed's "Skunk Works" is famously known for designing and building the top secret U2 and SR-71 Blackbird spy planes. The legacy of "Skunk Works" for corporate America is one where within a large corporation, the organization creates an environment with a high tolerance for risk, few bureaucratic constraints and freedom to try new technologies and organizational models. The Skunk Works has morphed into what we now call "Intrapreneurship" where corporations support their entrepreneurial minded employees in bringing innovations to market.

The Analog Devices Inc. (ADI) team in the Business Innovation Center (BIC) at the Photonics Center provides a case study in how ADI executes intrapreneurship with their Analog Garage model. ADI's Nanoteam started as an Analog Garage initiative before gaining further support and spinning-off into the Digital Health Care business unit at Analog as the technology matured. Now known as NTDHC,

the team is focused on developing the next generation of Biosensor platform-on-chip for diagnostics and therapeutics. To deliver point-of-care, low-cost, rapid, disposable diagnostics that don't require sample prep and still having molecular accuracy to "gold standard" techniques requires a skilled team with expertise across multiple disciplines. Being part of a larger organization, NTDHC can draw from ADI's expertise in Biology, Chemistry and Materials Science as well as ADI's analog/mixed signal electronics expertise and capabilities in device manufacturing. Exposure to this scope of talent augurs well for the experiences of BU students who have interned at NTDHC, some of whom have joined the team as full-time employees and further demonstrating BIC's commitment to education and delivering on BU's task of training a pipeline of talented engineers and scientists.

NTDHC has the additional benefit of tapping into ADI's financial resources and economies of scale in the supply chain, production, and in sales and marketing. Scale does have some drawbacks as new innovations are challenged with the "More-than-Moore" strategy in manufacturing which standardizes on materials and processes in the production line. According to Professor Azize, the team leader of NTDHC, this is where the Photonics Center comes in and he tells us the maturity of the biosensor technology has been significantly accelerated by using the facilities at the Photonics Center. Dr. Azize calls this the LAB to FAB model, where small wafer lots can be processed to build confidence with data prior to scaling and completing an in-depth analysis of sensor performance. Dr. Azize mentions that each team leader can develop their own partnerships and organizational models. "I have picked a strategy of leveraging BU facilities based on my background as a serial entrepreneur and my belief in the LAB to FAB mindset. So far, the achievements in technology development are extremely encouraging and I'm betting on this model for future projects and encouraging others at ADI to work with the BU Photonics Business Innovation Center." While the NTDHC product expects to launch in 2023, BIC looks forward to further engagement with other ADI Business Units and their respective intrapreneurial teams.

CELL-MET Innovation Ecosytem

A critical component of the NSF Engineering Research Center is developing an innovation ecosystem with an Industry Practitioner Advisory Board (IPAB) of corporate members who bring industry perspective and facilitate and accelerate technology development and transfer to clinical use. The Photonics Center Director of Industry Engagement and Technical Programs, Tom Dudley, has led the effort as the Industry Liaison Officer of CELL-MET and over the first four years has developed an engaged IPAB with 15 members currently. The NSF prescribes levels of membership and corresponding fees which can include both cash and in-kind contributions. Over the course of the 10 year ERC, the key to sustainability of the center's work beyond the NSF funding is through industry participation and support. CELL-MET has used industry membership fees to seed two BU CELL-MET research projects in Year 3 for a total of $170,000. A recent call for new proposals for Year 5 has resulted in 14 projects with the plan to allocate another $300,000. The IPAB reviews and selects the projects. Industry membership has generated a total of $450,917 in membership income, as well as $588,490 in in-kind contributions.

CELL-MET Industry Membership	
Company	Membership Level
Beckman Coulter	Sustaining
BioMetrix	Associate
Bioventus	Full
Boston Micromachines	Associate
Boston Scientific	Full
Corning	Full
Hamamatsu	Sustaining
Imagion	Full
LightWave	Affiliate
Nanoscribe	Associate
Phenomix	Contributing
Poly6	Associate
Sublime	Associate
TARA	Associate
Thorlabs	Sustaining

Events & Programs

THE PHOTONICS CENTER offers an exciting array of events and programs throughout the year to engage the community and offer enriching opportunities to Boston University, Boston area universities, and local companies. These events foster interdisciplinary discussion and encourage faculty and students to collaborate with a variety of professionals on fundamental research.

This year, many events that we typically host such as the Photonics Cafes, Photonics Forums, the annual ice cream truck and cookout, and additional meetings and events were cancelled or postponed due to the COVID-19 pandemic, however a number of our events moved online and were held virtually.

PHOTONICS SEMINAR CALENDAR

Over the past year, the BU Photonics Center organized and hosted the following **Photonics Events and Speakers:**

Date	Speaker	Title
December 7, 2020	**OSA/SPIE BU Student Chapter Hosted Virtual Photonics Center Distinguished Lecture with Dr. Nimmi Ramanujam, Duke University**	"Addressing Structural and Social Barriers to Global Cancer Inequities Through Biomedical Innovation"
April 29, 2021	**OSA/SPIE BU Student Chapter Hosted Virtual Photonics Center Distinguished Lecture with Dr. Vadim Backman, Northwestern University**	"What Can Optical Nanoscopy Reveal About the Structure and Function of the Genome"

CELL-MET ERC EVENTS

Photonics Center staff organized the following CELL-MET ERC events during the 2020-2021 fiscal year.

Date	Event
August 3-4, 2020	**CELL-MET ERC Virtual Industry Liaison Officer Summit**
October 19-21, 2020	**CELL-MET ERC Virtual Annual NSF Site Visit**
October 23, 3030	**Virtual CELL-MET/Materials Day on Design and Fabrication of Tissue Architectures**
June 1-4, 2021	**CELL-MET ERC Annual Virtual NSF Site Visit**

In addition, Photonics Center staff planned and hosted a perfect pitch competition, a monthly student journal club, a CELL-MET technical workshop, monthly inclusion meetings, monthly and special technical seminars, weekly lectures series, monthly and special diversity trainings, monthly professional development workshops, monthly team calls, monthly journal clubs, and weekly community building wellness sessions.

NEUROPHOTONICS EVENTS

This past year, the Photonics and Neurophotonics Centers continued to co-sponsor Neurophotonics/NRT seminars with a focus on Neurophotonics. Photonics Center staff played a role in planning and managing the following seminars and symposia and supported additional smaller events for the Neurophotonics Center.

Date	Speaker	Title
September 30, 2020	**Virtual Faculty Spotlight Event**	n/a
October 19-29, 2020	**Virtual fNIRS Training Workshop**	n/a
October 26, 2020	**Virtual NRT Alumni Panel**	n/a
January 12, 2021	**Neurophotonics Center's 4th Annual Virtual Symposium**	n/a
March 31, 2021	**Virtual Neurophotonics NRT Seminar: Mark Howe, Boston University**	"Large-Scale Optical Fiber Arrays for Measuring Striatum-Wide Signals During Learning and Action"
May 27, 2021	**Virtual Neurophotonics NRT Seminar: Flavie Lavoie-Cardinal, Laval University**	"Machine Learning-Assisted Super-Resolution Microscopy of Molecular Interactions in the Brain"
June 3, 2021	**Virtual Neurophotonics NRT Seminar: Marie-Ève Paquet, Laval University**	"The Optogenetics and Vectorology Foundry: An Ecosystem to Support the Translation of New Optogenetic Tools for Basic and Clinical Neuroscience"
June 10, 2021	**Virtual Neurophotonics NRT Seminar: Caroline Menard, Laval University**	"The Biology of Stress and Mood Disorders: A Multidisciplinary and Whole-Body Approach"

Shared Facilities for Research

The Photonics Center is committed to supporting and promoting research infrastructure that provides advantages to its researchers. That commitment is realized in three main areas.

- Support for faculty research lab startup equipment and routine laboratory upgrades and repairs
- Support for one-time building projects that leverage new opportunities or initiatives within the Photonics Center to enhance research productivity
- Support for major shared laboratory facilities and for technical personnel to operate them and train students.

RECENT BUILDING PROJECTS

- **PHO 712C – NSF CELL-MET ERC BSL2 Laboratory** – The former Class 100 Cleanroom, located in room 712C at the Photonics Center, was repurposed and renovated for a much-needed BSL2/optics space for CELL-MET research. Construction is complete and the lab is currently moved in and using this space for tissue engineering research.
- **PHO 509/609 – Former Draw Tower Space** – After the two-story Fiber Optic Draw Tower was removed from between the fifth and sixth floor of the Photonics Center, the resulting hole was filled. This renovation is complete and new graduate student/lab space is available on the 6th floor, and short-term swing space is available on the 5th floor.
- **PHO 503D – Former BSL2 Space for NSF ERC CELL-MET** – The former BSL2 space for the NSF ERC CELL-MET was reclaimed for faculty space after the PHO712C renovations and approvals were confirmed. This space has been updated to provide additional Class 4 laser space for Siddharth Ramachandran's laboratory.
- **PHO B11 – Former Ultra-fast Laser Lab** – The former laboratory space that was occupied by Bennett Goldberg prior to his move to Northwestern University, had formerly housed research for IARPA and his graduate student who was finishing up his research. New Photonics Center and ECE faculty member Abdoulaye Ndao, moved into this space that was renovated by the College of Engineering and managed by the Photonics Center. Prior to January 2021, Professor Ndao's lab was completed, and research was running.
- **PHO 614/614A – BIC Tenant Office Space** – New BIC tenant, AEMtec, supported the build out of former office space into an ESD floored, modular cleanroom, laboratory space, and office seat. The construction was completed during the COVID-19 pandemic with final equipment moved in and commissioning completed in July.

SHARED LABORATORY FACILITIES

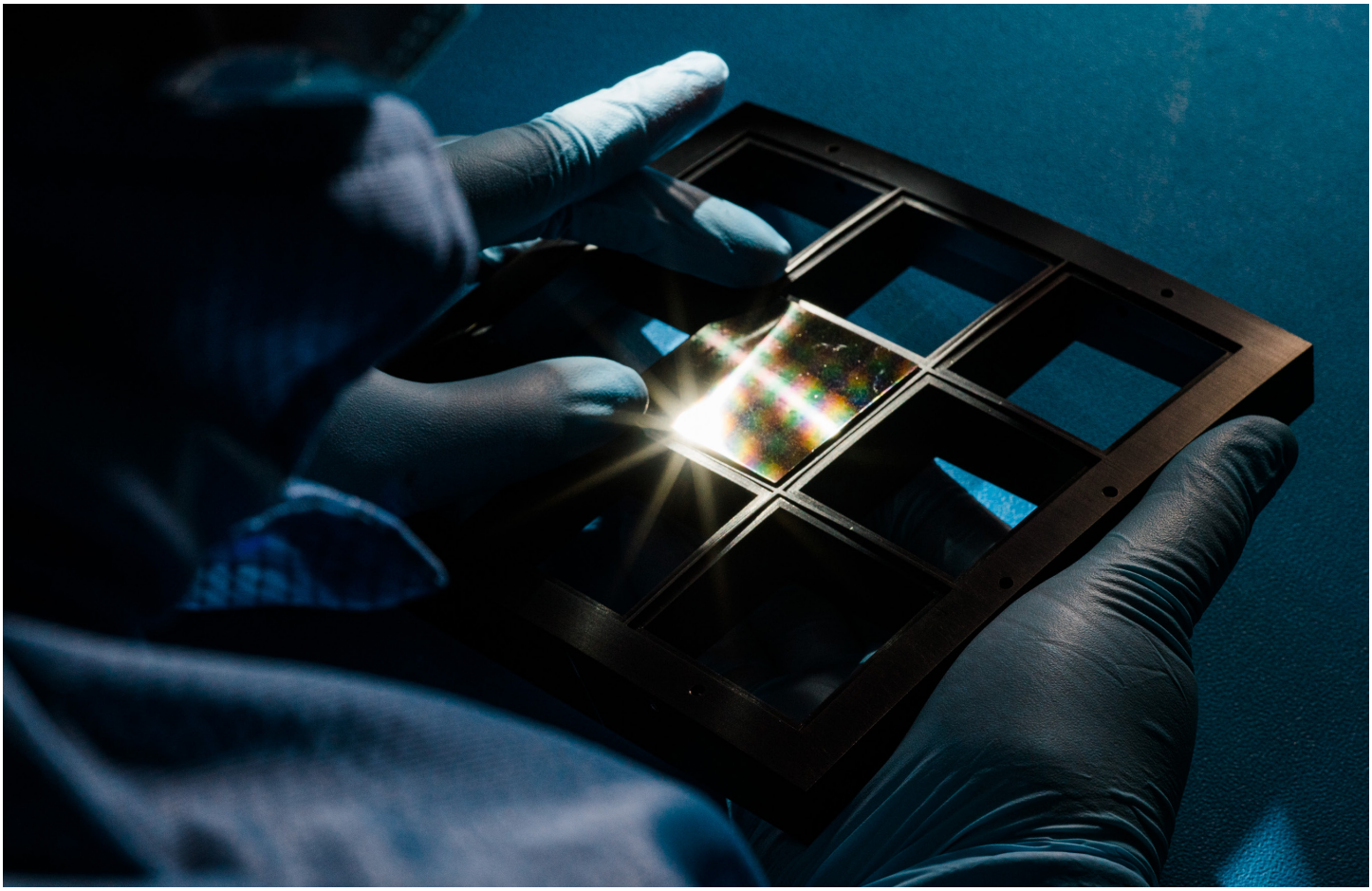
The Photonics Center staffs and maintains four shared core equipment laboratories for its community. These shared facilities provide researchers with access to essential infrastructure for optics and photonics device fabrication and measurement. Faculty, staff, and student access to training and usage is unrestricted, and all operational costs, except for individual researcher supplies, are supported by Photonics Center's core budget. Shared facilities access is also available on a fee-for-use basis by current and former BIC companies, outside universities, and outside companies.

- **Optoelectronic Processing Facility** – The Optoelectronic Processing Facility (OPF) is a multi-user 2500 sq. ft. laboratory dedicated to fabrication of optoelectronic and photonic devices. The facility is housed in a cleanroom with processing and test equipment for die and wafer level thin film deposition, photolithography, wet and dry chemical processing, plasma etching and cleaning, metallization, thermal oxidation, thermal annealing, wire bonding, electrical characterization, test, and assembly. It is managed by Photonics Center staff member Paul Mak.
- **The Precision Measurement Laboratory** (PML) is dedicated to measurement and analysis

of photonic components and to e-beam writing of nanoscale photonic structures. It consists of two laboratory spaces with equipment for field emission scanning electron microscopy, atomic force microscopy, surface mapping interferometry, and Fourier transform infrared spectroscopy, and scanning electron beam writing. It is managed by Photonics Center staff member Anlee Krupp.

- **The Focused Ion Beam/ Transmission Electron Microscope Facility** (FTF) is dedicated to atomic-scale machining and characterization of material composition, image surface morphology, and micro/nano machined materials. It consists of a laboratory with a focused ion beam tool and a transmission electron microscope, along with facilities for sample preparation and characterization. It is managed by Photonics Center staff member Alexey Nikiforov.
- **The Materials Science Core Facility** (MSCF) is dedicated to materials science characterization. It consists of processing hoods for materials preparation and equipment for X-ray crystallography micro computed tomography, atomic force microscopy, and Raman Microscopy. It is managed collectively by staff from the Photonics Center with support from the Materials Science and Engineering Division of the College of Engineering.

In the past year, pandemic-related university guidelines resulted in significant disruption of shared facilities, including a months-long shut-down followed by a gradual return to operation. Lab managers adapted by providing remote training during the shut-down period and technician-led processing and measurement during the "ramp-up" period in which student and faculty access was limited. As of August 2021, all the shared labs are at 100% capacity and back to normal operation.



This photo was taken in the lab of Assistant Professor Brian Walsh. (Photo Credit: Christopher Mcintosh.)

These photos were taken in the labs of Assistant Professors Ian Davison and Michael Economo..
(Photo Credit: Christopher Mcintosh)

Strategic Goals

CENTRAL TO THE PHOTONICS CENTER STRATEGIC PLAN is an operational model where the Center functions as a university resource – promoting, supporting, and sustaining allied research centers and interdisciplinary programs across BU. The Center has been conducting business as an Institute, leading on several activities such as the BIC, managing and equipping shared laboratories, and administering/supporting block grants and supporting affiliated units. Some of the affiliated units include the Materials Science and Engineering Division, the Neurophotonics Center, and most recently the CELL-MET ERC. With respect to the Materials Division, the Photonics Center has managed substantial renovations for the Division and co-manages shared labs such as the FTF and the Materials Shared lab. In addition to these facilities, the Photonics Center also manages two other shared labs as described in the section on facilities, as well as the faculty labs in the building.

In support of its strategic goal of expanding core programs for research support, the Photonics Center provides strategic advice, critical review, management, and logistical support for large scale, complex collaborations proposed for external sponsorship, including research and educational projects. Major successes were the award of the NRT grant on Understanding the Brain (UtB) in FY17, and the award of the CELL-MET ERC in FY18. The support continues post-award with project administration and assistance on compliance matters from sponsor and University perspectives. The Photonics Center provides outsized support for the CELL-MET ERC, assuming leadership roles in Administration, Innovation Ecosystems, and in one of the four Research Thrusts. The Photonics Center is also taking on the implementation and management of the new multi-institutional NIH U19: Local Neuronal Drive and Neuromodulatory Control of Activity in the Pial Neurovascular Circuit. This was awarded to Professor Anna Devor as PI through the NIH BRAIN Initiative.

The Photonics Center is also taking on the implementation and management of the new multi-institutional NIH U19: Local Neuronal Drive and Neuromodulatory Control of Activity in the Pial Neurovascular Circuit.

The resources and expertise of the Photonics Center staff are employed to manage several training grants that include: RET, REU and NRT grants. In addition, the Center also supports major faculty-awarded grants such as the Department of Defense grant on Multi-Scale Multi-Disciplinary Modeling of Electronic Materials (MSME). MSME is a major grant involving close collaborations with the ARL's research scientist at the Sensors and Electronic Devices Directorate and interactions with ARL's Enterprise for Multiscale Research of Materials.

At the BIC, located on the 6th floor of the Photonics Center, Photonics Center staff are implementing strategic priorities that align the BIC more closely with ongoing faculty member research and educational activities. Placing an emphasis on translational research, BIC has added three companies in the past year that spun-out of BU research putting the total of BU spinouts to six companies over the last two years. Additionally, three strategic partners that have the resources to exploit photonics technologies anchor our educational, innovation, and technology transfer efforts.

Scholarly Work of the Photonics Center Faculty

BOOK CHAPTERS

Economo, M., Noueihed, J., Martinez, J., & **White, J.** (2020). Neural Modeling. In B. He (Ed.), *Neural Engineering. Springer Science & Business Media.**

Ferruzzi, J., **Roblyer, D.**, Zhang, Y., & Zaman, M. (2020). Multi-Scale Mechanics of Collagen Networks: Biomechanical Basis of Matrix Remodeling in Cancer. In Y. Zhang (Ed.), *Multi-Scale ECM Mechanics and Mechanobiology*. Springer.

Ferruzzi, J., **Roblyer, D.,** Zhang, Y., & Zaman, M. (2020). Multi-scale Mechanics of Collagen Networks: Biomechanical Basis of Matrix Remodeling in Cancer. In Y. Zhang (Ed.), *Multi-scale Extracellular Matrix Mechanics and Mechanobiology*. Springer.

Kimball., Afach., Aybas, D., Blanchard., Budker., **Sushkov, A.**, Centers., . . . Wu. (2020). Overview of the Cosmic Axion Spin Precession Experiment (CASPEr). In G. Carosi, & G. Rybka (Eds.), *Microwave Cavities and Detectors for Axion Research Proceedings of the 3rd International Workshop* (pp. 105-121). Springer Nature.

Foster, J., Erickson, P., & **Walsh, B.** (2020). *Multi-Point Observations of the Geospace Plume*. doi:10.1002/9781119509592.ch14

JOURNAL ARTICLES

Gasper, P., Lu, Y., Nikiforov, A., **Basu, S.**, Gopalan, S., & Pal, U. (2020). Detailed Electrochemical Performance and Microstructural Characterization of Nickel – Yttria Stabilized Zirconia Cermet Anodes Infiltrated with Nickel, Gadolinium Doped Ceria, and Nickel – Gadolinium Doped Ceria Nanoparticles. *Journal of Power Sources*, 447, 227357. doi:10.1016/j.jpowsour.2019.227357

Mo, B., Rix, J., Pal, U., **Basu, S.**, & Gopalan, S. (2020). Characterizing Performance of Electrocatalyst Nanoparticles Infiltrated into Ni-YSZ Cermet Anodes for Solid Oxide Fuel Cells. *Journal of The Electrochemical Society*, 167(5), 054515. doi:10.1149/1945-7111/ab74bf

Mo, B., Rix, J., Pal, U., **Basu, S.**, & Gopalan, S. (2020). Improving SOFC Anode Electrocatalytic Activity Using Nanoparticle Infiltration into MIEC Compositions. *Journal of The Electrochemical Society*, 167(13), 134506. doi:10.1149/1945-7111/abb70f

Ordu, M., & **Basu, S.** (2020). Recent Progress in Germanium-core Optical Fibers for Mid-infrared Optics. *Infrared Physics & Technology*, 111, 103507. doi:10.1016/j.infrared.2020.103507

Ordu, M., Guo, J., Akosman, A. E., **Erramilli, S.**, **Ramachandran, S.**, & **Basu, S.** (2020). Effect of Thermal Annealing on Mid-Infrared Transmission in Semiconductor Alloy-Core Glass-Cladded Fibers. *Advanced Fiber Materials*, 2(3), 178-184. doi:10.1007/s42765-020-00030-2*

Wang, R., Lu, Y., Ma, Y., Sun, Z., Gopalan, S., **Basu, S.**, & Pal, U. (2020). Experimental Validation of Solid Oxide Fuel Cell Polarization Modeling: An LSMYSZ/YSZ/Ni-YSZ Case Study. *Electrochimica Acta*, 361, 137052. doi:10.1016/j.electacta.2020.137052

Wang, R., Sun, Z., Lu, Y., Gopalan, S., **Basu, S.**, & Pal, U. (2020). Comparison of Chromium Poisoning Between Lanthanum Strontium Manganite and Lanthanum Strontium Ferrite Composite Cathodes in Solid Oxide Fuel Cells. *Journal of Power Sources*, 476, 228743. doi:10.1016/j.jpowsour.2020.228743

Zhu, Z., Sugimoto, M., Pal, U., Gopalan, S., & **Basu, S.** (2020). Electrochemical Cleaning: An in-Situ Method to Reverse Chromium Poisoning in Solid Oxide Fuel Cell Cathodes. *Journal of Power Sources*, 471, 228474. doi:10.1016/j.jpowsour.2020.228474

Bertazzi, F., Tibaldi, A., Goano, M., Montoya, J., & **Bellotti, E.** (2020). Nonequilibrium Green's Function Modeling of type-II Superlattice Detectors and its Connection to Semiclassical Approaches. *Physical Review Applied*, 14(1). doi:10.1103/physrevapplied.14.014083

Kyrtsos, A., Matsubara, M., & **Bellotti, E.** (2020). Band Offsets of Al x Ga1-x N Alloys Using First-principles Calculations. *J Phys Condens Matter*, 32(36), 365504. doi:10.1088/1361-648X/ab922a

Kyrtsos, A., Matsubara, M., & **Bellotti, E.** (2020). Investigation of the Band Gaps and Bowing Parameter of InAs1−xSbx Alloys Using the Modified Becke-Johnson Potential. *Physical Review Materials*, 4(1). doi:10.1103/physrevmaterials.4.014603

Prigozhin, I., Dominici, S., & **Bellotti, E.** (2020). FBMC3D--A Large-Scale 3-D Monte Carlo Simulation Tool for Modern Electronic Devices. *IEEE Transactions on Electron Devices*, 1-9. doi:10.1109/ted.2020.3039482

Sengupta, P., & **Bellotti, E.** (2020). Anomalous Lorenz Number in Massive and Tilted Dirac Systems. *Applied Physics Letters*, 117(22), 223103. doi:10.1063/5.0028959

Sharabani, Y., Palmieri, A., Kyrtsos, A., Matsubara, M., & **Bellotti, E.** (2020). Interfacial Charge Dynamics in Metal-Oxide–Semiconductor Structures: The Effect of Deep Traps and Acceptor Levels in GaN. *Physical Review Applied*, 13(1). doi:10.1103/physrevapplied.13.014007

Svensson, S., Sarney, W., Beck, W., Liu, J., Donetsky, D., Suchalkin, S., . . . **Bellotti, E.** (2020). P-doping with Beryllium of Long-wavelength InAsSb. *Semiconductor Science and Technology*, 35(12), 125001. doi:10.1088/1361-6641/abb7c0

Tibaldi, A., Montoya, J., Alasio, M., Gullino, A., Larsson, A., Debernardi, P., **Bellotti, E.** . . . Bertazzi, F. (2020). Analysis of Carrier Transport in Tunnel-Junction Vertical-Cavity Surface-Emitting Lasers by a Coupled Nonequilibrium Green's Function–Drift-Diffusion Approach. *Physical Review Applied*, 14(2). doi:10.1103/physrevapplied.14.024037

Beaulieu, D., **Davison, I., Bifano, T**., **Mertz, J.**, & Kılıç, K. (2020). Simultaneous Multiplane Imaging with Reverberation Multiphoton Microscopy. *Nature Methods*, 17(3), 283-286. doi:10.1038/s41592-019-0728-9*

Chen, C., Huang, Y., Wu, K., **Bifano, T.**, Anderson, S., Zhao, X., & **Zhang, X.** (2020). Polarization Insensitive, Metamaterial Absorber-enhanced Long-wave Infrared Detector. *Opt Express*, 28(20), 28843-28857. doi:10.1364/OE.403105*

Lin, P., Ni, H., Li, H., Vickers, N. A., Tan, Y., Gong, R., **Bifano, T.** . . . **Cheng, J.** (2020). Volumetric Chemical Imaging in vivo by a Remote-focusing Stimulated Raman Scattering Microscope. *Opt Express*, 28(20), 30210-30221. doi:10.1364/OE.404869*

Zhao, X., Wu, K., Chen, C., **Bifano, T.**, **Anderson, S**., & **Zhang, X.** (2020). Nonreciprocal Magnetic Coupling Using Nonlinear Meta-Atoms. *Adv Sci* (Weinh), 7(19), 2001443. doi:10.1002/advs.202001443*

Belghasem, M., A'amar, O., Roth, D., Walker, J., Arinze, N., Richards, S., . . . **Bigio, I.** (2019). Towards Minimally-invasive, Quantitative Assessment of Chronic Kidney Disease Using Optical Spectroscopy. *Sci Rep*, 9(1), 7168. doi:10.1038/s41598-019-43684-8

Raufer, S., Idoff, C., Zosuls, A., Marino, G., Blanke, N., **Bigio, I.**, . . . Nakajima, H. (2020). Anatomy of the Human Osseous Spiral Lamina and Cochlear Partition Bridge: Relevance for Cochlear Partition Motion. *J Assoc Res Otolaryngol*, 21(2), 171-182. doi:10.1007/s10162-020-00748-1

Rodriguez-Diaz, E., Manolakos, D., Christman, H., Bonning, M., Geisse, J., A'Amar, O., . . . **Bigio, I.** (2019). Optical Spectroscopy as a Method for Skin Cancer Risk Assessment. *Photochem Photobiol*, 95(6), 1441-1445. doi:10.1111/php.13140

Sharaha, U., Rodriguez-Diaz, E., Sagi, O., Riesenberg, K., Salman, A., **Bigio, I.**, & Huleihel, M. (2019). Fast and Reliable Determination of Escherichia coli Susceptibility to Antibiotics: Infrared Microscopy in Tandem with Machine Learning Algorithms. *J Biophotonics*, 12(7), e201800478. doi:10.1002/jbio.201800478

Barrett, L., Lally, R., Fuhr, N., Stange, A., & **Bishop, D.** (2020). A Chip-Scale, Low Cost PVD System. *Journal of Microelectromechanical Systems*, 29(6), 1547-1555. doi:10.1109/jmems.2020.3026533

Javor, J., Stange, A., Pollock, C., Fuhr, N., & **Bishop, D.** (2020). 100 pT/cm Single-point MEMS Magnetic Gradiometer from a Commercial Accelerometer. *Microsystems & Nanoengineering*, 6(1). doi:10.1038/s41378-020-0173-z

Pérez-Morelo, D., Stange, A., Lally, R., Barrett, L., Imboden, M., Campbell, D., . . . **Bishop, D.** (2020). Searching for the Casimir Energy. Retrieved from: http://arxiv.org/abs/2004.13771v1

Pérez-Morelo, D., Stange, A., Lally, R., Barrett, L., Imboden, M., Som, A., . . . **Bishop, D.** (2020). A System for Probing Casimir Energy Corrections to the Condensation Energy. *Microsyst Nanoeng*, 6, 115. doi:10.1038/s41378-020-00221-2

Pollock, C., Pardo, F., Imboden, M., & **Bishop, D.** (2020). Open Loop Control Theory Algorithms for High-speed 3D MEMS Optical Switches. *Optics Express*, 28(2), 2010. doi:10.1364/oe.367554

Cheng, X., Sadegh, S., Zilpelwar, S., **Devor, A., Tian, L.**, & **Boas, D.** (2020). Comparing the Fundamental Imaging Depth Limit of Two-photon, Three-photon, and Nondegenerate Two-Photon Microscopy. *Optics Letters*, 45, 2934-2937.*

Damseh, R., Pouliot, P., Gagnon, L., Sakadzic, S., **Boas, D.**, Cheriet, F., & Lesage, F. (2019). Automatic Graph-Based Modeling of Brain Microvessels Captured With Two-Photon Microscopy. *IEEE J Biomed Health Inform*, 23(6), 2551-2562. doi:10.1109/JBHI.2018.2884678

Erdener, Ş., Tang, J., Sajjadi, A., Kılıç, K., Kura, S., Schaffer, C., & **Boas, D.** (2019). Spatio-temporal Dynamics of Cerebral Capillary Segments with Stalling Red Blood Cells. *J Cereb Blood Flow Metab*, 39(5), 886-900. doi:10.1177/0271678X17743877

Jones, R., Grisot, G., Augustinack, J., Magnain, C., **Boas, D.**, Fischl, B., . . . Yendiki, A. (2020). Insight into the Fundamental Trade-offs of Diffusion MRI from Polarization-sensitive Optical Coherence Tomography in ex vivo Human Brain. *Neuroimage*, 214, 116704. doi:10.1016/j.neuroimage.2020.116704

Kılıç, K., Desjardins, M., Tang, J., Thunemann, M., Sunil, S., Erdener, Ş., . . . **Devor, A.** (2020). Chronic Cranial Windows for Long Term Multimodal Neurovascular Imaging in Mice. *Front Physiol*, 11, 612678. doi:10.3389/fphys.2020.612678

Kılıç, K., Tang, J., Erdener, Ş., Sunil, S., Giblin, J., Lee, B., . . . **Boas, D.** (2020). Chronic Imaging of Mouse Brain: From Optical Systems to Functional Ultrasound. *Curr Protoc Neurosci*, 93(1), e98. doi:10.1002/cpns.98

Li, X., Krol, M., Jahani, S., **Boas, D.**, Tager-Flusberg, H., & Yücel, M. (2020). Brain Correlates of Motor Complexity During Observed and Executed Actions. *Sci Rep*, 10(1), 10965. doi:10.1038/s41598-020-67327-5

Ortega-Martinez, A., Zimmermann, B., Cheng, X., Li, X., Yucel, M., & **Boas, D.** (2019). Contribution of Speckle Noise in Near-infrared Spectroscopy Measurements. *J Biomed Opt*, 24(10), 1-6. doi:10.1117/1.JBO.24.10.105003

Postnov, D., Tang, J., Erdener, S., Kılıç, K., & **Boas, D.** (2020). Dynamic Light Scattering Imaging. *Sci Adv*, 6(45). doi:10.1126/sciadv.abc4628

Robinson, M., **Boas, D.**, Sakadzic, S., Franceschini, M., & Carp, S. (2020). Interferometric Diffuse Correlation Spectroscopy Improves Measurements at Long Source–detector Separation and Low Photon Count Rate. *Journal of Biomedical Optics*, 25(09). doi:10.1117/1.jbo.25.9.097004

Robinson, M., Carp, S., Peruch, A., **Boas, D.**, Franceschini, M., & Sakadžić, S. (2020). Characterization of Continuous Wave Ultrasound for Acousto-optic Modulated Diffuse Correlation Spectroscopy (AOM-DCS). *Biomed Opt Express*, 11(6), 3071-3090. doi:10.1364/BOE.390322

Schytz, H., Amin, F., Selb, J., & **Boas, D.** (2019). Non-invasive Methods for Measuring Vascular Changes in Neurovascular Headaches. *J Cereb Blood Flow Metab*, 39(4), 633-649. doi:10.1177/0271678X17724138

Secomb, T., Bullock, K., **Boas, D.**, &

Sakadžić, S. (2020). The Mass Transfer Coefficient for Oxygen Transport from Blood to Tissue in Cerebral Cortex. *J Cereb Blood Flow Metab,* 40(8), 1634-1646. doi:10.1177/0271678X19870068

Secomb, T., Celaya-Alcala, J., **Boas, D.**, & Sakadžić, S. (2020). The Problem of Estimating Tissue Perfusion from Observations of Microvascular Flow. *The FASEB Journal*, 34(S1), 1. doi:10.1096/fasebj.2020.34.s1.05843

Selb, J., Wu, K., Sutin, J., Lin, P., Farzam, P., Bechek, S.**, Boas, D.** . . . Rosenthal, E. (2020). Erratum: Prolonged Monitoring of Cerebral Blood Flow and Autoregulation with Diffuse Correlation Spectroscopy in Neurocritical Care Patients. *Neurophotonics*, 7(1), 019801. doi:10.1117/1.NPh.7.1.019801

Şencan, İ., Esipova, T., Kılıç, K., Li, B., Desjardins, M., Yaseen, M., **Boas, D.** . . . Sakadžić, S. (2020). Optical Measurement of Microvascular Oxygenation and Blood Flow Responses in Awake Mouse Cortex During Functional Activation. *J Cereb Blood Flow Metab*, 271678X20928011. doi:10.1177/0271678X20928011

Sunil, S., Erdener, S. E., Lee, B., Postnov, D., Tang, J., Kura, S., **Boas, D.** . . . Kılıç, K. (2020). Awake Chronic Mouse Model of Targeted Pial Vessel Occlusion via Photothrombosis. *Neurophotonics*, 7(1), 015005. doi:10.1117/1.NPh.7.1.015005

Tamborini, D., Stephens, K. A., Wu, M., Farzam, P., Siegel, A., Shatrovoy, O., **Boas, D.** . . . Franceschini, M. (2019). Portable System for Time-Domain Diffuse Correlation Spectroscopy. *IEEE Trans Biomed Eng*, 66(11), 3014-3025. doi:10.1109/TBME.2019.2899762

Tang, J., Erdener, S., Sunil, S., & **Boas, D.** (2019). Normalized Field Autocorrelation Function-based Optical Coherence Tomography Three-dimensional Angiography. *J Biomed Opt*, 24(3), 1-8. doi:10.1117/1.JBO.24.3.036005

Tang, J., Postnov, D. D., Kilic, K., Erdener, S., Lee, B., Giblin, J., . . . **Boas, D.** (2020). Functional Ultrasound Speckle Decorrelation-Based Velocimetry of the Brain. *Adv Sci* (Weinh), 7(18), 2001044. doi:10.1002/advs.202001044

von Lühmann, A., Li, X., Gilmore, N., **Boas, D.**, & Yücel, M. (2020). Open Access Multimodal fNIRS Resting State Dataset With and Without Synthetic Hemodynamic Responses. *Front Neurosci,* 14, 579353. doi:10.3389/fnins.2020.579353

von Lühmann, A., Li, X., Müller, K., **Boas, D.**, & Yücel, M. (2020). Improved Physiological Noise Regression in fNIRS: A Multimodal Extension of the General Linear Model Using Temporally Embedded Canonical Correlation Analysis. *Neuroimage*, 208, 116472. doi:10.1016/j.neuroimage.2019.116472

von Lühmann, A., Ortega-Martinez, A., **Boas, D.,** & Yücel, M. (2020). Using the General Linear Model to Improve Performance in fNIRS Single Trial Analysis and Classification: A Perspective. *Front Hum Neurosci*, 14, 30. doi:10.3389/fnhum.2020.00030

Xie, H., Chung, D., Kura, S., Sugimoto, K., Aykan, S., Wu, Y., **Boas, D.** . . . Ayata, C. (2020). Differential Effects of Anesthetics on Resting State Functional Connectivity in the Mouse. *J Cereb Blood Flow Metab*, 40(4), 875-884. doi:10.1177/0271678X19847123

Xue, Y., Davison, I., **Boas, D.**, & Tian, L. (2020). Single-Shot 3D Widefield Fluorescence Imaging with a Computational Miniature Mesoscope. *Science Advances*, 6, eabb7508.*

Yang, J., Chen, I. A., Chang, S., Tang, J., Lee, B., Kılıç, K., . . . **Boas, D.** (2020). Improving the Characterization of ex vivo Human Brain Optical Properties Using High Numerical Aperture Optical Coherence Tomography by Spatially Constraining the Confocal Parameters. *Neurophotonics*, 7(4), 045005.

Alsharif, N., Eshaghi, B., **Reinhard, B**., & **Brown, K.** (2020). Physiologically Relevant Mechanics of Biodegradable Polyester Nanoparticles. *Nano Lett*, 20(10), 7536-7542. doi:10.1021/acs.nanolett.0c03004*

Alsharif, N., Uzarski, J., Lawton, T., & **Brown, K.** (2020). High-Throughput Multiobjective Optimization of Patterned Multifunctional Surfaces. *ACS Appl Mater Interfaces*, 12(28), 32069-32077. doi:10.1021/acsami.0c04202

Brown, K., Brittman, S., Maccaferri, N., Jariwala, D., & Celano, U. (2020). Machine Learning in Nanoscience: Big Data at Small Scales. *Nano Lett*, 20(1), 2-10. doi:10.1021/acs.nanolett.9b04090

Cao, W., Chern, M., **Dennis, A.**, & **Brown, K.** (2019). Measuring Nanoparticle Polarizability Using Fluorescence Microscopy. *Nano Lett*, 19(8), 5762-5768. doi:10.1021/acs.nanolett.9b02402*

Eshaghi, B., Alsharif, N., An, X., Akiyama, H., **Brown, K.**, Gummuluru, S., & **Reinhard, B.** (2020). Stiffness of HIV-1 Mimicking Polymer Nanoparticles Modulates Ganglioside-Mediated Cellular Uptake and Trafficking. *Adv Sci* (Weinh), 7(18), 2000649. doi:10.1002/advs.202000649*

Gongora, A., Xu, B., Perry, W., Okoye, C., Riley, P., Reyes, K., . . . **Brown, K.** (2020). A Bayesian Experimental Autonomous Researcher for Mechanical Design. *Science Advances*, 6(15). doi:10.1002/jbmr.3946

McDonald, K., Rendos, A., Woodman, S., **Brown, K**., & Ranzani, T. (2020). Magnetorheological Fluid-Based Flow Control for Soft Robots. *Advanced Intelligent Systems*, 2(11), 2000139. doi:10.1002/aisy.202000139

McDonald, K., Rendos, A., Woodman, S., **Brown, K.**, & Ranzani, T. (2020). Magnetorheological Fluid-Based Flow Control for Soft Robots. *Advanced Intelligent Systems*, 2(11), 2070107. doi:10.1002/aisy.202070107

Rendos, A., Woodman, S., McDonald, K., Ranzani, T., & **Brown, K.** (2020). Shear Thickening Prevents Slip in Magnetorheological Fluids. *Smart Materials and Structures*, 29(7), 07LT02. doi:10.1088/1361-665x/ab8b2e

Soffer, L., Rendos, A., Zosuls, A., **Walsh, B.,** & **Brown, K.** (2020). Dielectrophoresis of Air. *Applied Physics Letters*, 116(8), 084101. doi:10.1063/5.0002286*

Xu, B., Saygin, V., **Brown, K.**, & **Anderson, S.** (2020). High-resolution Measurement of Atomic Force Microscope Cantilever Resonance Frequency. *Rev Sci Instrum*, 91(12), 123705. doi:10.1063/5.0026069*

Bai, Y., Zhang, D., Lan, L., Huang, Y., Maize, K., Shakouri, A., & **Cheng, J.** (2019). Ultrafast Chemical Imaging by

Widefield Photothermal Sensing of Infrared Absorption. *Sci Adv*, 5(7), eaav7127. doi:10.1126/sciadv.aav7127

Bi, H., Huo, C., Song, X., Li, Z., Tang, H., Griesse-Nascimento, S., **Cheng, J.** . . . Saikin, S. (2020). Room-Temperature Phosphorescence and Low-Energy Induced Direct Triplet Excitation of Alq3 Engineered Crystals. *J Phys Chem Lett*, 11(21), 9364-9370. doi:10.1021/acs.jpclett.0c02416

Cao, Y., Alloosh, M., Sturek, M., & **Cheng, J.** (2020). Highly Sensitive Lipid Detection and Localization in Atherosclerotic Plaque with a Dual-frequency Intravascular photoacoustic/ultrasound catheter. *Translational Biophotonics*, 2(3). doi:10.1002/tbio.202000004

Chen, A., Huang, K., Bopp, S., Summers, R., Dong, P., Huang, Y., . . . **Cheng, J.** (2019). Quantitative Imaging of Intraerythrocytic Hemozoin by Transient Absorption Microscopy. *J Biomed Opt*, 25(1), 1-11. doi:10.1117/1.JBO.25.1.014507

Chen, X., Wang, X., Wang, L., Lin, P., Zhan, Y., & **Cheng, J. (**2020). Stimulated Raman Scattering Signal Generation in a Scattering Medium Using Self-reconstructing Bessel Beams. *Photonics Research*, 8(6), 929. doi:10.1364/prj.384604

Chen, X., Zhu, S., Wang, H., Bao, C., Yang, D., Zhang, C., **Cheng, J.** . . . Tian, J. (2020). Accelerated Stimulated Raman Projection Tomography by Sparse Reconstruction from Sparse-View Data. *IEEE Transactions on Biomedical Engineering*, 67(5), 1293-1302. doi:10.1109/tbme.2019.2935301

Dong, P., Lin, H., Huang, K., & **Cheng, J.** (2019). Label-free Quantitation of Glycated Hemoglobin in Single Red Blood Cells by Transient Absorption Microscopy and Phasor Analysis. *Sci Adv,* 5(5), eaav0561. doi:10.1126/sciadv.aav0561

Hekman, R., Hume, A., Goel, R., Abo, K., Huang, J., Blum, B., **Cheng, J.** . . . Emili, A. (2020). Actionable Cytopathogenic Host Responses of Human Alveolar Type 2 Cells to SARS-CoV-2. *Mol Cell*, 80(6), 1104-1122. e9. doi:10.1016/j.molcel.2020.11.028

Huang, K., Li, J., Zhang, C., Tan, Y., & **Cheng, J.** (2020). Multiplex Stimulated Raman Scattering Imaging Cytometry Reveals Lipid-Rich Protrusions in Cancer Cells under Stress Condition. *iScience*, 23(3), 100953. doi:10.1016/j.isci.2020.100953

Hui, J., Dong, P., Liang, L., Mandal, T., Li, J., Ulloa, E., . . . **Cheng, J.** (2020). Photo-Disassembly of Membrane Microdomains Revives Conventional Antibiotics against MRSA. *Adv Sci* (Weinh), 7(6), 1903117. doi:10.1002/advs.201903117

Hui, J., Dong, P., Liang, L., Mandal, T., Li, J., Ulloa, E., . . . **Cheng, J.** (2020). Antibiotic Resistance: Photo-Disassembly of Membrane Microdomains Revives Conventional Antibiotics Against MRSA (Adv. Sci. 6/2020). *Advanced Science*, 7(6), 2070035. doi:10.1002/advs.202070035

Jiang, L., Zhao, J., **Cheng, J.,** & Wolozin, B. (2020). Tau Oligomers and Fibrils Exhibit Differential Patterns of Seeding and Association With RNA Binding Proteins. *Front Neurol*, 11, 579434. doi:10.3389/fneur.2020.579434

Jiang, Y., Lee, H. J., Lan, L., Tseng, H., Yang, C., Man, H., **Han, X..** . . **Cheng, J.** (2020). Optoacoustic Brain Stimulation at Submillimeter Spatial Precision. *Nat Commun*, 11(1), 881. doi:10.1038/s41467-020-14706-1*

Jusuf, S., Hui, J., Dong, P., & **Cheng, J.** (2020). Staphyloxanthin Photolysis Potentiates Low Concentration Silver Nanoparticles in Eradication of Methicillin-Resistant Staphylococcus Aureus. *The Journal of Physical Chemistry C*, 124(9), 5321-5330. doi:10.1021/acs.jpcc.9b10209

Kole, A., Cao, Y., Hui, J., Bolad, I., Alloosh, M., **Cheng, J.**, & Sturek, M. (2019). Comparative Quantification of Arterial Lipid by Intravascular Photoacoustic-Ultrasound Imaging and Near-Infrared Spectroscopy-Intravascular Ultrasound. *J Cardiovasc Transl Res*, 12(3), 211-220. doi:10.1007/s12265-018-9849-2

Lan, L., Li, Y., Yang-Tran, T., Jiang, Y., Cao, Y., & **Cheng, J.** (2020). Ultraefficient Thermoacoustic Conversion Through a Split Ring Resonator. *Advanced Photonics*, 2 (03), 1. doi:10.1117/1.ap.2.3.036006

Leanse, L., Dong, P., Goh, X. S., Lu, M., **Cheng, J.**, Hooper, D., & Dai, T. (2020). Quinine Enhances Photo-Inactivation of Gram-Negative Bacteria. *J Infect Dis*, 221(4), 618-626. doi:10.1093/infdis/jiz487

Leanse, L., Goh, X., **Cheng, J.,** Hooper, D., & Dai, T. (2020). Dual-wavelength Photo-killing of Methicillin-resistant Staphylococcus Aureus. *JCI Insight*, 5 (11). doi:10.1172/jci.insight.134343

Li, H., Cheng, Y., Tang, H., Bi, Y., Chen, Y., Yang, G., **Cheng, J.** . . . Wang, P. (2020). Imaging Chemical Kinetics of Radical Polymerization with an Ultrafast Coherent Raman Microscope. *Adv Sci* (Weinh), 7(10), 1903644. doi:10.1002/advs.201903644

Li, X., Zhang, D., Bai, Y., Wang, W., Liang, J., & **Cheng, J.** (2019). Fingerprinting a Living Cell by Raman Integrated Mid-Infrared Photothermal Microscopy. *Anal Chem*, 91(16), 10750-10756. doi:10.1021/acs.analchem.9b02286

Li, Z., Lin, P., Huang, Y., Park, J., Chen, W., Shi, Z., C**heng, J.** . . . Capasso, F. (2020). 40-3: Invited Paper: A Large RGB-achromatic Metalens for Virtual/Augmented Reality Applications. SID Symposium Digest of Technical Papers, 51(1), 575-578. doi:10.1002/sdtp.13933

Lin, H., Lee, H., Tague, N., Lugagne, J., Zong, C., Deng, F., . . . **Cheng, J.** (2020). Fingerprint Spectroscopic SRS Imaging of Single Living Cells and Whole Brain by Ultrafast Tuning and Spatial-Spectral Learning. Retrieved from: http://arxiv.org/abs/2003.02224v1

Park, J., Zhang, S., She, A., Chen, W., Lin, P., Yousef, K., **Cheng, J.** . . . Capasso, F. (2019). All-Glass, Large Metalens at Visible Wavelength Using Deep-Ultraviolet Projection Lithography. *Nano Lett*, 19(12), 8673-8682. doi:10.1021/acs.nanolett.9b03333

Rishøj, L., Deng, F., Tai, B., **Cheng, J.,** & **Ramachandran, S.** (2020). Jitter-free, Dual-wavelength, Ultrashort-pulse, Energetic Fiber Sources Using Soliton Self-mode Conversion. *Optics Express*, 28(3), 4333. doi:10.1364/oe.384395*

Shi, L., Jiang, Y., Fernandez, F., Lan, L., Chen, G., Man, H., **Cheng, J.** . . . **Yang, C.** (2020). Non-genetic Acoustic Stimulation of Single Neurons by a Tapered Fiber Optoacoustic Emitter. Retrieved from: http://arxiv.org/abs/2012.09930v1*

Shi, L., Jiang, Y., Zhang, Y., Lan, L., Huang, Y., **Cheng, J.**, & **Yang, C.** (2020). A Fiber Optoacoustic Emitter with Controlled Ultrasound Frequency for Cell Membrane Sonoporation at Submillimeter Spatial Resolution. *Photoacoustics*, 20, 100208. doi:10.1016/j.pacs.2020.100208*

Wu, J., Lee, H. J., You, L., Luo, X., Hasegawa, T., Huang, K., . . . **Cheng, J.** (2020). Functionalized NIR-II Semiconducting Polymer Nanoparticles for Single-cell to Whole-Organ Imaging of PSMA-Positive Prostate Cancer. *Small*, 16(19), e2001215. doi:10.1002/smll.202001215

Wu, J., Zhu, Y., You, L., Dong, P., Mei, J., & **Cheng, J.** (2020). Polymer Electrochromism Driven by Metabolic Activity Facilitates Rapid and Facile Bacterial Detection and Susceptibility Evaluation. *Adv Funct Mater*, 30(49). doi:10.1002/adfm.202005192

Xu, J., Li, X., Guo, Z., Huang, W., & **Cheng, J.** (2020). Fingerprinting Bacterial Metabolic Response to Erythromycin by Raman-Integrated Mid-Infrared Photothermal Microscopy. *Anal Chem*, 92(21), 14459-14465. doi:10.1021/acs.analchem.0c02489

Zhang, J., Lin, H., Zhao, J., Tan, Y., & **Cheng, J.** (2020). High-Speed Multiplexed Vibrational Imaging by Femtosecond Stimulated Raman Scattering and Deep Learning. Conference on Lasers and Electro-Optics. doi:10.1364/cleo_at.2020.aw3t.3

Zhang, J., Zhao, J., Lin, H., Tan, Y., & **Cheng, J.** (2020). High-Speed Chemical Imaging by Dense-Net Learning of Femtosecond Stimulated Raman Scattering. *J Phys Chem Lett*, 11(20), 8573-8578. doi:10.1021/acs.jpclett.0c01598

Zhang, M., Hong, W., Abutaleb, N., Li, J., Dong, P., Zong, C., . . . **Cheng, J.** (2020). Rapid Determination of Antimicrobial Susceptibility by Stimulated Raman Scattering Imaging of D2O Metabolic Incorporation in a Single Bacterium. *Adv Sci* (Weinh), 7(19), 2001452. doi:10.1002/advs.202001452

Zhu, Y., & **Cheng, J.** (2020). Transient Absorption Microscopy: Technological Innovations and Applications in Materials Science and Life Science. *J Chem Phys*, 152 (2), 020901. doi:10.1063/1.5129123

Zong, C., & **Cheng, J.** (2020). Origin of Dispersive Line Shapes in Plasmon-enhanced Stimulated Raman Scattering Microscopy. *Nanophotonics*, 10(1), 617-625. doi:10.1515/nanoph-2020-0313

Zong, C., Premasiri, R., Lin, H., Huang, Y., Zhang, C., Yang, C., **Ziegler, L.** . . **Cheng, J.** (2019). Plasmon-enhanced Stimulated Raman Scattering Microscopy with Singlemolecule Detection Sensitivity. *Nat Commun*, 10(1), 5318. doi:10.1038/s41467-019-13230-1*

Britton, W., Chen, Y., Sgrignuoli, F., & **Dal Negro, L.** (2020). Phase-Modulated Axilenses As Ultracompact Spectroscopic Tools. *ACS Photonics*, 7(10), 2731-2738. doi:10.1021/acsphotonics.0c00762

Chen, Y., Britton, W., & **Dal Negro, L**. (2020). Design of Infrared Microspectrometer Based on Phase-modulated Axilenses. *Applied Optics*, 59(18), 5532. doi:10.1364/ao.390610

Chen, Y., Britton, W., & **Dal Negro, L.** (2020). Phase-modulated Axilenses for Infrared Multiband Spectroscopy. *Opt Lett*, 45(8), 2371-2374. doi:10.1364/OL.388704

Chen, Y., Lu, L., Karniadakis, G., & **Dal Negro, L.** (2020). Physics-informed Neural Networks for Inverse Problems in Nano-optics and Metamaterials. *Opt Express*, 28(8), 11618-11633. doi:10.1364/OE.384875

Sgrignuoli, F., & **Dal Negro, L.** (2020). Subdiffusive Light Transport in Three-Dimensional Subrandom Arrays. *Physical Review B*, 101(21). doi:10.1103/physrevb.101.214204

Sgrignuoli, F., Gorsky, S., Britton, W., Zhang, R., Riboli, F., & **Dal Negro, L.** (2020). Multifractality of Light in Photonic Arrays Based on Algebraic Number Theory. *Communications Physics*, 3(1). doi:10.1038/s42005-020-0374-7

Trojak, O., Gorsky, S., Sgrignuoli, F., Pinheiro, F., Park, S., **Dal Negro, L.**, Song, J., . . . Sapienza, L. (2020). Cavity Quantum Electro-dynamics with Solid-state Emitters in Aperiodic Nano-photonic Spiral Devices. *Applied Physics Letters*, 117(12), 124006. doi:10.1063/5.0024719

Tsitoura, C., Malinowski, S., Mohrhardt, J., Degen, R., DiBenedictis, B., Gao, Y., **Davison, I.** . . . Spehr, M. (2020). Synchronous Infra-Slow Oscillations Organize Ensembles of Accessory Olfactory Bulb Projection Neurons into Distinct Microcircuits. *J Neurosci,* 40(21), 4203-4218. doi:10.1523/JNEUROSCI.2925-19.2020

Chen, M., Grazon, C., Sensharma, P., Nguyen, T., Feng, Y., Chern, M., **Dennis, A**. . . . Grinstaff, M. (2020). Hydrogel-Embedded Quantum Dot-Transcription Factor Sensors for Quantitative Progesterone Detection. *ACS Appl Mater Interfaces*, 12(39), 43513-43521. doi:10.1021/acsami.0c13489

Chen, M., Nguyen, T., Varongchayakul, N., Grazon, C., Chern, M., Baer, R., **Dennis, A.** . . . Grinstaff, M. (2020). Surface Immobilized Nucleic Acid-Transcription Factor Quantum Dots for Biosensing. *Adv Healthc Mater*, 9(17), e2000403. doi:10.1002/adhm.202000403

Chern, M., Garden, P., Baer, R., Galagan, J., & **Dennis, A.** (2020). Transcription Factor Based Small-Molecule Sensing with a Rapid Cell Phone Enabled Fluorescent Bead Assay. *Angewandte Chemie*, 132(48), 21781-21786. doi:10.1002/ange.202007575

Chern, M., Garden, P., Baer, R. C., Galagan, J., & **Dennis, A.** (2020). Transcription Factor Based Small-Molecule Sensing with a Rapid Cell Phone Enabled Fluorescent Bead Assay. *Angew Chem Int Ed Engl*, 59(48), 21597-21602. doi:10.1002/anie.202007575

Chern, M., Grazon, C., & **Dennis, A.** (2020). Phase Transfer and DNA Functionalization of Quantum Dots Using an Easy-to-Prepare, Low-Cost Zwitterionic Polymer. Methods Mol Biol, 2135, 125-139. doi:10.1007/978-1-0716-0463-2_7

Chern, M., Toufanian, R., & **Dennis, A.** (2020). Quantum Dot to Quantum Dot Förster Resonance Energy Transfer: Engineering Materials for Visual Color *Change Sensing*. *Analyst*, 145(17), 5754-5767. doi:10.1039/d0an00746c

Grazon, C., Baer, R., Kuzmanović, U., Nguyen, T., Chen, M., Zamani, M., **Dennis, A.** . . . Galagan, J. (2020). A Progesterone Biosensor Derived from Microbial Screening. *Nat Commun*, 11(1), 1276. doi:10.1038/s41467-020-14942-5

Kays, J., Saeboe, A., Toufanian, R., Kurant, D., & **Dennis, A.** (2020). Shell-Free Copper Indium Sulfide Quantum Dots Induce Toxicity in Vitro and in Vivo. *Nano Lett*, 20(3), 1980-1991. doi:10.1021/acs.nanolett.9b05259

Nguyen, T., Chern, M., Baer, R., Galagan, J., & **Dennis, A.** (2020). A Förster Resonance Energy Transfer-Based Ratiometric Sensor with the Allosteric Transcription Factor TetR. *Small*, 16(17), e1907522. doi:10.1002/smll.201907522

Saeboe, A., Kays, J., & **Dennis, A.** (2020). Encapsulating Quantum Dots in Lipid-PEG Micelles and Subsequent Copper-Free Click Chemistry Bioconjugation. *Methods Mol Biol*, 2135, 95-108. doi:10.1007/978-1-0716-0463-2_5

Wang, X., Li, Y., Toufanian, R., Kogos, L., **Dennis, A.**, & **Paiella, R.** (2020). Geometrically Tunable Beamed Light Emission from a Quantum-Dot Ensemble Near a Gradient Metasurface. *Advanced Optical Materials*, 8(8), 1901951. doi:10.1002/adom.201901951*

Kılıç, K., Desjardins, M., Tang, J., Thunemann, M., Sunil, S., Erdener, Ş., . . . **Devor, A.** (2020). Chronic Cranial Windows for Long Term Multimodal Neurovascular Imaging in Mice. *Front Physiol*, 11, 612678. doi:10.3389/fphys.2020.612678

Rogers, N., Thunemann, M., **Devor, A.**, & Gilja, V. (2020). Impact of Brain Surface Boundary Conditions on Electrophysiology and Implications for Electrocorticography. *Frontiers in Neuroscience*, 14. doi:10.3389/fnins.2020.00763

Sadegh, S., Yang, M., Ferri, C., Thunemann, M., **Devor, A.**, & Fainman, Y. (2020). Advantages of Non-degenerate Two-photon Microscopy for Deep Tissue Imaging. *Biophysical Journal*, 118(3), 311a. doi:10.1016/j.bpj.2019.11.1752

Sætra, M., Solbrå, A., Devor, A., Sakadžić, S., Dale, A., & Einevoll, G. (2020). Spatially Resolved Estimation of Metabolic Oxygen Consumption from Optical Measurements in Cortex. *Neurophotonics*, 7(3), 035005. doi:10.1117/1.NPh.7.3.035005

Şencan, İ., Esipova, T., Kılıç, K., Li, B., Desjardins, M., Yaseen, M., **Devor, A.** . . . Sakadžić, S. (2020). Optical Measurement of Microvascular Oxygenation and Blood Flow Responses in Awake Mouse Cortex During Functional Activation. *J Cereb Blood Flow Metab*, 271678X20928011. doi:10.1177/0271678X20928011

Todd, N., Angolano, C., Ferran, C., **Devor, A.**, Borsook, D., & McDannold, N. (2020). Secondary Effects on Brain Physiology Caused by Focused Ultrasound-mediated Disruption of the Blood-brain Barrier. *J Control Release*, 324, 450-459. doi:10.1016/j.jconrel.2020.05.040

van der Meer, D., Frei, O., Kaufmann, T., Shadrin, A., **Devor, A.**, Smeland, O., . . . Dale, A. (2020). Author Correction: Understanding the Genetic Determinants of the Brain with MOSTest. *Nat Commun*, 11(1), 4700. doi:10.1038/s41467-020-18628-w

van der Meer, D., Frei, O., Kaufmann, T., Shadrin, A.**, Devor, A**., Smeland, O., . . . Dale, A. (2020). Understanding the Genetic Determinants of the Brain with MOSTest. *Nat Commun*, 11(1), 3512. doi:10.1038/s41467-020-17368-1

van der Meer, D., Frei, O., Kaufmann, T., Shadrin, A., **Devor, A.**, Smeland, O., . . . Dale, A. (2020). Making the MOSTest of Imaging Genetics. *Biological Psychiatry*, 87(9), S304-S305. doi:10.1016/j.biopsych.2020.02.784

Ari, A., Hanay, M., Paul, M., & **Ekinci, K.** (2021). Nanomechanical Measurement of the Brownian Force Noise in a Viscous Liquid. *Nano Letters*, 21(1), 375-381. doi:10.1021/acs.nanolett.0c03766

Bello, V., Ari, A. B., Selim Hanay, M., & **Ekinci, K.** (2020). Measurement and Characterization of Nano-Electro-Mechanical Systems Using Laser Interferometry. 2020 IEEE International Instrumentation and Measurement Technology Conference (I2MTC). doi:10.1109/i2mtc43012.2020.9129282

Liem, A., Ari, A., McDaniel, J., & **Ekinci, K.** (2020). An Inverse Method to Predict NEMS Beam Properties from Natural Frequencies. *Journal of Applied Mechanics*, 87(6). doi:10.1115/1.4046445

Tien, J., Ghani, U., Dance, Y., Seibel, A., Karakan, M., **Ekinci, K.**, & Nelson, C. (2020). Matrix Pore Size Governs Escape of Human Breast Cancer Cells from a Microtumor to an Empty Cavity. *iScience*, 23(11), 101673. doi:10.1016/j.isci.2020.101673

Yang, Y., Gupta, K., & **Ekinci, K.** (2020). All-electrical Monitoring of Bacterial Antibiotic Susceptibility in a Microfluidic Device. Proceedings of the National *Academy of Sciences*, 117(20), 10639-10644. doi:10.1073/pnas.1922172117

Economo, M., Winnubst, J., Bas, E., Ferreira, T., & Chandrashekar, J. (2019). Single-neuron Axonal Reconstruction: The Search for a Wiring Diagram of the Brain. *J Comp Neurol*, 527(13), 2190-2199. doi:10.1002/cne.24674

Gao, Z., Thomas, A., **Economo, M.**, Abrego, A., Svoboda, K., De Zeeuw, C.., & Li, N. (2019). Response to "Fallacies of Mice Experiments". *Neuroinformatics*, 17(4), 475-478. doi:10.1007/s12021-019-09433-y

Ueda, H., Dodt, H., Osten, P., **Economo, M.**, Chandrashekar, J., & Keller, P. (2020). Whole-Brain Profiling of Cells and Circuits in Mammals by Tissue Clearing and Light-Sheet Microscopy. *Neuron*, 106(3), 369-387. doi:10.1016/j.neuron.2020.03.004

Winnubst, J., Bas, E., Ferreira, T., Wu, Z., **Economo, M.**, Edson, P., . . . Chandrashekar, J. (2019). Reconstruction of 1,000 Projection Neurons Reveals New Cell Types and Organization of Long-Range Connectivity in the Mouse Brain. Cell, 179(1), 268-281.e13. doi:10.1016/j.cell.2019.07.042

Andino, R., Liu, J., Miller, C., Chen, X., Devlin, S., Hong, M., **Erramilli, S.** . . . **Ziegler, L.** (2020). Anomalous pH-Dependent Enhancement of p-Methyl Benzoic Acid Sum-Frequency Intensities: Cooperative Surface Adsorption Effects. *J Phys Chem A*, 124(16), 3064-3076. doi:10.1021/acs.jpca.9b10809*

Bensussen, S., Shankar, S., Ching, K., Zemel, D., Ta, T. L., Mount, R., . . . **Han, X.** (2020). A Viral Toolbox of Genetically Encoded Fluorescent Synaptic Tags. *iScience*, 23(7), 101330. doi:10.1016/j.isci.2020.101330

Keaveney, M., Rahsepar, B., Tseng, H., Fernandez, F., Mount, R., Ta, T., . . . **Han, X.** (2020). CaMKIIα-Positive Interneurons Identified via a microRNABased Viral

Gene Targeting Strategy. *J Neurosci*, 40(50), 9576-9588. doi:10.1523/JNEUROSCI.2570-19.2020

Nocera, A., Mueller, S., Stephan, J., Hing, L., Seifert, P., **Han, X.**, . . . Bleier, B. (2019). Exosome Swarms Eliminate Airway Pathogens and Provide Passive Epithelial Immunoprotection Through Nitric Oxide. *J Allergy Clin Immunol*, 143(4), 1525-1535.e1. doi:10.1016/j.jaci.2018.08.046

Piatkevich, K., Bensussen, S., Tseng, H.., Shroff, S., Lopez-Huerta, V., Park, D., . . . **Han, X.** (2019). Population Imaging of Neural Activity in Awake Behaving Mice. *Nature*, 574(7778), 413-417. doi:10.1038/s41586-019-1641-1

Romano, M., Bucklin, M., Gritton, H., Mehrotra, D., Kessel, R., & **Han, X.** (2019). A Teensy Microcontroller-based Interface for Optical Imaging Camera Control During Behavioral Experiments. *J Neurosci Methods*, 320, 107-115. doi:10.1016/j.jneumeth.2019.03.019

Shemesh, O., Linghu, C., Piatkevich, K., Goodwin, D., Celiker, O., Gritton, H., **Han, X.** . . . Boyden, E. (2020). Precision Calcium Imaging of Dense Neural Populations via a Cell-Body-Targeted Calcium Indicator. *Neuro*n, 107(3), 470-486.e11. doi:10.1016/j.neuron.2020.05.029

Shroff, S., Das, S., Tseng, H., Noueihed, J., Fernandez, F., **White, J.**, . . . **Han, X.** (2020). Voltage Imaging of Cardiac Cells and Tissue Using the Genetically Encoded Voltage Sensor Archon1. *iScience*, 23(4), 100974. doi:10.1016/j.isci.2020.100974*

Han, X. (2020). What is the Key Conceptual or Methodological Bottleneck to Controlling Neural Biology? C*ell Syst*, 10(6), 461-462. doi:10.1016/j.cels.2020.06.001

Xiao, S., Gritton, H., Tseng, H., Zemel, D., **Han, X.**, & **Mertz, J.** (2020). High-contrast Multifocus Microscopy with a Single Camera and Z-splitter Prism. *Optica*, 7 (11), 1477. doi:10.1364/optica.404678*

Coskun, A., Eris, F., **Joshi, A.**, Kahng, A., Ma, Y., Narayan, A., Joshi, A. & Srinivas, V. (2020). Cross-Layer Co-Optimization of Network Design and Chiplet Placement in 2.5-D Systems. *IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems*, 39(12), 5183-5196. doi:10.1109/tcad.2020.2970019

Petrisko, D., Gilani, F., Wyse, M., Jung, D., Davidson, S., Gao, P., **Joshi, A**. . . . Taylor, M. B. (2020). BlackParrot: An Agile Open-Source RISC-V Multicore for Accelerator SoCs. *IEEE Micro*, 40(4), 93-102. doi:10.1109/mm.2020.2996145

Zaraee, N., Zhou, B., Vigil, K., Shahajamali, M., **Joshi, A**., & **Unlu, M.** (2020). Gate-level Validation of Integrated Circuits with Structured-Illumination Read-out of Embedded Optical Signatures. *IEEE Access*. doi:10.1109/ACCESS.2020.2987088*

Zhou, B., Aksoylar, A., Vigil, K., Adato, R., Tan, J., **Goldberg, B.**, . . . **Joshi, A.** (2020). Hardware Trojan Detection using Backside Optical Imaging. *IEEE Transactions on Computer - Aided Design of Integrated Circuits and Systems,* (40), 24-37. doi:10.1109/TCAD.2020.2991680*

Lin, Y., Gao, T., Pan, X., **Kamenetska, M.**, & Thon, S. (2020). Local Defects in Colloidal Quantum Dot Thin Films Measured via Spatially Resolved Multi-Modal Optoelectronic Spectroscopy. *Adv Mater*, 32(11), e1906602. doi:10.1002/adma.201906602

McNeely, J., Miller, N., Pan, X., Lawson, B., & **Kamenetska, M.** (2020). Angstrom-Scale Ruler Using Single Molecule Conductance Signatures. *The Journal of Physical Chemistry C*, 124(24), 13427-13433. doi:10.1021/acs.jpcc.0c02063

Pan, X., Lawson, B., Rustad, A., & **Kamenetska, M.** (2020). pH-Activated Single Molecule Conductance and Binding Mechanism of Imidazole on Gold. *Nano Letters*, 20(6), 4687-4692. doi:10.1021/acs.nanolett.0c01710

Chen, M., Grazon, C., Sensharma, P., Nguyen, T., Feng, Y., Chern, M., **Klapperich, C.** . . . Grinstaff, M. (2020). Hydrogel-Embedded Quantum Dot-Transcription Factor Sensors for Quantitative Progesterone Detection. *ACS Appl Mater Interfaces*, 12(39), 43513-43521. doi:10.1021/acsami.0c13489

Chen, M., Nguyen, T.., Varongchayakul, N., Grazon, C., Chern, M., Baer, R., **Klapperich, C.** . . . Grinstaff, M. (2020). Surface Immobilized Nucleic Acid-Transcription Factor Quantum Dots for Biosensing. *Adv Healthc Mater*, 9(17), e2000403. doi:10.1002/adhm.202000403

Claure, I., Anderson, D., **Klapperich, C.**, Kuohung, W., & Wong, J. (2020). Biomaterials and Contraception: Promises and Pitfalls. *Ann Biomed Eng*, 48(7), 2113-2131. doi:10.1007/s10439-019-02402-1

Grazon, C., Baer, R., Kuzmanović, U., Nguyen, T., Chen, M., Zamani, M., **Klapperich, C.** . . . Galagan, J. E. (2020). A Progesterone Biosensor Derived from Microbial Screening. *Nat Commun*, 11(1), 1276. doi:10.1038/s41467-020-14942-5

Kolluri, N., Albarran, N., Fan, A., Olson, A., Sagar, M., Young, A., . . . **Klapperich, C.** (2020). SNAPflex: A Paper-and-plastic Device for Instrument-free RNA and DNA Extraction from Whole Blood. *Lab Chip*, 20(18), 3386-3398. doi:10.1039/d0lc00277a

Landaverde, L., Wong, W., Hernandez, G., Fan, A., & **Klapperich, C.** (2020). Method for the Elucidation of LAMP Products Captured on Lateral Flow Strips in a Point of Care Test for HPV 16. *Anal Bioanal Chem*, 412(24), 6199-6209. doi:10.1007/s00216-020-02702-9

Lee, R., Puig, H., Nguyen, P., Angenent-Mari, N., Donghia, N., McGee, J., **Klapperich, C.** . . . Collins, J. (2020). Ultrasensitive CRISPR-based Diagnostic for Fieldapplicable Detection of Plasmodium Species in Symptomatic and Asymptomatic Malaria. *Proc Natl Acad Sci U S A*, 117(41), 25722-25731. doi:10.1073/pnas.2010196117

Raju, L., Kamath, S., Shetty, M., Satpathi, S., Mohanty, A., Ghosh, S., **Klapperich, C.** . . . Nagaraj, V. (2019). Genome Mining-Based Identification of Identical Multirepeat Sequences in Plasmodium falciparum Genome for Highly Sensitive Real-Time Quantitative PCR Assay and Its Application in Malaria Diagnosis. *J Mol Diagn*, 21(5), 824-838. doi:10.1016/j.jmoldx.2019.04.004

Cao, J., Li, T., Gao, H., Lin, Y., Wang, X., Wang, H., . . . **Ling, X.** (2020). Realization of 2D Crystalline Metal Nitrides via Selective Atomic Substitution. *Sci Adv*, 6(2), eaax8784. doi:10.1126/sciadv.aax8784

Chen, W., Li, N., Ma, Y., Minus, M., Benson, K., Lu, X., **Ling, X.**. . . Zhu, H. (2019). Superstrong and Tough Hydrogel through Physical Cross-Linking and Molecular

Alignment. *Biomacromolecules*, 20(12), 4476-4484. doi:10.1021/acs.biomac.9b01223

Gray, M., Kumar, N., O'Connor, R., Hoek, M., Sheridan, E., Doyle, M., **Ling, X.**. . . Burch, K. (2020). A Cleanroom in a Glovebox. *Rev Sci Instrum*, 91(7), 073909. doi:10.1063/5.0006462

Han, B., Lin, Y., Yang, Y., Mao, N., Li, W., Wang, H., Ling, X., **Ling, X.** . . . Palacios, T. (2020). Deep-Learning-Enabled Fast Optical Identification and Characterization of 2D Materials. *Adv Mater*, 32(29), e2000953. doi:10.1002/adma.202000953

Jiang, X., Zhang, M., **Ling, X.**, González, P., & Zhang, H. (2020). 2D Xenes: From Fundamentals to Applications. *Nanophotonics*, 9(7), 1555-1556. doi:10.1515/nanoph-2020-0320

Kumar, N., Wang, W., Ortiz-Marquez, J., Catalano, M., Gray, M., Biglari, N., **Ling, X.**. . . Burch, K. (2020). Dielectrophoresis Assisted Rapid, Selective and Single Cell Detection of Antibiotic Resistant Bacteria with G-FETs. *Biosens Bioelectron*, 156, 112123. doi:10.1016/j.bios.2020.112123

Luo, W., Oyedele, A., Gu, Y., Li, T., Wang, X., Haglund, A., . . . **Ling, X.** (2020). Anisotropic Phonon Response of Few-Layer PdSe 2 under Uniaxial Strain. *Advanced Functional Materials*, 30(35), 2003215. doi:10.1002/adfm.202003215

Wang, Y., Balgley, J., Gerber, E., Gray, M., Kumar, N., Lu, X., **Ling. X.**. . . Burch, K. (2020). Modulation Doping via a Two-Dimensional Atomic Crystalline Acceptor. *Nano Lett*, 20(12), 8446-8452. doi:10.1021/acs.nanolett.0c03493

Wu, J., Chen, H., Yang, N., Cao, J., Yan, X., Liu, F., **Ling, X.** . . . Wang, H. (2020). High Tunnelling Electroresistance in a Ferroelectric van der Waals Heterojunction via Giant Barrier Height Modulation. *Nature Electronics*, 3(8), 466-472. doi:10.1038/s41928-020-0441-9

Weber, T., & **Mertz, J.** (2020). In vivo Corneal and Lenticular Microscopy with Asymmetric Fundus Retroillumination. *Biomed Opt Express*, 11(6), 3263-3273. doi:10.1364/BOE.391815

Kogos, L. C., Li, Y., Liu, J., Li, Y., **Tian, L.**, & **Paiella, R.** (2020). Plasmonic Ommatidia for Lensless Compound-eye Vision. *Nature Communications*, 11, 1-9.*

Kogos, L., Li, Y., Liu, J., Li, Y., **Tian, L.**, & **Paiella, R.** (2020). Plasmonic Computational Compound-Eye Camera. *Optics and Photonics News*, 41.*

Li, Y., & **Paiella, R.** (2020). Terahertz Radiation Processes in Critically Coupled Graphene Plasmonic Nanostructures. *Journal of Applied Physics*, 128(15), 153105. doi:10.1063/5.0027159

Al Qubaisi, K., & **Popović, M.** (2020). Reflectionless Dual Standing-wave Microcavity Resonator Units for Photonic Integrated Circuits. *Opt Express*, 28(24), 35986-35996. doi:10.1364/OE.403486

Dostart, N., & **Popović, M.** (2020). Multiplexing Guided Optical and Acoustic Waves for EfficientAcousto-Optic Devices. *Opt. Lett.*, 45, 6066-6069. doi:10.1364/OL.404188

Dostart, N., & **Popović, M.** (2020). Mode Multiplexer for Guided Optical and Acoustic Waves. *Opt Lett*, 45(21), 6066-6069. doi:10.1364/OL.404188

Dostart, N., Ehrlichman, Y., Gentry, C., & **Popović, M.** (2020). Integrated Optical Isolators Using Electrically Driven Acoustic Waves. *Opt Express*, 28(24), 36055-36069. doi:10.1364/OE.409381

Dostart, N., Zhang, B., Khilo, A., Brand, M., Al Qubaisi, K., Onural, D., . . . **Popović, M.** (2020). Serpentine Optical Phased Arrays for Scalable Integrated Photonic Lidar Beam Steering. *Optica*, 7(6), 726. doi:10.1364/optica.389006

Gevorgyan, H., Khilo, A., Ehrlichman, Y., & **Popović, M.** (2020). Triply Resonant Coupled-cavity Electro-optic Modulators for RF to Optical Signal Conversion. *Opt Express*, 28(1), 788-815. doi:10.1364/OE.385856

Antikainen, A., Kabagöz, H., & **Ramachandran, S.** (2020). Fragility of a Soliton's Shot-to-shot Coherence. *Optics Letters*, 45(19), 5393. doi:10.1364/ol.400250

Greenberg, A., Prabhakar, G., & **Ramachandran, S.** (2020). High Resolution Spectral Metrology Leveraging Topologically Enhanced Optical Activity in Fibers. *Nat Commun*, 11(1), 5257. doi:10.1038/s41467-020-18931-6

Gregg, P., Kristensen, P., Rubano, A., Golowich, S., Marrucci, L., & **Ramachandran, S.** (2019). Enhanced Spin orbit Interaction of Light in Highly Confining Optical Fibers for Mode Division Multiplexing. *Nat Commun*, 10(1), 4707. doi:10.1038/s41467-019-12401-4

Liu, X., Christensen, E., Rottwitt, K., & **Ramachandran, S.** (2020). Nonlinear Four-wave Mixing with Enhanced Diversity and Selectivity via Spin and Orbital Angular Momentum conservation. *APL Photonics*, 5(1), 010802. doi:10.1063/1.5130715

Ma, Z., & **Ramachandran, S.** (2020). Propagation Stability in Optical Fibers: Role of Path Memory and Angular Momentum. *Nanophotonics*, 10(1), 209-224. doi:10.1515/nanoph-2020-0404

Ramachandran, S., Jung, Y., Alam, S., Richardson, D., & Abedin, K. (2020). Multicore and Multimode Optical Amplifiers for Space Division Multiplexing. Optical Fiber Telecommunications, VII, 301-333. doi:10.1016/B978-0-12-816502-7.00008-7

Chen, B., Murawski, N., Cincotta, C., McKissick, O., Finkelstein, A., Hamidi, A., . . . **Ramirez, S.** (2019). Artificially Enhancing and Suppressing Hippocampus-Mediated Memories. *Curr Biol*, 29(11), 1885-1894.e4. doi:10.1016/j.cub.2019.04.065

Doucette, E., Merfeld, E., Leblanc, H., Monasterio, A., Cincotta, C., Grella, S., . . . **Ramirez, S.** (2020). Social Behavior in Mice Following Chronic Optogenetic Stimulation of Hippocampal Engrams. *Neurobiol Learn Mem*, 176, 107321. doi:10.1016/j.nlm.2020.107321

Fortin, A., Grella, S., McKissick, O., & **Ramirez, S.** (2020). Odor Modulates the Temporal Dynamics of Fear Memory Consolidation. *Biological Psychiatry*, 87(9), S317. doi:10.1016/j.biopsych.2020.02.815

Grella, S., Fortin, A., McKissick, O., Leblanc, H., & **Ramirez, S.** (2020). Odor Modulates the Temporal Dynamics of Fear Memory Consolidation. *Learn Mem*, 27(4), 150-163. doi:10.1101/lm.050690.119

Leblanc, H., & **Ramirez, S.** (2020). Linking Social Cognition to Learning and Memory.

J Neurosci, 40(46), 8782-8798. doi:10.1523/JNEUROSCI.1280-20.2020

Ramirez, S., Shpokayte, M., McKissick, O., Cincotta, C., Liu, S., & **Ramirez, S**. Ruesch, E. (2020). Population and Projection-Specific Segregation of Hippocampal Fear and Reward Engrams. *Biological Psychiatry*, 87(9), S31. doi:10.1016/j.biopsych.2020.02.103

An, X., Naowarojna, N., Liu, P., & **Reinhard, B.** (2020). Hybrid Plasmonic Photoreactors as Visible Light-Mediated Bactericides. *ACS Appl Mater Interfaces*, 12(1), 106-116. doi:10.1021/acsami.9b14834

Wong, C., Gromisch, C., Ozturk, S., Papageorgis, P., Abdolmaleky, H., **Reinhard, B.**, . . . Thiagalingam, S. (2019). MicroRNA-4417 is a Tumor Suppressor and Prognostic Biomarker for Triple-negative Breast Cancer. *Cancer Biol Ther*, 20(8), 1113-1120. doi:10.1080/15384047.2019.1595285

Xi, M., & **Reinhard, B.** (2020). Evolution of Near- and Far-field Optical Properties of Au Bipyramids Upon Epitaxial Deposition of Ag. *Nanoscale*, 12(9), 5402-5411. doi:10.1039/d0nr00330a

Zhang, S., & **Reinhard, B.** (2019). Characterizing Large-Scale Receptor Clustering on the Single Cell Level: A Comparative Plasmon Coupling and Fluorescence Superresolution Microscopy Study. *J Phys Chem B*, 123(26), 5494-5505. doi:10.1021/acs.jpcb.9b05176

Applegate, M., Istfan, R., Spink, S., Tank, A., & **Roblyer, D.** (2020). Recent Advances in High Speed Diffuse Optical Imaging in Biomedicine. *APL Photonics*, 5(4), 040802. doi:10.1063/1.5139647

Applegate, M., Karrobi, K., Angelo, J., Austin, W., Tabassum, S., Aguénounon, E., . . . Roblyer, D. (2020). OpenSFDI: An Open-source Guide for Constructing a Spatial Frequency Domain Imaging System. *J Biomed Opt*, 25(1), 1-13. doi:10.1117/1.JBO.25.1.016002

Cochran, J., Busch, D., Leproux, A., Zhang, Z., O'Sullivan, T., Cerussi, A., **Roblyer, D.** . . . Yodh, A. G. (2018). Tissue Oxygen Saturation Predicts Response to Breast Cancer Neoadjuvant Chemotherapy Within 10 Days of Treatment. *J Biomed Opt*, 24(2), 1-11. doi:10.1117/1.JBO.24.2.021202

DeCamp, S., Tsuda, V., Ferruzzi, J., Koehler, S., Giblin, J., **Roblyer, D.**, . . . Fredberg, J. (2020). Epithelial Layer Unjamming Shifts Energy Metabolism Toward Glycolysis. *Sci Rep*, 10(1), 18302. doi:10.1038/s41598-020-74992-z

Ferruzzi, J., Sun, M., Gkousioudi, A., Pilvar, A., **Roblyer, D.**, Zhang, Y., & Zaman, M. (2019). Compressive Remodeling Alters Fluid Transport Properties of Collagen Networks - Implications for Tumor Growth. *Sci Rep*, 9(1), 17151. doi:10.1038/s41598-019-50268-z

Karrobi, K., Tank, A., Tabassum, S., Pera, V., & **Roblyer, D.** (2019). Diffuse and Nonlinear Imaging of Multiscale Vascular Parameters for In vivo Monitoring of Preclinical Mammary Tumors. *J Biophotonics*, 12(6), e201800379. doi:10.1002/jbio.201800379

Peterson, H., Tank, A., Geller, D., Yang, R., Gorlick, R., Hoang, B., & **Roblyer, D.** (2020). Characterization of Bony Anatomic Regions in Pediatric and Adult Healthy Volunteers Using Diffuse Optical Spectroscopic Imaging. *J Biomed Opt*, 25(8), 1-17. doi:10.1117/1.JBO.25.8.086002

Roblyer, D. (2020). Perspective on the Increasing Role of Optical Wearables and Remote Patient Monitoring in the COVID-19 Era and Beyond. *J Biomed Opt*, 25(10). doi:10.1117/1.JBO.25.10.102703

Tank, A., Peterson, H., Pera, V., Tabassum, S., Leproux, A., O'Sullivan, T., . . . **Roblyer, D.** (2020). Diffuse Optical Spectroscopic Imaging Reveals Distinct Early Breast Tumor Hemodynamic Responses to Metronomic and Maximum Tolerated Dose Regimens. *Breast Cancer Res*, 22(1), 29. doi:10.1186/s13058-020-01262-1

Ganapathy, S., Kratz, S., Chen, Q., Hellingwerf, K., de Groot, H., **Rothschild, K.**, & de Grip, W. (2019). Redshifted and Near-infrared Active Analog Pigments Based upon Archaerhodopsin-3. *Photochem Photobiol*, 95(4), 959-968. doi:10.1111/php.13093

Mei, G., Mamaeva, N., Ganapathy, S., Wang, P., DeGrip, W., & **Rothschild, K.** (2020). Analog Retinal Redshifts Visible Absorption of QuasAr Transmembrane Voltage Sensors into Near-infrared. *Photochem Photobiol*, 96(1), 55-66. doi:10.1111/php.13169

Klein, A., Sibony, I., Meir, S., Duadi, H., **Sander, M.**, & Fridman, M. (2020). Temporal Imaging with a High Filling Factor. *APL Photonics*, 5(9), 090801. doi:10.1063/5.0002850

Zeng, J., & **Sander, M.** (2020). Real-time Transition Dynamics Between Multi-pulsing States in a Mode-locked Fiber Laser. Optics Letters, 45(1), 5. doi:10.1364/ol.45.000005

Zhu, X., Lin, J., & **Sander, M.** (2020). Infrared Inhibition Impacts on Locally Initiated and Propagating Action Potentials and the Downstream Synaptic Transmission. *Neurophotonics*, 7(4), 045003. doi:10.1117/1.NPh.7.4.045003

Mrak, S., **Semeter, J.**, Nishimura, Y., Foster, J., Hairston, M., & Bristow, W. (2020). Modulation of Storm-time Mid-latitude Ionosphere by magnetosphereionosphere coupling 2. *Earth and Space Science Open Archive*. doi:10.1002/essoar.10504405.1

Mrak, S., **Semeter, J.**, Nishimura, Y., Rodrigues, F., Coster, A., & Groves, K. (2020). Leveraging Geodetic GPS Receivers for Ionospheric Scintillation Science. *Radio Science*, 55(11). doi:10.1029/2020rs007131

Ozturk, D., Meng, X., Verkhoglyadova, O., Varney, R., Reimer, A., & **Semeter, J.** (2020). A New Framework to Incorporate High-Latitude Input for Mesoscale Electrodynamics. Journal of Geophysical Research: *Space Physics*, 125(1). doi:10.1029/2019ja027562

Semeter, J., Hunnekuhl, M., MacDonald, E., Hirsch, M., Zeller, N., Chernenkoff, A., & Wang, J. (2020). The Mysterious Green Streaks Below STEVE. *AGU Advances*, 1 (4). doi:10.1029/2020AV000183

Osawa, S., Simon, D., & **Sergienko, A.** (2020). Higher-dimensional Hong-Ou-Mandel Effect and State Redistribution with Linear-optical Multiports. *Physical Review A*, 102(6). doi:10.1103/physreva.102.063712

Simon, D., Osawa, S., & **Sergienko, A.** (2020). Quantum-clustered Two-photon Walks. *Physical Review A*, 101(3). doi:10.1103/physreva.101.032118

Boyers, E., Crowley, P., Chandran,

A., & **Sushkov, A.** (2020). Exploring 2D Synthetic Quantum Hall Physics with a Quasiperiodically Driven Qubit. *Phys Rev Lett*, 125(16), 160505. doi:10.1103/PhysRevLett.125.160505

Chen, Y., Kadic, M., Kaplan, D., Rajendran, S., **Sushkov, A**., & Wegener, M. (2020). High-Frequency Gravitational-Wave Detection Using a Chiral Resonant Mechanical Element and a Short Unstable Optical Cavity. Retrieved from: http://arxiv.org/abs/2007.07974v1

Gramolin, A., Aybas, D., Johnson, D., Adam, J., & **Sushkov, A.** (2021). Search for Xxion-like Dark Matter with Ferromagnets. *Nature Physics*, 17(1), 79-84. doi:10.1038/s41567-020-1006-6

Li, Y., Tantiwanichapan, K., **Swan, A**., & **Paiella, R.** (2020). Graphene Plasmonic Devices for Terahertz Optoelectronics. *Nanophotonics*, 9(7), 1901-1920. doi:10.1515/nanoph-2020-0211*

Chen, Y., Xiong, B., Xue, Y., Jin, X., Greene, J., & **Tian, L.** (2020). Design of a High-Resolution Light Field Miniscope for Volumetric Imaging in Scattering Tissue. *Biomedical Optics Express*, 11, 1662-1678.

Lai, Y., Xue, Y., Côté, C., Liu, X., Laramée, A., Jaouen, N., **Tian, L.** . . . Liang, J. (2020). Single-Shot Ultraviolet Compressed Ultrafast Photography. *Laser & Photonics Reviews*, 2000122.

Li, J., Matlock, A., Li, Y., Chen, Q., **Tian, L.**, & Zuo, C. (2020). Resolution-enhanced Intensity Diffraction Tomography in High Numerical Aperture Label-free Microscopy. *Photonics Research*, 8, 1818-1826.

Li, Y., McKay, G., Durr, N., & **Tian, L.** (2020). Diffuser-based Computational Imaging Funduscope. *Optics Express*, 28, 19641.

Matlock, A., Sentenac, A., Chaumet, P., Yi, J., & **Tian, L.** (2020). Inverse Scattering for Reflection Intensity Phase Microscopy. *Biomedical Optics Express*, 11, 911-926.

McKay, G., Li, Y., Nam, A. S., Dave, S., **Tian, L.**, & Durr, N. (2020). Towards Multi-modal Aberrometry and Fundus Screening with Diffuser-based Computational Imaging. Investigative *Ophthalmology & Visual Science*, 61, 1847.

Song, W., Matlock, A., Fu, S., Qin, X., Feng, H., **Tian, L., Gabel, C.**, . . . **Yi, J.** (2020). LED Array Reflectance Microscopy for Scattering-based Multi-contrast Imaging. *Optics Letters,* 45, 1647-1650.*

Tian, L., Petruccelli, J., & Preza, C. (2020). Computational Imaging V. *Computational Imaging V*, 11396.

Wu, Z., Sun, Y., Matlock, A., Liu, J., **Tian, L.**, & Kamilov, U. (2020). Simba: Scalable Inversion in Optical tomography Using Deep Denoising Priors. *IEEE Journal of Selected Topics in Signal Processing*, 14, 1163-1175.

Yurdakul, C., Avci, O., Matlock, A., Devaux, A., Quintero, M., Ozbay, E., **Tian, L.** . . . others. (2020). High-throughput, High-resolution Interferometric Light Microscopy of Biological Nanoparticles. *ACS nano*, 14, 2002-2013.

Celebi, I., Geib, M. T., Chiodi, E., Lortlar Ünlü, N., Ekiz Kanik, F., & **Unlu, S.** (2020). Instrument-Free Protein Microarray Fabrication for Accurate Affinity Measurements. Biosensors (Basel), 10(11). doi:10.3390/bios10110158

Chiodi, E., Marn, A., Geib, M., Ekiz Kanik, F., Rejman, J., AnKrapp, D., & **Unlu, M.** (2020). Highly Multiplexed Label-Free Imaging Sensor for Accurate Quantification of Small-Molecule Binding Kinetics. *ACS Omega*, 5(39), 25358-25364. doi:10.1021/acsomega.0c03708

Chiodi, E., Marn, A., Geib, M., Ekiz Kanik, F., Rejman, J., AnKrapp, D., & **Unlu, M.** (2020). Highly Multiplexed Label-free Imaging Sensor for Accurate Quantification of Small Molecule Binding Kinetics. Proceedings of the 1st International Electronic Conference on Biosensors. doi:10.3390/iecb2020-07032

Chiodi, E., Sola, L., Brambilla, D., Cretich, M., Marn, A., **Unlu, M.**, & Chiari, M. (2020). Simultaneous Evaluation of Multiple Microarray Surface Chemistries Through Real-time Interferometric Imaging. *Anal Bioanal Chem*, 412(14), 3477-3487. doi:10.1007/s00216-019-02276-1

Needham, J., Ünlü, N., Yurdakul, C., & **Unlu, M.** (2019). Interferometric Reflectance Imaging Sensor (IRIS) for Molecular Kinetics with a Low-Cost, Disposable Fluidic Cartridge. *Methods Mol Biol*, 2027, 15-28. doi:10.1007/978-1-4939-9616-2_2

Yurdakul, C., & **Unlu, M.** (2020). Computational Nanosensing from Defocus in Single Particle Interferometric Reflectance Microscopy. *Opt Lett*, 45(23), 6546-6549. doi:10.1364/OL.409458

Yurdakul, C., Avci, O., Matlock, A., Devaux, A., Quintero, M., Ozbay, E., **Unlu, M.** . . . others. (2020). High-throughput, High-resolution Interferometric Light Microscopy of Biological Nanoparticles. *ACS nano*, 14, 2002-2013.

Zaraee, N., Kanik, F., Bhuiya, A., Gong, E., Geib, M., Lortlar Ünlü, N., . . . **Unlu, M.** (2020). Highly Sensitive and Label-free Digital Detection of Whole Cell E. coli with Interferometric Reflectance Imaging. *Biosens Bioelectron*, 162, 112258. doi:10.1016/j.bios.2020.112258

Walsh, B., Hull, A., Agapitov, O., Mozer, F., & Li, H. (2020). A Census of Magnetospheric Electrons from Several eV to 30 keV. Journal of Geophysical Research: *Space Physics*, 125(5). doi:10.1029/2019ja027577

Zou, Y., **Walsh, B.**, Atz, E., Liang, H., Ma, Q., & Angelopoulos, V. (2020). Azimuthal Variation of Magnetopause Reconnection at Scales Below an Earth Radius. *Geophysical Research Letters*, 47(4). doi:10.1029/2019gl086500

Otchy, T., Michas, C., Lee, B., Gopalan, K., Nerurkar, V., Gleick, J., **White, A.** . . . Gardner, T. J. (2020). Printable Microscale Interfaces for Long-term Peripheral Nerve Mapping and Precision Control. *Nature Communications*, 11(1), 4191. doi:10.1038/s41467-020-18032-4

Song, J., Michas, C., Chen, C., **White, A**., & Grinstaff, M. (2020). From Simple to Architecturally Complex Hydrogel Scaffolds for Cell and Tissue Engineering Applications: Opportunities Presented by Two-Photon Polymerization. *Adv Healthc Mater*, 9(1), e1901217. doi:10.1002/adhm.201901217

Clarkson, C., Smeal, R., Hasenoehrl, M., **White, J.**, Rubio, M., & Wilcox, K. (2020). Ultrastructural and Functional Changes at the Tripartite Synapse During Epileptogenesis

in a Model of Temporal Lobe Epilepsy. *Exp Neurol*, 326, 113196. doi:10.1016/j.expneurol.2020.113196

Fernandez, F., Noueihed, J., & **White, J.** (2019). Voltage-Dependent Membrane Properties Shape the Size But Not the Frequency Content of Spontaneous Voltage Fluctuations in Layer 2/3 Somatosensory Cortex. *J Neurosci*, 39(12), 2221-2237. doi:10.1523/JNEUROSCI.1648-18.2019

Keaveney, M., Rahsepar, B., Tseng, H., Fernandez, F., Mount, R., Ta, T., **White, J.** . . . **Han, X.** (2020). CaMKIIα-Positive Interneurons Identified via a microRNABased Viral Gene Targeting Strategy. *J Neurosci*, 40(50), 9576-9588. doi:10.1523/JNEUROSCI.2570-19.2020*

Melonakos, E., **White, J.,** & Fernandez, F. (2019). A Model of Cholinergic Suppression of Hippocampal Ripples Through Disruption of Balanced Excitation/Inhibition. *Hippocampus*, 29(9), 773-786. doi:10.1002/hipo.23051

Royzen, F., Williams, S., Fernandez, F., & **White, J.** (2019). Balanced Synaptic Currents Underlie Low-frequency Oscillations in the Subiculum. *Hippocampus*, 29 (12), 1178-1189. doi:10.1002/hipo.23131

Shi, L., Jiang, Y., Fernandez, F., Lan, L., Chen, G., Man, H., **White, J.** . . . **Yang, C.** (2020). Non-genetic Acoustic Stimulation of Single Neurons by a Tapered Fiber Optoacoustic Emitter, 10, 143, Retrieved from: http://arxiv.org/abs/2012.09930v1*

White, J., Gaver, D., Butera, R., Choi, B., Dunlop, M., Grande-Allen, K., . . . Lee, A. (2020). Core Competencies for Undergraduates in Bioengineering and Biomedical Engineering: Findings, Consequences, and Recommendations. *Ann Biomed Eng*, 48(3), 905-912. doi:10.1007/s10439-020-02468-2

Hansen, K., Cardona, M., Dutta, A., & **Yang, C.** (2020). Plasma Enhanced Atomic Layer Deposition of Plasmonic TiN Ultrathin Films Using TDMATi and NH3. *Materials*, 13(5), 1058. doi:10.3390/ma13051058

Hansen, K., Dutta, A., Cardona, M., & **Yang, C.** (2020). Zirconium Nitride for Plasmonic Cloaking of Visible Nanowire Photodetectors. *Plasmonics*, 15(5), 1231-1241. doi:10.1007/s11468-020-01145-3

Huang, Y., Fitzpatrick, V., Zheng, N., Cheng, R., Huang, H., Ghezzi, C., . . . **Yang, C.** (2020). Self-Folding 3D Silk Biomaterial Rolls to Facilitate Axon and Bone Regeneration. *Adv Healthc Mater*, 9(18), e2000530. doi:10.1002/adhm.202000530

Jiang, Y., Lee, H., Lan, L., Tseng, H., **Yang, C.**, Man, H., Yang, C. . . . **Cheng, J.** (2020). Optoacoustic Brain Stimulation at Submillimeter Spatial Precision. *Nat Commun*, 11(1), 881. doi:10.1038/s41467-020-14706-1*

Shi, L., Jiang, Y., Fernandez, F., Lan, L., Chen, G., Man, H., . . . **Yang, C.** (2020). Non-genetic Acoustic Stimulation of Single Neurons by a Tapered Fiber Optoacoustic Emitter. Retrieved from http://arxiv.org/abs/2012.09930v1

Chen, C., Can, S., Schalch, J., Zhao, X., Duan, G., Averitt, R., & **Zhang, X.** (2020). Ultrathin Terahertz Triple-Band Metamaterial Absorbers: Consideration of Interlayer Coupling. *Physical Review Applied*, 14(5). doi:10.1103/physrevapplied.14.054021

Gao, J., Xie, D., Wang, X., **Zhang, X.**, & Yue, Y. (2020). High Thermal Conductivity of Free-standing Skeleton in Graphene Foam. *Applied Physics Letters*, 117(25), 251901. doi:10.1063/5.0032408

Schalch, J., Chi, Y., He, Y., Tang, Y., Zhao, X., **Zhang, X.**, . . . Averitt, R. (2020). Broadband Electrically Tunable VO 2 -Metamaterial Terahertz Switch with Suppressed Reflection. *Microwave and Optical Technology Letters*, 62(8), 2782-2790. doi:10.1002/mop.32354

Zhao, X., Chen, C., Kaj, K., Hammock, I., Huang, Y., Averitt, R., & **Zhang, X.** (2020). Terahertz Investigation of Bound States in the Continuum of Metallic Metasurfaces. *Optica*, 7(11), 1548. doi:10.1364/optica.404754

Andino, R., Liu, J., Miller, C., Chen, X., Devlin, S., Hong, M., . . . **Ziegler, L.** (2020). Anomalous pH-Dependent Enhancement of p-Methyl Benzoic Acid Sum-Frequency Intensities: Cooperative Surface Adsorption Effects. *J Phys Chem A*, 124(16), 3064-3076. doi:10.1021/acs.jpca.9b10809

McNeely, J., Ingraham, H., Premasiri, W., & **Ziegler, L.** (2021). Chemical Enhancement Effects on Protoporphyrin IX Surface-enhanced Raman Spectra: Metal Substrate Dependence and a Vibronic Theory Analysis. *Journal of Raman Spectroscopy*, 52(2), 323-338. doi:10.1002/jrs.6009

Shaine, M., Premasiri, W., Ingraham, H., Andino, R., Lemler, P., Brodeur, A., & **Ziegler, L.** (2020). Surface Enhanced Raman Scattering for Robust, Sensitive Detection and Confirmatory Identification of Dried Bloodstains. *Analyst*, 145(18), 6097-6110. doi:10.1039/d0an01132k

Awards

AWARDS

David Bishop was elected to the National Academy of Engineering.

Michael Albro received the 2020 Dr. James R. Neff Research Award from the Musculoskeletal Transplant Foundation (MTF).

Irving Bigio was awarded the 2020 Joseph W. Goodman Book Writing Award from OSA & SPIE.

Keith Brown was named Professor of the Year by the Department of Mechanical Engineering at Boston University; he was awarded the Frontiers of Materials Award from the TMS The Minerals Metals and Materials Society; he was the co-PI for the 2020 Dean's Catalyst Award from the College of Engineering at Boston University; he was awarded the 2021 Early Career Research Excellence Award by the BU College of Engineering; he received the 2020 Best Speaker Award by the Materials Research Society (MRS) Fall 2020; he received the 2020 Frontiers of Materials Award by The Minerals, Metals, & Materials Society (TMS); and his student Abigail Rendos received the Student Award Honorable Mention at the 4th International Conference on Dielectrophoresis and the Cross-Disciplinary Fellowship from the BU Nanotechnology Innovation Center.

Ji-Xin Cheng was awarded the 2020 Microscopy Today Innovation Award from Microscopy Today; he received the 2020 Pittsburg Spectroscopy Award from the Spectroscopy Society of Pittsburgh; and he received the 2020 MIRA award from NIGMS/NIH.

Allison Dennis was named the 2020 SPIE Community Champion; her student Reyhaneh Toufanian was awarded the 2021 Outstanding Dissertation in MSE Award; she was named Scialog Fellow in Advancing Bioimaging; and she was named a MAVEN Senior Scientist, which is an NIH-funded leadership and development program.

Anna Devor was named the Chief Editor of Neurophotonics SPIE.

Xi Ling received the 2020 BU Ignition Award and the 2020 NSF Career Award.

Masha Kamenetska was named a fellow by the Research Corporation for the Scialog: Chemical Machinery of the Cell conference for 2019-2020.

Catherine Klapperich was named one of 50 professionals changing Boston for the better in 2020 by the Boston Business Journal; she was named the 2020 BME Department Teacher of the Year by the Department of Biomedical Engineering at Boston University; and was a 2020 Fellow for the American Association for the Advancement of Science.

Ted Moustakas was elected Fellow of OSA in 2021 in recognition of distinguished contributions to the advancement of optics and photonics.

Siddharth Ramachandran received the Vannevar Bush Faculty Fellowship and was the PI of MURI award.

Bjoern Reinhard received the 2020 Ignition Award from BU.

Michelle Sander was awarded SPIE senior membership; and was elected to the IEEE Photonics Society Board of Governors.

Alexander Sergienko was reappointed this summer as an Associate Editor (Quantum Information) at Physical Review Letters (the leading American Institute of Physics and American Physical Society journal) for another three-year term.

Anna Swan received the 2020 Nottingham Prize from the 78th Physical Electronics Conference at Lawrence Berkeley National Laboratory in Berkley, CA.

Lei Tian's PhD Advisee Alex Matlock received the Emil Wolf Outstanding Student Paper Prize in 2020 from The Optical Society; his PhD Advisee Yujia Xue received the Best Student Paper in 2020 from the IEEE Photonics Society and the 2020 Emil Wolf Outstanding Student Paper Prize in 2020 from the Optical Society; and he earned the Early Career Excellence in Research from the BU College of Engineering.

Selim Unlu was named AIMBE Fellow from the American Institute for Medical and Biological Engineering.

Lawrence Ziegler was selected to be a Fellow of the Society of Applied Spectroscopy for "Exceptional Contributions to Spectroscopy."

PATENTS

Bifano, T., **Mertz, J.**, & Beaulieu, D. (2019, July 12). 10678037, *Reverberation microscopy systems and methods.* Retrieved from: https://patentimages.storage.googleapis.com/

Paiella, R., & Kogos, L. (2020, October 8). US 2020/0321378 A1, *Lens-Free compound eye cameras based on angle-sensitive metasurfaces.*

Popovic, M. Sun, C., Meade, R. E., Wade, M., Wright, A. C., Stojanovic, V., Ram, R.,. . . Davenport, M. (2018, November 21). 10,749,603, *Laser module for optical data communication system.* Retrieved from: https://patents.google.com/patent/US10749603B2/

Popovic, M., Sun, C., Meade, R. E., Wade, M., Wright, A., Stojanovic, V., Ram, R., . . . Van Orden, D. (2016, July 14). 10,771,160, *Laser module for optical data communication system.* Retrieved from: https://patents.google.com/patent/US10771160B2/en

Ramachandran, S., Prabhakar, G., & Greenberg, A. (2020, November 3). 10823667, *Engineered optical fibers and uses thereof.*

Ramachandran, S., Rishoj, L., & Demas, J. (2020, August 4). 10734782, *Ultrashort pulse fiber laser employing raman scattering in higher order mode fibers.*

Ramachandran, S., Yan, L., & Kristensen, P. (2020, November 10). 10827911, *Optical imaging system employing vortex fiber for multiple-mode illumination.*

Unlu, S., Bergstein, D., Ruane, M., & **Goldberg, B.** (2020, February 18). US10564107, *Structured substrates for optical profiling.*

Unlu, S., **Goldberg, B.**, & Leblebici, Y. (2020, July 7). 10705138, *Optical antennas for advanced integrated circuit testing.*

Unlu, S., Sevenler, D., Trueb, J., Avci, O., Yurdakul, C., Scherr, S., . . . Freedman, D. (2020, March 10). US10585042B2, *Systems and methods for imaging microwell plate samples.*

Zhang, X., **Anderson, S.**, Duan, G., & Zhao, X. (2020, April 15). EP3635424A1, *Apparatus for improving magnetic resonance imaging***.** European Patent Office. Retrieved from: https://patents.google.com/patent/EP3635424A1/en

Zhang, X., **Anderson, S.**, Duan, G., & Zhao, X. (2020, August 6). JP2020523097A, *Apparatus for improving magnetic resonance imaging. Japan.* Retrieved from: https://patents.google.com/patent/JP2020523097A/en

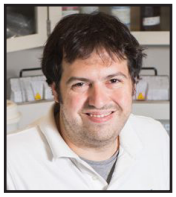
Zhang, X., **Anderson, S.**, Duan, G., & Zhao, X. (2020, January 10). CN110678769A, *Apparatus for improving magnetic resonance imaging.* China. Retrieved from: https://patents.google.com/patent/CN110678769A/en

Zhang, X., Duan, G., Zhao, X., & **Anderson, S.** (2020, February 12). KR20200015720A, *Apparatus for improving magnetic resonance imaging.* South Korea. Retrieved from: https://patents.google.com/patent/KR20200015720A/en

Zhang, X., Ghaffarivardavagh, R., & **Anderson, S.** (2020, February 6). US20200043456A1, *Air-transparent selective sound silencer using ultra-open metamaterial.*

Zhang, X., Ghaffarivardavagh, R., & Anderson, S. (2020, February 6). WO2020028838A1, *Air-transparent selective sound silencer using ultra-open metamaterial.*

Faculty List



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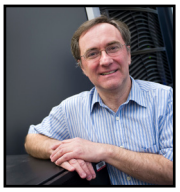

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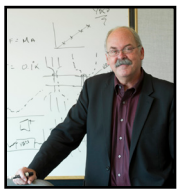

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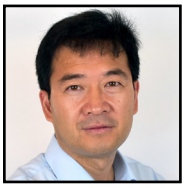

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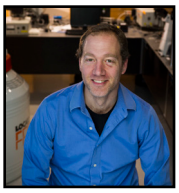

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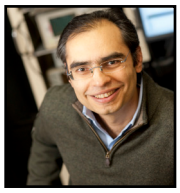

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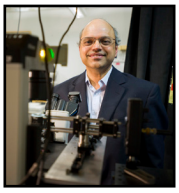

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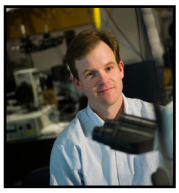

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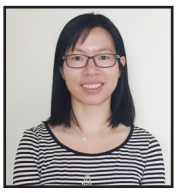
- Nanomechanics of hydrated biomaterials
- Microfluidic device design



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- Nanomaterials and their hybrid structures
- Synthesis of van der Waals materials

Jerome Mertz
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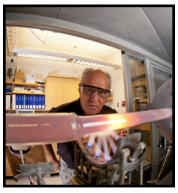
Research interests:
- Development and applications of novel optical microscopy for biological imaging
- High resolution imaging



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Research interests:
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Theodore Moustakas
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Research interests:
- Amorphous semiconductors

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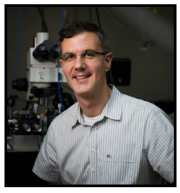
Research interests:
- Prototype device development



Roberto Paiella
Professor, ECE, MSE

8 St. Mary's St., 529
617-353-8883
rpaiella@bu.edu

Research interests:
- Terahertz photonics

Milos Popovic
Associate Professor, ECE

8 St. Mary's St., 726
617-358-6188
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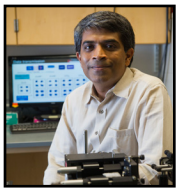
Research interests:
- Silicon photonics



Siddharth Ramachandran
Professor, ECE, MSE, Physics

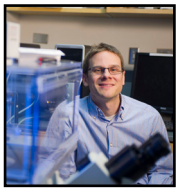
8 St. Mary's St., 521
617-353-9881
sidr@bu.edu

Research interests:
- Micro and nano optical fibers

Steve Ramirez
Assistant Professor, Psychological & Brain Sciences

610 Commonwealth Ave., 905C
617-358-1554
dvsteve@bu.edu

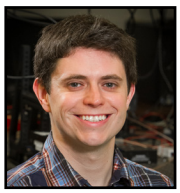
Research interests:
- Memory and Optogenetics



Bjoern Reinhard
Professor, Chemistry

8 St. Mary's St., 727
617-353-8669
bmr@bu.edu

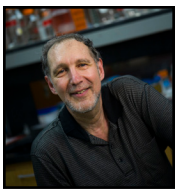
Research interests:
- Micro and nano optical fibers



Darren Roblyer
Associate Professor, BME

44 Cummington Mall, 231
617-358-1554
roblyer@bu.edu

Research interests:
- Diffuse optics



Kenneth Rothschild
Professor, Physics

590 Commonwealth Ave, 209
617-353-2603
kjr@bu.edu

Research interests:
- Biomembrane technology and biomolecular photonics
- Ion transport

Michael Ruane
Professor Emeritus, ECE

mfr@bu.edu

Research interests:
- Resonant cavity biosensors

Michelle Sander
Associate Professor, ECE, MSE

8 St. Mary's St., 534
617-358-0505
msander@bu.edu

Research interests:
- Femtosecond lasers

Ben Scott
Assistant Professor,
Psychological & Brain Sciences

610 Commonwealth Ave., 705C
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Research interests:
- Neural Dynamics
- Optical Imaging

Joshua Semeter
Professor, ECE

8 St. Mary's St., 537
617-358-3498
jls@bu.edu

Research interests:
- Ionospheric and space plasma physics
- Image processing

Alexander Sergienko
Professor, ECE

8 St. Mary's St.,729
617-353-6564
alexserg@bu.edu

Research interests:
- Ultrafast quantum optics
- Quantum metrology
- Quantum biophotonics

Andre Sharon
Professor, ME, MSE
15 St. Mary's St., 101
617-353-1888
sharon@bu.edu

Research interests:
- Electromechanical machines
- Fiber optic manufacture
- Biomedical devices

Alexander Sushkov
Assistant Professor, Physics, ECE

590 Comm. Ave, 213
617-353-2619
asu@bu.edu

Research interests:
- Quantum tools for precision measurements
- Magnetic imaging

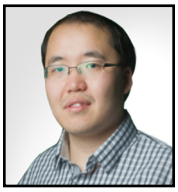
Anna Swan
Associate Professor, ECE, MSE, Physics

8 St. Mary's St., 828
617-353-1275
swan@bu.edu
Research interests:
- Interactions of biomaterials with nanostructures
- Carbon nanotubes

Malvin Teich
Professor Emeritus, ECE, BME, Physics

teich@bu.edu

Research interests:
- Quantum photonics
- Neural coding



Lei Tian
Assistant Professor, ECE

8 St. Mary's St., 830
617-353-1334
leitian@bu.edu

Research interests:
- Computational imaging and sensing
- Gigapixel 3D microscopy
- Compressive imaging

Barry Unger
Professor Emeritus, MET

unger@bu.edu

Research interests:
- High technology
- Venture capital businesses

Selim Unlu
Professor, ECE, BME, MSE

8 St. Mary's St., 826
617-353-5067
selim@bu.edu

Research interests:
- Near-field optical microscopy
- Nanoscale imaging of biological samples
- Biosensors

Brian Walsh
Assistant Professor, ME, ECE

110 Cummington Mall, 303
617-353-3414
bwalsh@bu.edu

Research interests:
- Space plasma dynamics
- Solar wind-planetary coupling
- Small spacecraft

Alice White
Professor, ME, MSE, BME, Physics

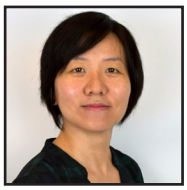
110 Cummington Mall, 107
617-353-4846
aew1@bu.edu

Research interests:
- Nanoscale 3D printing
- Mechanical metamaterials

John White
Professor, BME

44 Cummington Mall, 403
617-353-2805
jwhite@bu.edu

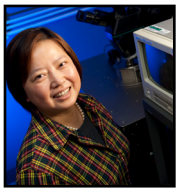
Research interests:
- Mechanisms of episodic memory
- Pathophysiology of epilepsy
- Computational neuroscience



Chen Yang
Associate Professor, Chemistry, ECE

8 Saint Mary's St., 829
617-358-4837
cheyang@bu.edu

Research interests:
- Nano materials for their potential applications in nanoscale devices and biological applications



Xin Zhang
Professor, ME, MSE, ECE, BME

8 St. Mary's St., 921
617-353-2702
xinz@bu.edu

Research interests:
- Micro nanomaterials
- Micro nanomechanics

Lawrence Ziegler
Professor, Chemistry

8 St. Mary's St., 719
617-353-8663
lziegler@bu.edu

Research interests:
- Spontaneous resonance Raman studies of photodissociative and biological chromophores

FACULTY COMMITTEES

The Photonics Center has five standing committees that support and serve its faculty and staff. The Photonics Center Director appoints the committee chairs.

Photonics Center Guest Speakers: 2020-2021 Chair – Anup Tank
The Distinguished Speaker Seminar Series is managed by student leaders of the BU student chapters of the OSA and SPIE. With support by the Photonics Center for travel and seminar expenses, students host a distinguished speaker of their choice each semester.

Academic Advisory: 2020-2021 Chair – Professor Thomas Bifano
The Academic Advisory Committee advises the Director of the Photonics Center on educational and academic issues and is comprised of the chairs from the Center's affiliated departments.

Space Allocation: 2020-2021 Chair – Professor Thomas Bifano
This committee chair generates policy guidelines for space management.

Symposium: 2020-2021 Chair – Postponed Due to COVID-19 Pandemic
The Photonics Center Symposium was postponed due to COVID-19. The next symposium will take place in Fall 2022, and is currently being planned as an in-person event.

Education Committee: 2020-2021 Chair – Professor Ji-Xin Cheng
This committee will focus on the recruitment of graduate students with a particular interest in photonics or optics to graduate programs in the Photonics Center's cognate departments, as well community building and applying for training grants and fellowships for graduate students. Faculty members on the committee are Darren Roblyer, Anna Swan, and Bjoern Reinhard, and staff members are Beth Mathisen, Cara Ellis McCarthy, and Helen Fawcett.

Photonics Ph.D.s and Dissertation Titles

Photonics Center Faculty Member	Academic Year 2020-2021 Ph.D. Graduates and Dissertation Titles
Keith Brown	**Nourin Alsharif** *"Interrogation of Nanostructured Soft Materials and Interfaces from Fundamental to Emergent Properties"* **Wenhan Cao** *"From Single Particle Polarizability to Assembling and Imaging Hierarchical Materials"*
Ji-Xin Cheng	**Ying Jiang** *"High Precision Optoacoustic Neural Modulation"* **Haonan Lin** *"Stimulated Raman Spectroscopic Imaging: Data Science Driven Innovations & Applications"*
Allison Dennis	**Reyhaneh Toufanian** *"Synthesis and Characterization of Indium Phosphide-Based Quantum Dot Heterostructures"*
Kamil Ekinci	**Atakan B. Ari** *"Nanomechanical Resonators at Extreme Dissipation Limits: Measurement of the Brownian Force in a Highly Viscous Liquid and Acoustically-Shielded Optomechanical Resonators for Quantum-Limited Transduction"*
Ajay Joshi	**Leila Delshadtehrani** *"Enabling Software Security Mechanisms Through Architectural Support"* **Md Saiful Arefin Mojumder** *"True Shared Memory Architecture for Next-Generation Multi-GPU Systems"* **Aditya Narayan** *"Energy-efficient Architectures for Chip-scale Networks and Memory Systems Using Silicon-photonics Technology"*
Catherine Klapperich	**Marjon Zamani** *"Affordable Technologies for Point-of-Care Diagnostics"*
Jerome Mertz	**Jean Marc Fan Chung Tsang Min Ching** *"Techniques for Single-Shot Volumetric Fluorescence Imaging"*
Bjoern Reinhard	**Qianyun Zhang** *"Novel Gold Nanoparticles as Platform for Investigating Epidermal Growth Factor Receptor Activation and Intestinal Epithelium Cell Metabolomics"*
Darren Roblyer	**Raeef Eric Istfan** *"Frequency-Domain Diffuse Optical Spectroscopy for Cardiovascular and Respiratory Applications"*
Alexander Sergienko	**Shuto Osawa** *"Photonic Quantum Information Processing Based on Directionally-Unbiased Linear-Optical Multiports"*
Alexander Sushkov	**Deniz Aybas** *"Searching for Axionlike Dark Matter Using Nuclear Magnetic Resonance and Precision Magnetometry"*
Anna Swan	**Mounika Vutukuru** *"Straining the Flatland: Novel Physics from Strain Engineering of Atomically Thin Graphene and Molybdenum Disulfide"*
Lei Tian/Selim Unlu	**Alex Matlock** *"Model and Learning-Based Strategies for Intensity Diffraction Tomography"*
Lei Tian	**Waleed Tahir** *"Deep Learning for Large-scale Holographic 3D Particle Localization and Two-photon Angiography Segmentation"*
Selim Unlu	**Allison Marn** *"Interferometric Imaging for High Sensitivity Multiplexed Molecular Measurements"* **Celalettin Yurdakul** *"Interferometric Reflectance Microscopy for Physical and Chemical Characterization of Biological Nanoparticles"* **Negin Zaraee** *"Development of an Optical Biosensor for Pathogenic Bacteria Identification and Antibiotic Susceptibility Testing"*
John White	**Samuel Garrett Brown** *"Experimental Demonstration of Single Neuron Specificity During Underactuated Neurocontrol"*
Chen Yang	**Amartya Dutta** *"Plasmonic Nanomaterials for Energy Harvesting and Sensing"*

Leadership & Staff

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Director

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Director of Operations & Program Management

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Administration & Finance Manager

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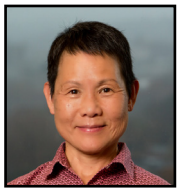

Anlee Krupp
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Laboratory Manager

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Beth Mathisen
Communications & Events Manager

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617-353-8907
bethmath@bu.edu

Cara Ellis McCarthy
Director, Finance, Administration & Personnel Management

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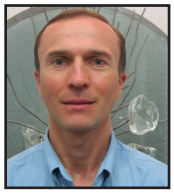
617-358-4257
cellis@bu.edu



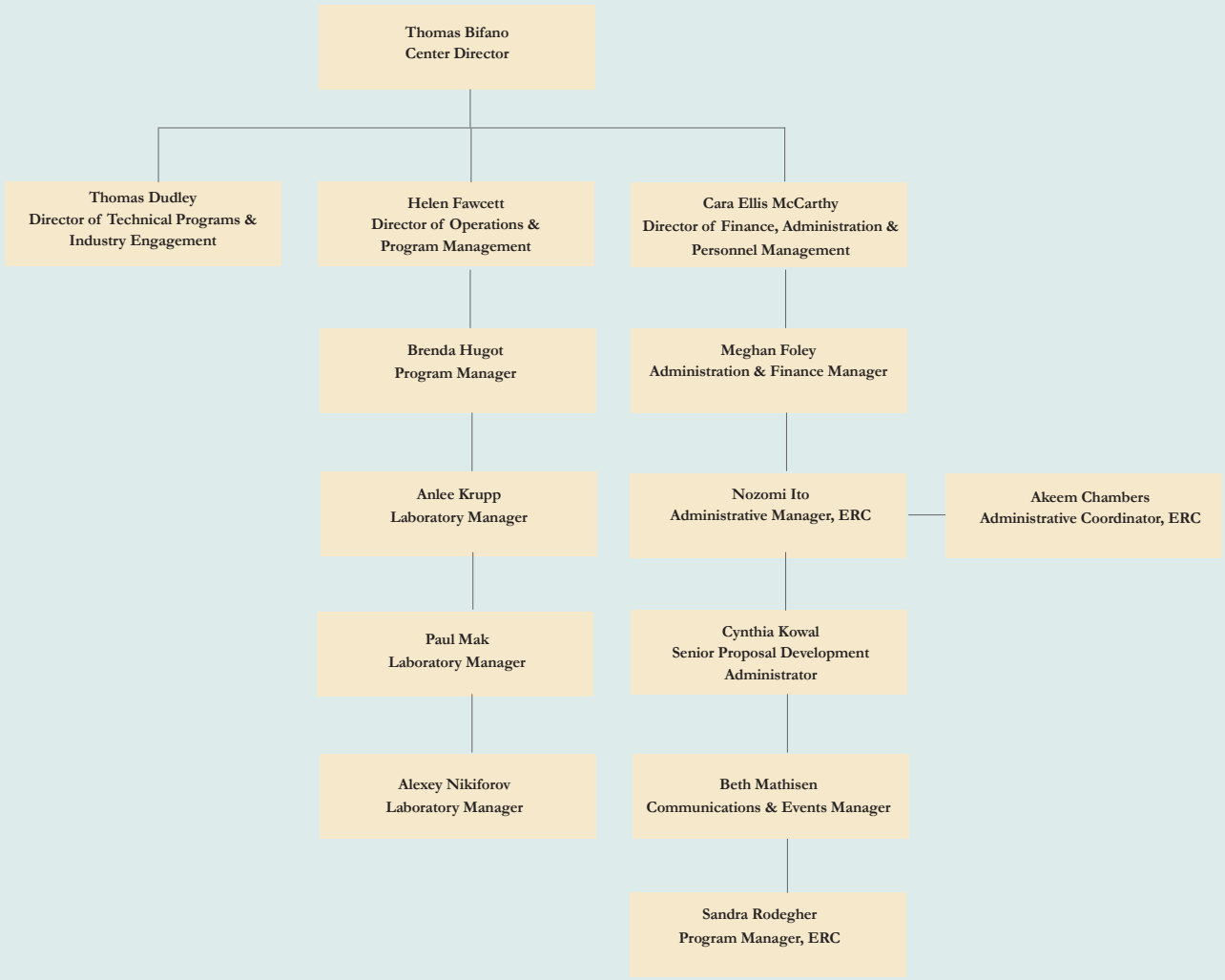
Alexey Nikiforov
Laboratory Manager

8 St. Mary's St., 909
617-353-9045
alnik@bu.edu

Sandra Rodegher
Program Manager, ERC

860-608-4250
srodegh@bu.edu

Center Organizational Chart



Staff Retirements

Thomas Dudley, Director of Technical Programs and Industry Engagement, has been a member of the staff of the BU Photonics Center for 13 years, and retired at the end of December 2021 to spend more time with family and to pursue his sailing hobby.

During his tenure, he led the technical programs and Business Innovation Center, and more recently for the last four years also assumed the role as the Industry Liaison Officer for the NSF CELL-MET Engineering Research Center. Mr. Dudley's strategic leadership was pivotal in recruiting companies to create and foster an innovation ecosystem with strong engagement by industry members both in the Photonics Center Business Innovation Center and for CELL-MET.

Anlee Krupp, Lab Manager of the Precision Measurement Laboratory (PML), has worked at BU for a total of 30 years of which the last 24 years were on the staff of the Photonics Center, since its inception in 1997. She is transitioning to retirement in February 2022 to spend more time with family, travel, volunteer in the Asian community utilizing her bilingual abilities, and to pursue hobbies such as Chinese brush painting.

During her tenure as Lab Manager of PML, new instruments and capabilities have been added each year, which she successfully supported, and which have also allowed her to continually learn and be challenged. Anlee has implemented and led a successful train-the-trainer program, which involves training students on the use of an instrument who then in turn can train other students, with some students ultimately becoming "super-users" of the equipment. This train-the-trainer model has allowed for expedited training and reduced downtime on the instruments, a very important management and training feature.

LIST OF AWARDED GRANTS

Photonics faculty members received more than **$37.4.M** in new external funding in the past year. The following table lists funds in the fiscal year (July 1, 2020 - June 30, 2021), as reported by the Sponsored Programs office.

AWARD TITLE	PI NAME	SPONSOR	FUNDING PERIOD	AMOUNT FUNDED IN FY21
A RAMAN SPECTROSCOPIC PROBE FOR OSTEOCHONDRAL ALLOGRAFT QUALITY ASSESSMENTS	ALBRO MICHAEL	MTF Biologics	1/15/2021-1/14/2024	$250,000
RAMAN NEEDLE ARTHROSCOPY FOR POST-TRAUMATIC OSTEOARTHRITIS DIAGNOSTICS AND TREATMENT MONITORING	ALBRO MICHAEL	Arthritis Foundation	4/1/2021-3/31/2024	$297,000
DEVELOPMENT OF AN ADVANCED SHOWERHEAD FOR PECVD	SOUMENDRA BASU	Lam Research Corporation	5/10/2017-5/31/2023	$204,310
PHASE I: DEMONSTRATION OF CONFORMAL OXIDATION RESISTANCE COATINGS DEPOSITED BY ELECTROPHORETIC DEPOSITION ON DENSE AND POROUS SUBSTRATES	SOUMENDRA BASU	Nissan North America Inc.	3/23/2020-3/31/2022	$125,000
CLARE BOOTHE LUCE GRADUATE FELLOWSHIP FOR JILLIAN RIX	SOUMENDRA BASU	The Henry Luce Foundation, Inc.	9/1/2020-8/31/2022	$100,460
CRA: COMPUTATIONALLY-GUIDED DESIGN OF ENERGY EFFICIENT ELECTRONIC MATERIALS (CDE3M)	BELLOTTI ENRICO	University of Utah	1/1/2014-12/31/2021	$160,105
CRA: COMPUTATIONALLY-GUIDED DESIGN OF ENERGY EFFICIENT ELECTRONIC MATERIALS (CDE3M)	BELLOTTI ENRICO	University of Utah	1/1/2014-12/31/2021	$346,895
CENTER FOR SEMICONDUCTOR MODELLING	BELLOTTI ENRICO	Department of Defense/ARL	9/1/2017-11/30/2022	$85,041
CENTER FOR SEMICONDUCTOR MODELLING	BELLOTTI ENRICO	Department of Defense/ARL	9/1/2017-11/30/2022	$90,000
FIELD EMITTER ROBUST VACUUM INTEGRATED NANOELECTRONICS (FERVIN)	BELLOTTI ENRICO	Florida International University	7/15/2019-2/14/2024	$130,000
FIELD EMITTER ROBUST VACUUM INTEGRATED NANOELECTRONICS (FERVIN)	BELLOTTI ENRICO	Florida International University	7/15/2019-2/14/2024	$130,000
DETECTOR DEVICE MODELING AND SIMULATION SERVICES	BELLOTTI ENRICO	DRS Network & Imaging Systems, LLC	6/29/2020-5/31/2021	$84,915
DETECTOR DEVICE MODELING AND SIMULATION SERVICES	BELLOTTI ENRICO	DRS Network & Imaging Systems, LLC	6/29/2020-5/31/2021	$40,000
VIRTUAL SUBSTRATE SIMULATION	BELLOTTI ENRICO	Department of Defense/ARL	5/1/2021-4/30/2022	$99,000
THEORETICAL AND EXPERIMENTAL STUDY OF THE TRANSPORT PROPERTIES OF III-V SLS FOR INFRARED IMAGING	BELLOTTI ENRICO	Government of Israel - Ministry of Defen	9/1/2021-8/31/2024	$100,000
OPTICAL AND THERMOMECHANICAL DESIGN OF HIGH REFLECTIVITY DEFORMABLE MEMBRANES	BIFANO G THOMAS	Regents of the University of Minnesota	9/1/2017-8/31/2021	$128,091

AWARD TITLE	PI NAME	SPONSOR	FUNDING PERIOD	AMOUNT FUNDED IN FY21
VALIDATION OF LIGHT SCATTERING SPECTROSCOPY FOR INTRA-OPERATIVE MARGIN GUIDANCE DURING ORAL CANCER RESECTION	BIGIO J IRVING	Boston Medical Center Corporation	7/7/2020-6/30/2025	$186,275
NANOSYSTEMS ENGINEERING RESEARCH CENTER FOR DIRECTED MULTISCALE ASSEMBLY OF CELLULAR METAMATERIALS WITH NANOSCALE PRECISION: CELL-MET	BISHOP DAVID	National Science Foundation	10/1/2017-9/30/2022	$8,250
NANOSYSTEMS ENGINEERING RESEARCH CENTER FOR DIRECTED MULTISCALE ASSEMBLY OF CELLULAR METAMATERIALS WITH NANOSCALE PRECISION: CELL-MET	BISHOP DAVID	National Science Foundation	10/1/2017-9/30/2022	$2,833,000
NANOSYSTEMS ENGINEERING RESEARCH CENTER FOR DIRECTED MULTISCALE ASSEMBLY OF CELLULAR METAMATERIALS WITH NANOSCALE PRECISION: CELL-MET	BISHOP DAVID	National Science Foundation	10/1/2017-9/30/2022	$754,139
NANOSYSTEMS ENGINEERING RESEARCH CENTER FOR DIRECTED MULTISCALE ASSEMBLY OF CELLULAR METAMATERIALS WITH NANOSCALE PRECISION: CELL-MET	BISHOP DAVID	National Science Foundation	10/1/2017-9/30/2022	$1,417,000
NANOSYSTEMS ENGINEERING RESEARCH CENTER FOR DIRECTED MULTISCALE ASSEMBLY OF CELLULAR METAMATERIALS WITH NANOSCALE PRECISION: CELL-MET	BISHOP DAVID	National Science Foundation	10/1/2017-9/30/2022	$49,999
NANOSYSTEMS ENGINEERING RESEARCH CENTER FOR DIRECTED MULTISCALE ASSEMBLY OF CELLULAR METAMATERIALS WITH NANOSCALE PRECISION: CELL-MET	BISHOP DAVID	National Science Foundation	10/1/2017-9/30/2022	$109,998
DETECTION OF BIOMAGNETIC FIELDS VIA MEMS GRADIOMETER	BISHOP DAVID	Sony Corporation of America	3/31/2021-3/30/2022	$100,000
DEFORMABLE MIRROR (DM) DESIGN AND MODELING: MAGNETICALLY-ACTUATED DM	BISHOP DAVID	Boston Micromachines Corporation	6/2/2021-10/2/2021	$22,641
ESTABLISHING AN FNIRS ECOSYSTEM FOR OPEN SOFTWARE-HARDWARE DISSEMINATION	BOAS DAVID	NIH/National Institute of Neurological D	1/1/2018-12/31/2021	$127,433
IMPROVING HUMAN FMRI THROUGH MODELING AND IMAGING MICROVASCULAR DYNAMICS	BOAS DAVID	Massachusetts General Hospital	11/1/2017-7/31/2021	$113,167
THE IMPACT OF MICROVASCULAR (DYS)REGULATION ON CEREBRAL FLOW AND OXYGEN HETEROGENEITY	BOAS DAVID	NIH/National Institute of Neurological D	9/1/2018-5/31/2023	$632,670

AWARD TITLE	PI NAME	SPONSOR	FUNDING PERIOD	AMOUNT FUNDED IN FY21
THE IMPACT OF MICROVASCULAR (DYS)REGULATION ON CEREBRAL FLOW AND OXYGEN HETEROGENEITY	BOAS DAVID	NIH/National Institute of Neurological D	9/1/2018= 5/31/2023	$626,919
IMAGING AND ANALYSIS TECHNIQUES TO CONSTRUCT A CELL CENSUS ATLAS OF THE HUMAN BRAIN	BOAS DAVID	Massachusetts General Hospital	8/22/2018-5/31/2023	$290,854
IMAGING AND ANALYSIS TECHNIQUES TO CONSTRUCT A CELL CENSUS ATLAS OF THE HUMAN BRAIN	BOAS DAVID	Massachusetts General Hospital	8/22/2018-5/31/2023	$293,118
TIME-GATED DIFFUSE CORRELATION SPECTROSCOPY FOR FUNCTIONAL IMAGING OF THE HUMAN BRAIN	BOAS DAVID	Massachusetts General Hospital	9/21/2019-6/30/2024	$128,285
THE NEUROSCIENCE OF EVERYDAY WORLD- A NOVEL WEARABLE SYSTEM FOR CONTINUOUS MEASUREMENT OF BRAIN FUNCTION	BOAS DAVID	NIH/National Institute of Biomedical Ima	9/22/2020-5/31/2025	$1,238,194
MONTE CARLO SIMULATIONS OF THE EFFECT OF NEURAL ACTIVATION AND VASCULAR DILATION ON THE DIFFUSE CORRELATION SPECTROSCOPY SIGNAL MEASURED NON-INVASIVELY IN THE HUMAN HEAD	BOAS DAVID	Facebook Technologies, LLC	3/26/2020-10/6/2020	$10,963
FIBER-BASED LASER SPECKLE CONTRAST IMAGING	BOAS DAVID	Facebook Technologies, LLC	4/24/2020-6/1/2021	$20,066
COMPARING LASER SPECKLE CONTRACT AND DIFFUSE CORRELATION SPECTROSCOPY MEASUREMENTS IN HUMAN BRAIN FUNCTION	BOAS DAVID	Facebook Technologies, LLC	4/20/2021-2/1/2022	$336,511
(MURI 15) A 4D NANOPRINTER FOR MAKING AND MANIPULATING MACROSCOPIC MATERIAL	BROWN KEITH	Northwestern University	12/15/2016-12/12/2020	$75,000
CLOSED-LOOP, TIP-DIRECTED NANOCHEMISTRY	BROWN KEITH	National Science Foundation	9/1/2017-8/31/2021	$69,973
DESIGN OF HELMET PAD STRUCTURES USING AUTONOMOUS EXPERIMENTAL RESEARCH	BROWN KEITH	Department of Defense/ Natick Soldier Res	5/13/2020-5/12/2022	$100,000
MASSIVELY PARALLEL SCANNING PROBE SYSTEM FOR MULTISCALE WRITING AND READING	BROWN KEITH	Department of Defense/ AFOSR	9/15/2020-9/14/2021	$238,215
NEUROTECHNOLOGY HUB: NEMONIC: NEXT-GENERATION MULTIPHOTON NEUROIMAGING CONSORTIUM	CHEN JERRY	University of California, Santa Barbara	10/1/2018-9/30/2021	$156,637
CORTICAL INTERACTIONS UNDERLYING SENSORY REPRESENTATIONS	CHEN JERRY	NIH/National Institute of Neurological D	9/30/2018-6/30/2023	$75,692
CORTICAL INTERACTIONS UNDERLYING SENSORY REPRESENTATIONS	CHEN JERRY	NIH/National Institute of Neurological D	9/30/2018-6/30/2023	$455,192
CORTICAL INTERACTIONS UNDERLYING SENSORY REPRESENTATIONS	CHEN JERRY	NIH/National Institute of Neurological D	9/30/2018-6/30/2023	$379,500

AWARD TITLE	PI NAME	SPONSOR	FUNDING PERIOD	AMOUNT FUNDED IN FY21
HARVARD UNIVERSITY/ MASSACHUSETTS INSTITUTE OF TECHNOLOGY JOINT RESEARCH GRANT PROGRAM IN BASICNEUROSCIENCE	CHEN JERRY	President and Fellows of Harvard College	7/1/2019-6/30/2021	$50,000
QUANTITATIVE SRS IMAGING OF CANCER METABOLISM AT SINGLE CELL LEVEL	CHENG JI-XIN	NIH/National Cancer Institute	9/20/2018-8/31/2021	$375,540
UNVEILING THE MECHANISMS OF ULTRASOUND NEUROMODULATION VIA SPATIALLY CONFINED STIMULATION AND TEMPORALLY RESOLVED RECORDING	CHENG JI-XIN	NIH/National Institute of Neurological D	9/30/2018-6/30/2023	$654,740
METABOLIC ASSESSMENT OF ANTI-MICROBIAL SUSCEPTIBILITY WITHIN ONE CELL CYCLE	CHENG JI-XIN	NIH/National Institute of Allergy & Infe	12/1/2018-11/30/2022	$518,480
TARGETING LIPID UNSATURATION IN OVARIAN CANCER STEM CELLS	CHENG JI-XIN	Northwestern University	8/1/2018-7/31/2023	$173,600
OPTICAL PHOTOTHERMAL IR (O-PTIR) MICROSCOPY FOR HIGHLY SENSITIVE CHEMICAL IMAGING AT SUB-MICRON RESOLUTION	CHENG JI-XIN	Photothermal Spectroscopy Corp.	9/12/2019-8/31/2021	$174,872
VIBRATIONAL SPECTROSCOPIC IMAGING TO UNVEIL HIDDEN SIGNATURES IN LIVING SYSTEMS	CHENG JI-XIN	NIH/National Institute of General Medica	7/1/2020-6/30/2025	$577,500
SENSING VULNERABLE PLAQUE IN VIVO BY AN ALL-OPTICAL INTRAVASCULAR ULTRASOUND AND PHOTOACOUSTIC CATHETER	CHENG JI-XIN	NIH/National Heart, Lung, and Blood Inst	9/1/2020-8/31/2024	$612,478
IRAMAN: BREAKTHROUGH BIOMEDICAL MICROSCOPE WITH SIMULTANEOUS INFRARED AND RAMAN SPECTROSCOPY AT SUB-MICRON SPATIAL RESOLUTION	CHENG JI-XIN	Photothermal Spectroscopy Corp.	4/15/2020-3/31/2021	$150,000
IRAMAN: BREAKTHROUGH BIOMEDICAL MICROSCOPE WITH SIMULTANEOUS INFRARED AND RAMAN SPECTROSCOPY AT SUB-MICRON SPATIAL RESOLUTION	CHENG JI-XIN	Photothermal Spectroscopy Corp.	4/15/2020-3/31/2022	$150,000
SBIR PHASE 1: FLUORESCENCE-ENHANCED PHOTOTHERMAL INFRARED SPECTROSCOPY	CHENG JI-XIN	Photothermal Spectroscopy Corp.	4/2/2021-9/30/2021	$79,999
AN INFRARED PHOTOTHERMAL PHASE MICROSCOPE FOR HIGH-RESOLUTION CHEMICAL IMAGING IN FINGERPRINT REGION	CHENG JI-XIN	Leonardo DRS Daylight Solutions	10/1/2019-9/30/2021	$176,618
ADVANCEMENT OF A POXVIRUS INHIBITOR	CONNOR H JOHN	NIH/National Institute of Allergy & Infe	3/12/2020-2/28/2025	$590,147
ANTIMICROBIAL SURFACE COATINGS TO REDUCE COVID-19 SPREAD	CONNOR H JOHN	Physical Sciences, Inc.	11/18/2020-8/24/2022	$241,405
DETERMINANTS OF COVID19-INDUCED VENOUS THROMBOSIS AND TARGETED THERAPY ASSESSED WITH BIOENGINEERED VEIN-CHIP	CONNOR H JOHN	NIH/National Heart, Lung, and Blood Inst	5/1/2021-4/30/2025	$1,830

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DETERMINANTS OF COVID19-INDUCED VENOUS THROMBOSIS AND TARGETED THERAPY ASSESSED WITH BIOENGINEERED VEIN-CHIP	CONNOR H JOHN	NIH/National Heart, Lung, and Blood Inst	5/1/2021-4/30/2025	$719,803
IN VITRO EVALUATION AND VALIDATION OF THE VIREX TEST STRIPS AND DEVICES	CONNOR H JOHN	Virex Health, Inc	1/1/2021-12/31/2021	$80,093
SARS-COV-2 VARIANTS IN THE TUFTS POPULATION	CONNOR H JOHN	Trustees of Tufts College, Inc	4/1/2021-3/31/2022	$11,600
COMPACT PHASE-MODULATED PHOTONIC STRUCTURES FOR ON-CHIP MULTIBAND SPECTROSCOPY	DAL NEGRO LUCA	National Science Foundation	9/1/2020-8/31/2023	$379,999
NEURAL CIRCUITS FOR REGULATING SOCIAL BEHAVIOR IN RODENTS	DAVISON IAN	NIH/National Institute on Deafness & Com	3/1/2019-2/28/2024	$340,966
MULTIPLEXED IMAGING IN THE NEAR INFRARED WITH INDIUM PHOSPHIDE QUANTUM SHELLS	DENNIS ALLISON	NIH/National Institute of General Medica	7/1/2019-7/31/2023	$462,000
BIODEGRADABLE AND BIOCOMPATIBLE SEMICONDUCTOR NANOPARTICLES FOR DEEP TISSUE IMAGING	DENNIS ALLISON	NIH/National Institute of General Medica	4/1/2020-3/31/2022	$206,250
EFFECTS OF INTRINSIC AND DRUG-INDUCED NEUROMODULATION ON FUNCTIONAL BRAIN IMAGING	DEVOR ANNA	NIH/National Institute on Drug Abuse	8/1/2020-5/31/2025	$419,919
EFFECTS OF INTRINSIC AND DRUG-INDUCED NEUROMODULATION ON FUNCTIONAL BRAIN IMAGING	DEVOR ANNA	NIH/National Institute on Drug Abuse	8/1/2020-5/31/2025	$388,170
MICROSCOPIC FOUNDATION OF MULTIMODAL HUMAN IMAGING	DEVOR ANNA	NIH/National Institute of Mental Health	6/1/2020-5/31/2022	$53,243
MICROSCOPIC FOUNDATION OF MULTIMODAL HUMAN IMAGING	DEVOR ANNA	NIH/National Institute of Mental Health	6/1/2020-5/31/2021	$1,177,864
TRANSPARENT NEURAL INTERFACE FOR IN VIVO INTERROGATION OF HUMAN ORGANOIDS	DEVOR ANNA	NIH/National Eye Institute	8/1/2020-7/31/2021	$270,342
UNDERSTANDING THE RELATIONSHIPS BETWEEN FUS-BBB OPENING, NEUROINFLAMMATION, AND THE NEUROVASCULAR RESPONSE	DEVOR ANNA	The Brigham and Women's Hospital, Inc.	9/2/2020-6/30/2023	$112,634
REVERSE ENGINEERING THE BRAIN STEM CIRCUITS THAT GOVERN EXPLORATORY BEHAVIOR	ECONOMO NICHOLAS MICHAEL	University of California, San Diego	6/1/2020-5/31/2023	$93,075
INVESTIGATING THE CONTROL OF MOVEMENTS BY SUBSPACES AND CELL TYPES IN THE MOUSE OROFACIAL SYSTEM	ECONOMO NICHOLAS MICHAEL	Whitehall Foundation, Inc.	3/1/2021-2/28/2022	$75,000
THE ROLE OF HISTONE DEACETYLASE 9 IN VASCULAR CALCIFICATION	GOLDSTEIN E LEE	Massachusetts General Hospital	6/1/2020-5/31/2021	$361,350
MOLECULAR AND CELLULAR PATHWAYS REGULATING NEUROVASCULAR DYSFUNCTION IN DEGENERATIVE TAUOPATHIES	GOLDSTEIN E LEE	NIH/National Institute on Aging	9/30/2020-8/31/2021	$827,748

AWARD TITLE	PI NAME	SPONSOR	FUNDING PERIOD	AMOUNT FUNDED IN FY21
LENS -AMYLOID BIOMARKER FOR EARLY DETECTION OF PRECLINICAL ALZHEIMER'S DISEASE IN THE FRAMINGHAM STUDY	GOLDSTEIN E LEE	NIH/National Institute on Aging	4/1/2021-3/31/2024	$1,682,982
VOLTAGE IMAGING ANALYSIS OF STRIATAL NETWORK DYNAMICS RELATED TO VOLUNTARY MOVEMENT AND PARKINSONS DISEASE	HAN XUE	NIH/National Institute of Neurological D	4/1/2020-3/31/2025	$382,313
MULTIDIMENSIONAL OPTIMIZATION OF VOLTAGE INDICATORS FOR IN VIVO NEURAL ACTIVITY IMAGING	HAN XUE	NIH/National Institute of Mental Health	3/1/2020-1/31/2025	$707,360
COLLABORATIVE RESEARCH: DYNAMIC INTERACTIONS OF INDIVIDUAL NEURONS IN SUPPORTING HIPPOCAMPAL NETWORK OSCILLATIONS DURING BEHAVIOR	HAN XUE	National Science Foundation	10/1/2020-9/30/2025	$399,231
WABOSH - WASHINGTON AND BU DO OPEN SOURCE HARDWARE	JOSHI JAYANT AJAY	University of Washington		$104,909
WABOSH - WASHINGTON AND BU DO OPEN SOURCE HARDWARE	JOSHI JAYANT AJAY	University of Washington		$72,828
SECURING CMOS IC CHIPS USING BACKSIDE IMAGING	JOSHI JAYANT AJAY	Honeywell Federal Manufacturing & Techno	9/9/2020-12/18/2020	$80,999
ROBUST CONDUCTANCE AND FORCE MEASUREMENTS OF SINGLE DNA MOLECULES TO QUANTIFY NUCLEOSOME UNWINDING	KAMENETSKA MARIA	Department of Defense/ AFOSR	1/1/2019-12/31/2021	$149,995
FLIPPED BIOMEDICAL GRAND ROUNDS: CREATING A CLINICAL IMMERSION CLASSROOM	KLAPPERICH M CATHERINE	NIH/National Institute of Biomedical Ima	6/4/2018-3/31/2023	$21,600
CAREER: DECIPHERING 2-DIMENSIONAL, CRYSTAL-MEDIATED, SURFACE- ENHANCED RAMAN SCATTERING FOR QUANTITATIVE ANALYSIS	LING XI	National Science Foundation	3/1/2020-2/28/2025	$571,061
SYNTHESIS OF NEW 2D CRYSTALS VIA SELECTIVE ATOMIC SUBSTITUTION	LING XI	Department of Energy		$157,960
SYNTHESIS OF NEW 2D CRYSTALS VIA SELECTIVE ATOMIC SUBSTITUTION	LING XI	Department of Energy		$149,808
RAPID ASSESSMENT OF ILLICIT DRUGS IN WASTEWATER	LING XI	Giner Inc.		$8,000
A NEW STRATEGY FOR ULTRA-LONG RANGE ORDERED TWO-DIMENSIONAL METAL ORGANIC FRAMEWORKS	LING XI	American Chemical Society Petroleum Rese		$110,000
SPECKLE-FREE PHASE-CONTRAST ULTRASOUND IMAGING	MERTZ JEROME	NIH/National Institute of General Medica	9/15/2019-8/31/2021	$206,250
FAST, LARGE-SCALE NEURONAL IMAGING WITH MULTI-Z CONFOCAL MICROSCOPY	MERTZ JEROME	NIH/National Institute of Biomedical Ima	2/1/2020-11/30/2023	$36,000

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FAST, LARGE-SCALE NEURONAL IMAGING WITH MULTI-Z CONFOCAL MICROSCOPY	MERTZ JEROME	NIH/National Institute of Biomedical Ima	2/1/2020-11/30/2023	$405,004
MULTI-LAYER NEURONAL IMAGING WITH REVERBERATION MULTIPHOTON MICROSCOPY	MERTZ JEROME	NIH/National Institute of Neurological D	3/15/2020-12/31/2024	$360,466
MULTI-LAYER NEURONAL IMAGING WITH REVERBERATION MULTIPHOTON MICROSCOPY	MERTZ JEROME	NIH/National Institute of Neurological D	3/15/2020-12/31/2024	$40,050
GRAPHENE PLASMONIC NANOSTRUCTURES FOR TERAHERTZ LIGHT EMISSION	PAIELLA ROBERTO	National Science Foundation	6/15/2021-5/31/2024	$400,000
ICENET: INTEGRATED CRYOGENIC ENERGY-EFFICIENT NANOPHOTONIC EGRESS TECHNOLOGY	POPOVIC MILOS	Department of Defense/ ARO	5/1/2019-4/30/2021	$304,376
ASCENT: COLLABORATIVE RESEARCH: SCALING DISTRIBUTED AI SYSTEMS BASED ON UNIVERSAL OPTICAL I/O	POPOVIC MILOS	National Science Foundation	8/15/2020-7/31/2023	$325,000
SILICON PHOTONIC CIRCUITS: LIGHT FORCES BASED CLASSICAL AND QUANTUM PHOTONICS ON-CHIP	POPOVIC MILOS	The David and Lucile Packard Foundation	5/1/2021-12/31/2022	$159,306
HIGH CAPACITY DATA CENTERS WITH ORBITAL ANGULAR MOMENTUM (OAM) SUPPORTING FIBERS	RAMACHANDRAN SIDDHARTH	Brookhaven National Laboratory	11/6/2018-12/31/2021	$118,500
ARTIFICIALLY MODULATING MEMORIES TO ALLEVIATE PSYCHIATRIC DISEASE-LIKE STRESS	RAMIREZ STEVE	NIH/Office of the Director	7/1/2017-8/31/2022	$412,500
SINGLE-CELL AND TARGET SPECIFIC RESOLUTION OF MULTIPLE MEMORIES ACROSS THE BRAIN	RAMIREZ STEVE	Research Foundation for Mental Hygiene	9/13/2019-8/31/2021	$391,877
RESTORING ACCESS TO MEMORIES 'LOST' AS A RESULT OF SLEEP DEPRIVATION	RAMIREZ STEVE	Department of Defense/ AFOSR	9/1/2021-8/31/2024	$262,517
ARTIFICIALLY MODULATING POSITIVE AND NEGATIVE MEMORIES TO ALLEVIATE MALADAPTIVE FEAR RESPONSES	RAMIREZ STEVE	The McKnight Foundation	2/1/2018-1/31/2022	$100,000
NANOPARTICLE DELIVERY OF HIV ENV TRIMER FOR INDUCING SOMATIC HYPERMUTATION AND BNAB	REINHARD M BJOERN	Antagen Pharmaceuticals, Inc.	8/1/2019-7/31/2021	$49,828
ILLUMINATING DYNAMIC RECEPTOR CLUSTERING IN THE EPIDERMAL GROWTH FACTOR RECEPTOR SIGNAL TRANSDUCTION PATHWAY USING PLASMON COUPLING	REINHARD M BJOERN	NIH/National Cancer Institute	4/1/2020-3/31/2025	$376,438
CAS-MNP: ELUCIDATING NANOPLASTICS - CELL INTERACTIONS THAT ENHANCE POLYCYCLIC AROMATIC HYDROCARBON UPTAKE IN AN INTESTINAL MEMBRANE MODEL	REINHARD M BJOERN	National Science Foundation	9/1/2020-8/31/2023	$400,000
EFRI CEE: OPTICALLY CONTROLLED LOCALIZED EPIGENETIC CHROMATIN REMODELING WITH PHOTOACTIVATABLE CRISPR-DCAS9	ROBLYER DARREN	Beth Israel Deaconess Medical Center, In	9/1/2018-8/31/2022	$122,343

AWARD TITLE	PI NAME	SPONSOR	FUNDING PERIOD	AMOUNT FUNDED IN FY21
LABEL-FREE MEASUREMENT OF BLOOD LIPIDS WITH HYPERSPECTRAL SHORT-WAVE INFRARED SPATIAL FREQUENCY DOMAIN IMAGING TO IMPROVE CARDIOVASCULAR DISEASE RISK PREDICTION AND TREATMENT MONITORING	ROBLYER DARREN	NIH/National Institute of Biomedical Ima	7/1/2020-3/31/2023	$209,212
CAREER: TOWARDS SUPER-RESOLUTION LABEL-FREE MID-INFRARED PHOTOTHERMAL IMAGING	SANDER MICHELLE	National Science Foundation	3/1/2019-2/29/2024	$105,018
PEAK POWER, SPECTRAL BANDWIDTH AND X(3) NONLINEARITIES CHARACTERIZATION IN SPECIALTY FIBERS	SANDER MICHELLE	Department of Defense/ ONR	11/10/2020-11/9/2021	$75,000
FUNCTIONAL ARCHITECTURE FOR EVIDENCE ACCUMULATION IN THE RAT NEOCORTEX	SCOTT BENJAMIN	Whitehall Foundation, Inc.	7/1/2019-6/30/2022	$75,000
EFFECTS OF STRESS ON INFORMATION PROCESSING IN THE HIPPOCAMPAL FORMATION	SCOTT BENJAMIN	Brain & Behavior Research Foundation	1/15/2021-1/14/2023	$70,000
17-HELIO17F-0035, SIMULTANEOUS MEASUREMENTS OF SUBSTORM ELECTRON ENERGIZATION IN THE IONOSPHERE AND THE PLASMA SHEET	SEMETER L JOSHUA	NASA	9/1/2017-8/31/2020	$45,000
UNDERSTANDING THE IMPACTS OF DYNAMIC DRIVERS ON GLOBAL STORM-TIME IONOSPHERE-THERMOSPHERE (IT) SYSTEM	SEMETER L JOSHUA	Jet Propulsion Laboratory	5/22/2018-3/31/2022	$40,000
UNDERSTANDING THE IMPACTS OF DYNAMIC DRIVERS ON GLOBAL STORM-TIME IONOSPHERE-THERMOSPHERE (IT) SYSTEM	SEMETER L JOSHUA	Jet Propulsion Laboratory	5/22/2018-3/31/2022	$90,000
GEOSPACE ENERGY EXCHANGE IN STRUCTURED ELECTRODYNAMIC ENVIRONMENTS	SEMETER L JOSHUA	National Science Foundation	8/1/2018-7/31/2022	$70,990
LIGHT AXION DARK MATTER SEARCH USING TOROIDAL FERRITE	SUSHKOV ALEXANDER	National Science Foundation	9/1/2018-8/31/2021	$ 125,130
LOCAL DYNAMICS AND CONTROL OF NOISY TWO-LEVEL SYSTEMS COUPLED TO A CENTRAL QUBIT	SUSHKOV ALEXANDER	National Science Foundation		$279,072
SEARCHING FOR INTERACTIONS OF ULTRA-LIGHT AXION-LIKE DARK MATTER	SUSHKOV ALEXANDER	Simons Foundation		$399,969
SMALL-SCALE FUNDAMENTAL PHYSICS BLOCK GRANT	SUSHKOV ALEXANDER	Northwestern University	1/1/2021-12/31/2022	$62,752
CAREER: OPTICAL INTENSITY DIFFRACTION TOMOGRAPHY WITH MULTIPLE SCATTERING	TIAN LEI	The Brigham and Women's Hospital, Inc.	12/21/2020-11/30/2021	$291,868
CUPID CUBESAT OBSERVATORY	WALSH MICHAEL BRIAN	NASA	4/25/2016-9/30/2021	$252,769

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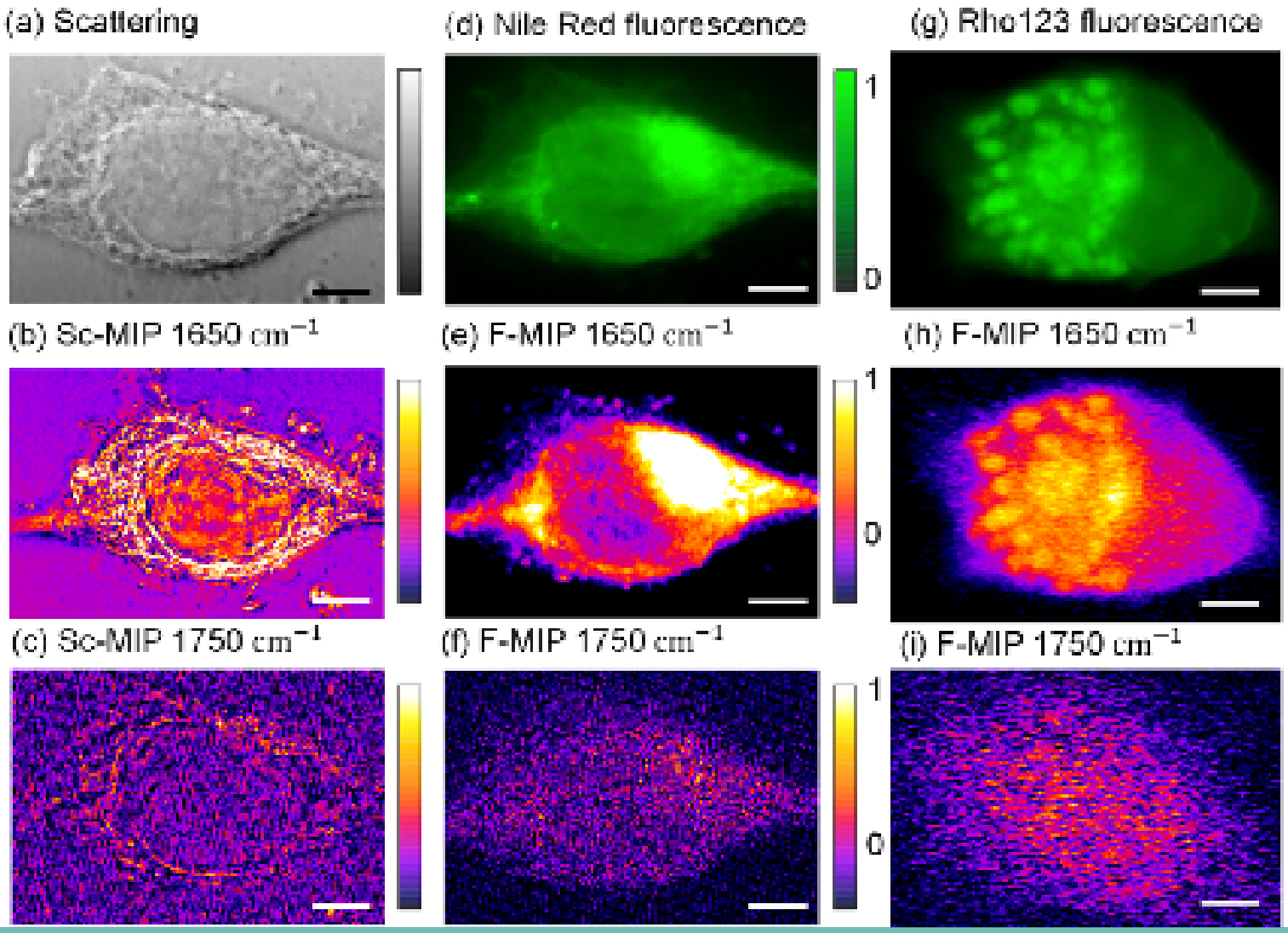
CUPID CUBESAT OBSERVATORY	WALSH MICHAEL BRIAN	NASA	4/25/2016-9/30/2022	$340,104
CAREER: SPREADING OF 3D MAGNETIC RECONNECTION	WALSH MICHAEL BRIAN	National Science Foundation	6/1/2019-5/31/2024	$135,430
LUNAR ENVIRONMENT HELIOPHYSICS X-RAY IMAGER (LEXI)	WALSH MICHAEL BRIAN	NASA	3/19/2020-3/18/2022	$61,525
REFINING PREDICTIONS OF RECONNECTION X-LINES AT EARTH'S MAGNETOPAUSE	WALSH MICHAEL BRIAN	NASA	7/22/2020-7/21/2023	$258,667
ACSEPT: A COMPACT SOLAR ENERGETIC PARTICLE TELESCOPE	WALSH MICHAEL BRIAN	NASA	8/19/2020-8/18/2023	$251,754
BOSTON UNIVERSITY PARTICIPATION IN THE SOLAR WIND MAGNETOSPHERE IONOSPHERE LINK EXPLORER (SMILE)	WALSH MICHAEL BRIAN	NASA	10/1/2020-9/30/2023	$153,033
MAGNETOPAUSE MODELS AND POSITION EXTRACTION FROM DATA	WALSH MICHAEL BRIAN	NASA	2/1/2021-1/31/2022	$30,000
SPECIFYING NEAR-EARTH SOLAR WIND CONDITIONS: A NOVEL MODEL FOR PROPAGATING SOLAR WIND VALUES AND UNCERTAINTIES	WALSH MICHAEL BRIAN	University of Alabama in Huntsville	12/15/2020-11/14/2022	$51,218
TRAINING PROGRAM IN QUANTITATIVE BIOLOGY AND PHYSIOLOGY	WHITE A JOHN	NIH/National Institute of General Medica	7/1/2017-6/30/2022	$350,973
SYNCHRONIZATION IN NOISY, HETEROGENEOUS EXCITATORY/ INHIBITORY NETWORKS	WHITE A JOHN	Louisiana State University	8/1/2018= 4/30/2023	$200,091
SINGLE-CELL ELECTRICAL MODULATION USING A MICROWAVE METASTRUCTURE	YANG CHEN	Department of Defense/ ARO	4/1/2021-1/31/2022	$60,000
DRAPER LABORATORIES STUDENT AGREEMENT (SAMUEL KANN)	ZHANG XIN	Draper Laboratory, Inc.	4/29/2019-4/24/2022	$46,241
REAL-TIME MONITORING OF EARTH SIGNALS USING NETWORKED SENSOR SYSTEMS TO ENABLE THE CONTROL OF SUBSURFACE EARTH PROCESSES	ZHANG XIN	University of Texas, Arlington	2/20/2019-8/15/2020	$27,524
ULTRAFAST 2DIR STUDIES OF DYNAMICS IN DENSE GAS AND SUPERCRITICAL FLUID SOLUTIONS	ZIEGLER LAWRENCE	National Science Foundation	8/1/2021-7/31/2024	$359,636

TOTAL: $ 37,423,224



Fluorescence-detected mid-infrared photothermal images of living MiaPaca2 cancer cells.

Zhang, Y., Zong, H., Zong, C., Tan, Y., Zhang, M., Zhan, Y., Cheng, J. (2021). Fluorescence-Detected Mid-Infrared Photothermal Microscopy, *Journal of the American Chemical Society*, 143, 11490-11499.

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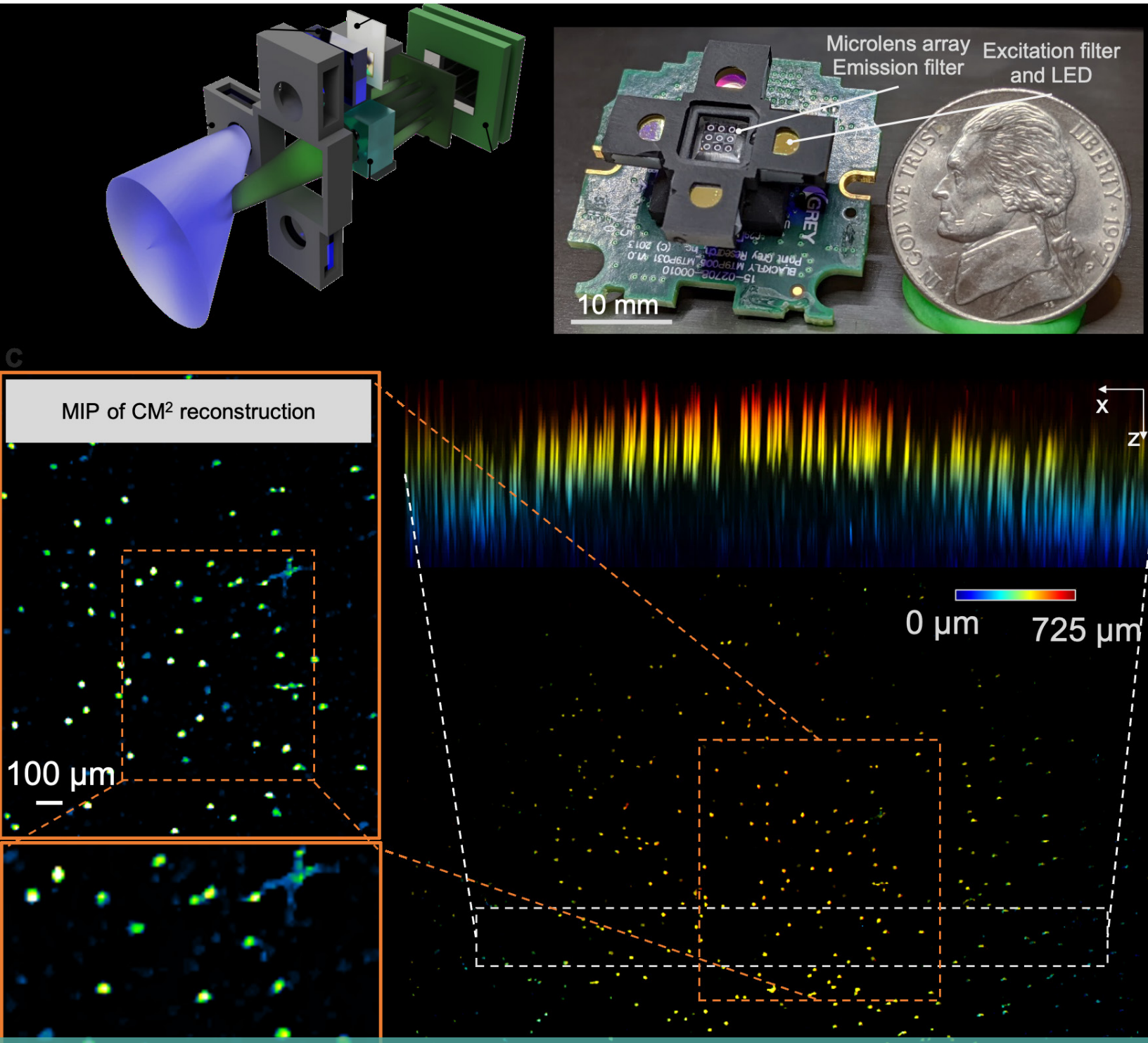

Computational Miniature Mesoscope (CM2) enables single-shot 3D fluorescence imaging using a simple lightweight miniaturized device. (A) Schematics of the CM2. (B) Picture of the CM2 prototype. (C) A 3D reconstruction result from the CM2. (Photo Courtesy of Assistant Professor Lei Tian)

Xue, Y., Davison, I., Boas, D & Tian, L.(2020). Single-shot Wide-field Fluorescence Imaging with a Computational Miniature Mesoscope, *ScienceAdvances*, 6, 43.