CURRICULUM VITAE

NAME	POSITION TITLE
Sanjay Krishna	George R Smith Professor of Engineering, Electrical & Computer Engineering, Ohio State University Founder and CTO, SK Infrared LLC Visiting Professor, Indian Institute of Technology

EDUCATION/TRAINING

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	YEAR(s)	FIELD OF STUDY
S.S.I.H.L Bangalore	B. Sc (Hons)	1994	Physics
Indian Institute of Technology, Madras	M.Sc	1996	Physics
University of Michigan Ann Arbor	M.S.	1999	Electrical Engineering
University of Michigan Ann Arbor	Ph D	2001	Applied Physics

Personal Statement

I am a faculty entrepreneur who has been involved with research and development of infrared (IR) detectors for the past 21 years. I was recruited to Ohio State University as a part of a discovery theme to set up a research, education, and entrepreneurial program on infrared sensors. I am the co-founder and CTO of two start-up companies leveraging the advances in IR detectors for defense and commercial applications. During my time at UNM, our group reported the first SLS nBn detector (Rodriquez et al, APL, 2007) and first dual band SLS nBn detector (Khoshakhlagh et al, APL 2007). I have a strong history of collaboration with industry, university, and DoD laboratories. I have received over $14M in funding after joining Ohio State in 2017.

A representative list of ongoing and recently completed projects I would like to highlight include:

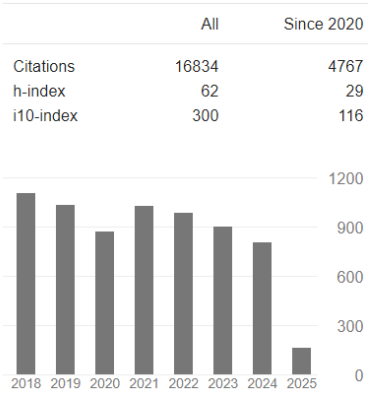
- President's Research Excellence (PRE) Catalyst Award - Brain Infrared Modulation of Pathways for Aging, Cognition, and Movement (Brain IMPACT) Krishna (PI), (01/01/2022 - 12/31/2024), $199,990.00
- Low Excess-Noise Avalanche Photodetectors (LEAPS) Office of Naval Research N00014-17-1-2440 - Krishna (PI) 09/2017-05/2023 ($3M)
- ALTITUDE: Affordable LIDAR technologies for integration and unmanned deployment, Ohio Federal Research Network, (11227-002), Krishna (PI) 10/29/2021 - 06/30/2023 ($1.8M)
- Bandstructure engineered type-II superlattice antimonide avalanche photodiodes (BETA-APD) for space lidar instruments, National Aeronautics and Space Administration (NASA), National Aeronautics and Space Administration, Krishna (PI) 04/06/2021 - 04/05/2024 ($1.2M)
- "CENTROID (CENter for Technology-transition and Rapid-Protoyping Of Infrared Detectors)" MMEC, $1,024,954, 11/2024 – 11/2025.

Positions and Appointments

2017 - present	Professor, George R. Smith Chair, Ohio State University, ECE, Columbus, OH, US
2023 - present	Graduate Chair, ECE Department, Ohio State University, Columbus OH, US
2010 - present	Founder/CTO, SK Infrared, Columbus, OH, US
2018 - 2024	Visiting Professor, Indian Institute of Technology Bombay, Mumbai, India
2017 - 2022	Research Professor, University of New Mexico, ECE Dept, Albuquerque, NM, US
2017 - 2020	Faculty Advisor to Ohio State's Nanotech West user facility at Institute for Materials Research
2013 - 2016	Director, University of New Mexico, Center for High Tech Materials, Albuquerque, NM, US
2010 - 2017	Professor, University of New Mexico, ECE, Albuquerque, NM, US
2010 - 2017	Associate Professor, University of New Mexico, ECE, Albuquerque, NM, US
2010 - 2013	Founder/CEO, SK Infrared, Columbus, OH, US
2009 - 2017	UNM Regents Lecturer, University of New Mexico, Albuquerque, NM, US
2009 - 2012	Associate Director, University of New Mexico, Center for High Tech Materials, Albuquerque, NM, US
2001 - 2006	Assistant Professor, University of New Mexico, ECE, Albuquerque, NM, US
1998 - 2001	Graduate Student Researcher, University of Michigan, Ann Arbor, MI, US
1997 - 1998	Graduate Student Instructor, University of Michigan, Ann Arbor, MI, US
1996 - 1997	Graduate Student Assistant, Tata Institute of Fundamental Research, Mumbai, India

Honors and Distinctions

1996 Gold Medal from Indian Institute of Technology, Madras
1997 First in Grad School of Physics at Tata Institute of Fundamental Research
1997 Graduate Student Fellowship, Dept. of Physics, University of Michigan
1998 North American Molecular Beam Epitaxy (NAMBE) Best Student Paper Award
2003 Outstanding Young Engineer Award by IEEE Albuquerque Chapter
2004 ECE Outstanding Researcher Award
2004 Oak Ridge Associated Universities Ralph Powe Jr. Faculty Enhancement Award
2005 UNM School of Engineering Junior Faculty Teaching Award
2007 North American Molecular Beam Epitaxy Young Investigator Award
2007 Defense Intelligence Agency Chief Scientist Award for Excellence
2008 IEEE-Nanotechnology Council Early Career Achievement Award
2008 SPIE Early Career Achievement Award
2009 UNM School of Engineering Sr. Research Excellence Award
2009 UNM Regents Lecturer Award
2010 UNM Teacher of the Year Award
2011 Fellow of SPIE (International Professional Society for Optics and Photonics Technology)
2011 UNM ECE Gardner-Zemke Award for Research Excellence
2013 International Symposium on Compound Semiconductor (ISCS) Young Scientist Award
2013 Fellow of IEEE (Institute of Electrical and Electronics Engineers)
2015 Fellow of Optical Society of America (OSA)
2018 Member of NASA Technical Discipline Team on Sensors and Instrumentation
2020 SPIE Aden and Marjorie Meinel Technology Achievement Award
2020 Departmental Recognition for Teaching Excellence
2020 IEEE Photonics Society Aron Kressel Award
2022 Ralph Boyer Award for Excellence in Undergraduate Education
2022 North American Molecular Beam Epitaxy Innovator Award
2025 Ohio State University Innovator of the Year Award



Selected Publications Other Significant Publications (>400 publications, >16,000 citations, H-index=62, G. Scholar); 24 issued patents

1. Ko, Hyunhyub, Kuniharu Takei, Rehan Kapadia, Steven Chuang, Hui Fang, Paul W. Leu, Kartik Ganapathi et al. "Ultrathin compound semiconductor on insulator layers for high-performance nanoscale transistors." Nature 468, no. 7321 (2010): 286. (484 Citations)
2. Watts, Claire M., David Shrekenhamer, John Montoya, Guy Lipworth, John Hunt, Timothy Sleasman, Sanjay Krishna, David R. Smith, and Willie J. Padilla. "Terahertz compressive imaging with metamaterial spatial light modulators." Nature Photonics 8, no. 8 (2014): 605. (920 citations)
3. Rodriguez, J. B, E. Plis, G. Bishop, Y. D. Sharma, H. Kim, L. R. Dawson, and S. Krishna. "n B n structure based on In As⁄ Ga Sb type-II strained layer superlattices." Applied Physics Letters 91, no. 4 (2007): 043514 (346 citations)
4. Khoshakhlagh, A., J. B. Rodriguez, E. Plis, G. D. Bishop, Y. D. Sharma, H. S. Kim, L. R. Dawson, and S. Krishna. "Bias dependent dual band response from InAs⁄GaInSb type II strain layer superlattice detectors." APL, 91, no. 26 (2007): 263504. (123 citations)
5. Kim, H. S., E. Plis, J. B. Rodriguez, G. D. Bishop, Y. D. Sharma, L. R. Dawson, S. Krishna et al. "Mid-IR focal plane array based on type-II In As⁄ Ga Sb strain layer superlattice detector with n B n design." APL, 92, no. 18 (2008): 183502. (152 citations)

Book Chapters

1. Plis, E., Krishna, S., "Type-II Superlattices: Status and Trends" in book The Wonder of Nanotechnology: Quantum Optoelectronic Devices and Applications, SPIE publisher, 2013.
2. Barve, A.V., Krishna, S., "Quantum Dot Infrared Photodetectors", in book Semiconductors and Semimetals, Vol. 84, Advances in Infrared Photodetectors, San Diego: Academic Press, 2011.
3. Fu, L., Vandervelde, T., Krishna, S., "Quantum Dot Infrared Photodetectors", in book VLSI Microphotonics: Science, Technology and Application, CRC Press, 2010.

Selected Plenary/Invited Talks and Presentations

1. The Infrared Retina: Towards, 4th Gen Focal Plane Arrays, International Symposium on Semiconductor Optoelectronics and Nanotechnology, Canberra. Dec 2024
2. Antimonide Superlattices and Avalanche Photodiodes, North American Molecular Beam Epitaxy Conference, Boston, July 2024
3. Antimonide Based Infrared Avalanche Photodiodes, KTH Royal Institute of Technology, Sweden, Mar 2024
4. Vision for 4th Generation of Infrared Detectors, Indian Institute of Science, Bangalore, India, Mar 2024
5. *Keynote Presentation:* "Antimonide Based Infrared Avalanche Photodiodes," 2023, Jeju, South Korea, Compound Semiconductor Week 2023.
6. Antimonide Avalanche Photodiodes on InP Substrates. IEEE Research and Applications of Photonics in Defense Conference (RAPID), 2021.
7. Krishna, S., Antimonide-Based Avalanche Photodiodes on InP Substrates, 2021, 2021 IEEE Photonics Conference (IPC). https://doi.org/10.1109/IPC48725.2021.9592949
8. Antimonide based infrared detectors: understanding band-structures and engineering band-diagrams (Conference Presentation). SPIE Defense + Commercial Sensing, SPIE, 2019.
9. Antimonide Based Infrared Detectors and Focal Plane Arrays. 2018 IEEE Research and Applications of Photonics In Defense Conference (RAPID), 2018.
10. Tutorial: Photonic Infrared Detectors Technologies. 30th Annual Conference of the IEEE Photonics Society, New York, IEEE, 2017.
11. SWOT Analysis of T2SL Technology. ARL West Workshop, 2017.
12. *Keynote Presentation:* "Multi-spectral Black Meta-Infrared Detectors" SPIE Annual Meeting, Aug 28th- Sept 1st 2016
13. *Keynote Presentation:* "Infrared Imaging: Ready for Prime Time?" SPIE Symposium on Security and Defence, Dresden, Germany.23 - 26 September 2013.
14. *Plenary Talk*: Infrared Imaging: From Defense to Medicine?, SPIE Fellows Luncheon, SPIE Defense and Security Symposium, April 2013.
15. *Plenary Talk:* The Infrared Retina: Bioinspired Sensing Using Nanoscale Superlattices and Quantum Dots, SPIE Lecturer for Optical Society of Korea, Busan, South Korea, July 2012
16. *Invited Talk*: "Ultrathin Deep-Subwavelength Infrared Detectors" The Workshop on Compound Semiconductor Materials and Devices, Feb 1st-4th, Tucson, AZ, 2016
17. *Invited Talk*: "Mid-infrared Interband Cascade Photodetectors with High Quantum Efficiency" SPIE Photonics West, San Francisco, February 15th-19th 2016
18. *NRO Technical Seminar:* "Multispectral Black Infrared Meta-Detectors" National Reconnaissance Office, 22nd Oct 2015 (co-presented with Prof. Willie Padilla, Duke University).
19. *Invited Talk*: "4th Generation Detectors and Focal Plane Arrays", IEEE AVFOP Meeting, Santa Barbara, Oct 2015
20. *Invited Colloquium*: "Antimonide Based Infrared Detectors for 4th Generation Imagers", Duke University, September 23rd, 2015
21. *Invited Colloquium*: "Antimonide Based Infrared Detectors for 4th Generation Imagers", Cornell University, September 10th, 2015
22. *Invited Colloquium*: "Thermal Infrared Imaging and its Application for Early Detection of Skin Cancer", Skin Diseases Research Center Seminar, Department of Dermatology, University of Colorado, Denver June 2nd, 2015.
23. *Invited Colloquium:* Next Generation Infrared Imagers with Quantum Dots and Antimonide Superlattices, University of California, Santa Barbara, April 2013.

24. *Invited Colloquium*: Mid-infrared Materials and Devices for Intelligent Imaging Systems, Sandia National Laboratory, Albuquerque NM Jan 2014
25. *Invited Colloquium*: Mid-infrared Materials and Devices for Intelligent Imaging Systems, Los Alamos National Laboratory, Los Alamos NM Dec 2013
26. *Invited Talk:* "Antimonide Nano-Engineered Membranes: A Platform for Studying Infrared Materials and Devices", Device Research Conference, Columbus Ohio. June 24th, 2015,
27. *Invited Talk,* "4th Generation Infrared Detectors and Focal Plane Arrays", IEEE Avionics and Vehicle Fiber-Optics and Photonics Conference, Santa Barbara, CA, Nov 10-12th, 2015.
28. *Invited Talk:* "Mid-infrared Materials and Devices for 4th Generation Infrared Imagers", Solid State Physics Laboratory, India, May 14th, 2015.
29. *Invited Talk:* Mid-infrared Detectors for Next Generation Neurophotonic Systems", Mid-infrared Optoelectronics Materials and Devices (MIOMD), Montpellier, France, Oct 8th, 2014
30. *Invited Talk:* Mid-infrared Materials, Devices and Focal Plane Arrays for Intelligent Imaging Systems, OSA Meeting, OSA Topical Meeting on Integrated Photonics Research, Silicon and Nano Photonics, San Diego, CA, July 14th, 2014
31. *Invited Talk:* "Heterostructure Engineering of Type II Superlattice Detectors", SPIE Annual Meeting, San Diego, CA, Aug 2014
32. *Invited Talk:* The Infrared Retina: Ushering in the Fourth Generation of Infrared Detectors, International DNTAC Symposium on Nanotechnology, Seoul, Korea, July 2012.
33. *Invited Talk:* The Infrared Retina: Bioinspired Sensing Using Nanoscale Superlattices and Quantum Dots, ICONN, Perth, Australia, Feb 2012.

Research Mentoring

Post Doctoral Fellows and Research Faculty Mentored

1. Dr. Tom Vandervelde (Faculty at Tufts University),
2. Dr. Jean Baptiste Rodriguez (Faculty, CNRS, Montpellier),
3. Dr. Jay Brown (Mikron)
4. Dr. Abdenour Amtout (Abound Solar)
5. Dr. Phil Dowd (Arizona State University)
6. Dr. M. Naydenkov (Lightspin)
7. Dr. Y.D. Sharma (OSI)
8. Dr. J.O.Kim (KRISS)
9. Dr. Von Winckel (Sandia National Lab)
10. Dr. Elena Plis (Assurance Technology Corp)
11. Dr. Alireza Kazemi (Intel)
12. Dr. Zahra Taghipour (FLIR)
13. Dr. Nicole Pfiester (Faculty at Rose Hulman)
14. Dr. Piotr Martyniuk (MUT)
15. Dr. Seunghyun Lee (OSU)
16. Dr. Punam Murkute (OSU)

Graduated Students (34 PhD and 18 M.S)

PhD

1. Greg von Winckel, PhD "Spectral Element Modeling of Semiconductor Nanostructures" (Spring 2006) (Sandia National Laboratory)

2. Zhimei Zhu, PhD "Materials Characterization of InAs/GaInSb Type II Superlattices" (Spring 2006) (Working in Law Firm in DC)

3. Elena Plis, PhD, " InAs/(In,Ga)Sb Strain Layer Superlattice (SLS) Photovoltaic Infrared Detectors" (Summer 2007) (Assurance Technology Corporation)

4. Ram Attaluri, PhD “Growth and Optimization of Dot-in-well (DWELL) Infrared Photodetectors” (Summer 2007) (Lehigh University)
5. Fred Newmann, PhD “Study of Techniques to Obtain Metamorphic Low Bandgap Devices on GaAs Substrates” (Fall 2007) (Emcore Corp)
6. Jonathan Andrews, PhD “High Precision Radiometry Using an InAs/InGaAs Quantum Dot-in-a-Well Focal Plane Array, (Fall 2008) (Naval Research Lab)
7. Chris Wilcox, PhD “Atmospheric Turbulence Simulation Using a Liquid Crystal Spatial Light Modulator”, (Fall 2009) (Naval Research Lab)
8. Arezou Khoshakhlagh, PhD, “Longwave and Bi-color Type-II InAs/(In)GaSb Superlattice Infrared Detectors” (Spring 2010) (NASA-JPL)
9. Hasul Kim, PhD "Investigation of InAs/GaSb Superlattice based nBn Detectors and Focal Plane Arrays" (Summer 2010) (Chonnam National University)
10. Rajeev Shenoi, PhD, “Multispectral Plasmon Enhanced Quantum Dots-in-a-Double Well Infrared Detectors” (Fall 2010) (RPI)
11. Jiayi Shao, PhD, “Engineered Quantum Dots for Infrared Photodetectors” (Fall 2011) (Intelliepi)
12. Ajit Barve, PhD, “Heterostructure Engineering of Quantum Dots in a Well Infrared Photodetectors” (Spring 2012) (Facebook)
13. David Ramirez, PhD, “Modeling and Engineering Impact Ionization in Avalanche Photodiodes for Near and Mid-infrared Applications” (Co-advised with Hayat, Spring 2012) (Skinfrared LLC)
14. Woo-Yang Jang, PhD, “Data Compressive Paradigm for Spectral Sensing and Classification Using Electrically Tunable Detectors” (Co-advised with Hayat, Fall 2012) (AFRL Sensors Directorate)
15. Nutan Gautam, PhD, “Unipolar Barrier Strained Layer Superlattice Infrared Photodiodes: Physics and Barrier Engineering” (Summer 2012) (JDS Uniphase)
16. Glauco Cugler Fiorante, “Spatio-Temporal Circuits with Imaging Sensors” (Co-advised with Zarkesh-Ha, Summer 2013) (Federal Institute for Education, Science and Technology, Sao Paolo, Brazil)
17. Stephen Myers, PhD, “Mid-wave and Long-Wave Single Unipolar Barrier Infrared Detectors Based on Antimonide Materials Systems”, (Spring 2013), Lumentum
18. Maya Narayan-Kutty, PhD, “Novel Etching and Passivation Schemes on InAs/GaSb Superlattice Based Infrared Detectors” (Summer 2013) (Indian Institute of Science)
19. Freddie Santiago, PhD “Design and Development of Adaptive Polymer Lens Doublet”, (Summer 2014) Sandia National Lab
20. Brianna Klein, PhD, “Defect Investigations in InAs/GaSb Type II strained layer superlattice”, (Fall 2014), University of New Mexico
21. Sebastian Godoy, PhD, “Detection Theory for Skin Cancer Diagnosis Using Dynamic Thermal Imaging” (Spring 2015, Co-advised by Hayat), University of Concepcion, Chile
22. John Montoya, PhD, “Metamaterial Absorber for Smart Imaging”, (Spring 2015), Duke University
23. Ted Schuler Sandy, PhD, “Investigation of Infrared Detectors Based on Ga-Free (InAs-InAsSb) Strained Layer Superlattice (Spring 2016)
24. Marziyeh Zamiri, “Antimonide-based superlattice membranes for infrared applications” (2016)
25. Vincent M. Cowan, PhD, “Measurement and Analysis of III-V & II-VI Infrared Detectors: Radiometric, Noise Spectrum, and Radiation Tolerance Performance,” The University of New Mexico (2016).
26. Lilian Casias, “Transport in Mid-Wavelength Infrared (MWIR) p- and n-type InAsSb and InAs/InAsSb Type-II Strained Layer Superlattices (T2SLs) for infrared detection” (2019), Sandia National Lab
27. Zahra Taghipour, “Vertical Transport Study of III-V Type-II Superlattices”, (2019) FLIR systems
28. Vinita Rogers, PhD, “Investigation of Antimonide based Metamorphic Buffers and Detectors,” The Ohio State University (Spring 2020), Intel.
29. Teressa Specht, PhD, “Advancements Toward High Operating Temperature Small Pixel Infrared Focal Plane Arrays: Superlattice Heterostructure Engineering, Passivation, and Open-Circuit Voltage Architecture,” The Ohio State University (Summer 2020), SK Infrared.

30. Seunghyun Lee, PhD, "High sensitivity AlGaAsSb avalanche photodiodes on InP substrates for 1.55 µm wavelength applications," The Ohio State University (Spring 2022), OSU.
31. Sri Harsha Kodati, PhD, "Low-noise Antimonide-Based Avalanche Photodiodes on InP Substrates," The Ohio State University (Fall 2022), Planet Labs.
32. Amber Arquitola, PhD, "Contactless Characterization of Carrier Dynamics in Infrared Materials," The Ohio State University (Spring 2024), L3-Harris.
33. Mariah Schwartz, PhD, "Antimonide-Based Avalanche Photodiodes on InP Substrates for Short-Wave Infrared Applications," The Ohio State University (Spring 2024), Northrop Grumman.
34. Hyemin Jung, PhD, "Antimonide-based SWIR avalanche photodiodes on InP substrates," The Ohio State University (Spring 2024).

M.S.

1. Sunil Raghavan, M.S. (Thesis), **with distinction**, Summer 03, "Intersubband Quantum Dots in a Well Infrared Detectors" (Research Engineer in India)
2. Capt. Mario Serna, M.S. (Thesis) Summer 03, "Model and Fabrication of a Proof of Concept Polarimeter in a Pixel" (Presently Teaching Physics at the Airforce Academy in Colorado Springs)
3. Christopher Wilcox, M.S. (Thesis), Fall 2005, "The Design of an Adaptive Tip/Tilt Mirror for Adaptive Optics", (Continuing with PhD) (Naval Research Lab)
4. Senthil Annamalai, M.S. (Thesis), Spring 2006, "Quantum Dots in a Well Detector grown by Molecular Beam Epitaxy and Metal Organic Chemical Vapor Deposition" (Triquint Semiconductors)
5. Kalyan Teja Posani M.S. (Thesis), Fall 2006 "Nanoscale Quantum Dot Photonic Crystal Detectors" (Qualcomm, San Diego)
6. Eric Varley, M.S. (Thesis), Spring 2007, "Two color quantum dots in a well focal planer arrays". (Sandia National Lab)
7. Diana Jepson, M.S. (Thesis), Spring 2007, "1/f Noise measurements in HgCdTe Detectors". (Air Force Research Lab)
8. Michael Lenz, M.S. (Thesis) Summer 2007, "Characterizing Spectral Response of Quantum Dots in a Well Focal Plane Arrays" (Sandia National Lab)
9. Greg Bishop M.S. (Thesis), Spring 2008, "nBn Based Strain Layer Superlattice Detectors". (Sandia National Lab)
10. Jason Shelton M.S. (Thesis), with distinction, Summer 2008, "Series Connected Photovoltaic Arrays". (Sandia National Lab)
11. Andrea Scott, M.S. "A Survey on Implementations of Integrated System Health Management (ISHM) for Air and Space Vehicles", Fall 2008 (AFRL)
12. Nina Weisse-Bernstein, M.S**.,** with distinction, "Investigation of the Feasibility of Creating Arbitrary Optical Transmission Using Surface Acoustic Waves and Surface Plasmons", Spring 2009 (LANL)
13. Jason Oberling, MS, "Aligning the Advanced LIGO Arm Cavity For the H2 One Arm Test", Summer 2012.
14. Kimberly R. Knobel, MS, "Predicting Coronal Holes Using Principle Components Regression", M.S. Optical Science and Engineering, Fall 2015.
15. Teressa R. Specht, M.S. (Thesis), "Wafer Level Characterization of Infrared Detectors," The University of New Mexico (2016).
16. D. Rudy Fink, M.S. (Thesis) "Capacitance-based characterization of PIN devices," The Ohio State University (2020), L3-Harris.
17. Brett L. Ringel, M.S. (Thesis) "Investigation of Mesa Etched Antimonide Detectors Using Time Resolved Microwave Reflectance," The Ohio State University (2020), Georgia Tech.
18. Mridula Khade, MS (Non-Thesis), Field Programmable Short Wave Infrared Avalanche Photodiodes", (2021), Industry-Freeform, CA

Undergraduate Students:

1. Nina Rae Weisse-Bernstein (Summer 2004-Spring 2005, LANL)

2. Shawn Humphrey (Spring 2005, Naval Postgrad School)
3. Darren Formann (Spring 2004, Industry)
4. Mark Spencer (Spring 2005)
5. Nicole Escude (Summer 2005, Biola Univ)
6. Vaibhav Tripati (Summer 2005, IIT, Kanpur)
7. Rasika Behl (Summer 2006, USC)
8. Pooja Singh (Summer 2006, IIT, Roorkee)
9. Amit Siroya (Summer 2007, IIT Mumbai)
10. Jennifer Hou (Summer 2008, Johns Hopkins University)
11. Shreyas Shah (Summer 2008, IIT Mumbai)
12. Niyanti Datye (Summer 2009, Georgia Tech)
13. Sreejan Meesala (Summer 2010, IIT Mumbai)
14. Patrick Wanninkhof (Summer 2010, Univ of Florida)
15. Nathan Henry (Spring-Summer 2011, UNM)
16. Isha Datye (Summer 2011, UIUC)
17. Megan Buczkowski (Summer 2011, MSU)
18. Ricky Flores (Fall 2012)
19. Emily Tansey (Summer 2012)
20. Travis Nelson (Summer 2012)
21. Tristan Garwood (2014)
22. Eric Frantz (2014)
23. Regina Eckert (Graduated May 2015, Grad School at Berkeley)
24. Tristan Garwood (Graduated May 2015, University of Michigan)
25. Clark Kadlec (2014-2015)
26. Frank Salas (Undergrad, UNM)
27. Rudy Fink (2018, L3-Harris)
28. Brett Ringel (2018, Georgia Tech Doctoral Program)
29. Jeffrey Simon (2019, Battelle)
30. Sophie Mills (2021, Ohio State Doctoral Program)
31. Nathan Gajowski (2021, Ohio State Doctoral Program)
32. Ababakar Okieh (2022, Naval Research Laboratory)
33. Arman Mehzad (2022-2023)
34. Cam Ringel (2022)
35. Matt Taubeneck (2022)
36. Bibhus Luitel (2022)
37. Surith Krishna (2023)
38. Dylan Plouffe (2023-Present)
39. Jackson Cook (2024-Present)
40. Jack Dvorak (2025-Present)

High School Students:

1. Mathew Rush (Fall'03/Spr'04)
2. Victoria Fowler (Summer'03)
3. Mallory Mallet (Summer 07, Fall 07)
4. Spencer Kent, Spring 2011
5. Sean Yonemoto, Spring 2012
6. Andzoa Jamus (AIMS-High School) Fall 2015
7. Chris Fettrow (AIMS-High School) Fall 2015

Current Research Group

Research Staff

1. Chris Ball, PhD, Sr. Research Scientist
2. Vinita Rogers, PhD, Research Scientist

Postdoctoral Fellows

1. Punam Murkute

Graduate Students

1. Manisha Muduli, PhD ECE
2. Nathan Gajowski, PhD ECE (SMART Scholarship)
3. Sophie Mills, PhD ECE (SMART Scholarship)
4. Neha Nooman, PhD ECE
5. Bhupesh Bhardwaj, PhD Physics, IIT Bombay (Frontier Center Research Scholar)
6. Rohit Kumar, PhD EE, IIT Bombay (Frontier Center Research Scholar)
7. Fritz Kyser (MS – starting Fall 2025)

Undergraduate Students

1. Dylan Plouffe
2. Jackson Cook
3. Jack Dvorak

Issued and Pending Patents

1. Krishna; Sanjay et al., "Detector with tunable spectral response", USPatent7217951, 2007
2. Krishna; Sanjay et al., "Intersubband detector with avalanche multiplier region", USPatent7271405, 2007
3. Krishna; Sanjay et al., "INTERSUBBAND DETECTOR WITH AVALANCHE MULTIPLIER REGION", USPatent Pub.20080006816, 2008
4. Hill; Peter O. et al., "Semiconductor conductive layers", USPatent7583715, 2009
5. Von Winckel; Gregory et al., "Spectral element eigensolver for inhomogeneous media", USPatent7617081, 2009
6. Krishna; Sanjay et al., "High performance hyperspectral detectors using photon controlling cavities", USPatent7659536, 2010
7. Krishna; Sanjay et al., "Infrared retina", USPatent8071945, 2011
8. Krishna; Sanjay et al., "Detector with tunable spectral response", USPatent8134141, 2012
9. Krishna; Sanjay et al., "APPARATUS AND TECHNIQUES OF NON-INVASIVE ANALYSIS", USPatent Pub.20130023773, 2013
10. Hayat; Majeed M. et al., "Spectral ratio contrast for edge detection in spectral images", USPatent8649607, 2014
11. Lee; Seung-Chang et al., "Plasmonic detectors", USPatent8835851, 2014
12. Montoya; John A et al., "Wafer level integration of focal plane arrays having a flexible conductive layer to provide an optical aperture for each pixel", USPatent9318517, 2016
13. Hayat; Majeed M. et al., "Impact ionization devices under dynamic electric fields", USPatent9354113, 2016
14. Hayat; Majeed M. et al., "Material classification fused with spatio-spectral edge detection in spectral imagery", USPatent9430842, 2016
15. Hayat; Majeed M. et al., "IMPACT IONIZATION DEVICES UNDER DYNAMIC ELECTRIC FIELDS", USPatent Pub.20160254867, 2016
16. Brueck; Steven R. J. et al., "Surface plasma wave coupled detectors", USPatent9466739, 2016
17. Krishna; Sanjay et al., "Method and system for feature extraction and decision making from series of images", USPatent9471974, 2016
18. Cugler-Fiorante; Glauco Rogerio et al., "Spatio-temporal tunable pixels ROIC for multi-spectral imagers", USPatent9521346, 2016
19. Krishna; Sanjay et al., "Method and system for feature extraction and decision making from series of images", USPatent9691147, 2017

20. KRISHNA; Sanjay et al., "MIXED GROUP-V SACRIFICIAL LAYERS FOR RELEASE AND TRANSFER OF MEMBRANES", USPatent Pub.20180337082, 2018
21. Hayat; Majeed M. et al., "Methods and systems for detecting cancer", USPatent10278649, 2019
22. Brueck; Steven R. J. et al., "Surface plasma wave coupled detectors", USPatent10283667, 2019
23. KRISHNA; Sanjay et al., "WAFER LEVEL GATE MODULATION ENHANCED DETECTORS", USPatent Pub.20190145926, 2019
24. Brueck; Steven R. J. et al., "Robust, compact, field-able tunable integrated photonic device", USPatent10411436, 2019
25. Krishna; Sanjay et al., "Lateral interband type II engineered (LITE) detector", USPatent11508869, 2022
26. Krishna; Sanjay et al., "Open circuit voltage photodetector", USPatent11521994, 2022
27. Krishna; Sanjay et al., "Photonic detector coupled with a dielectric resonator antenna", USPatent11552204, 2023
28. Ball; Christopher et al., "Laser imaging of gases for concentration and location identification", USPatent11714046, 2023
29. Ball; Christopher et al., "LASER IMAGING OF GASES FOR CONCENTRATION AND LOCATION IDENTIFICATION", USPatent Pub.20240035961, 2024
30. Rodriguez-Saona; Luis et al., "Portable spectrometer system and methods for determining nutritional and quality traits", USPatent11976972, 2024

Research Funding and Support (> $26M in external funding since 2001)

Current and Pending:

- PI: “DAGSI Fellowship (Jacob Tenorio) Wafer-level INfrared Detectors Integrated with Novel Growth (WINDING)” Defense Associated Graduate Student Innovators 7/2025- 6/2028 - PENDING
- Co-PI: “CENTROID (CENter for Technology-transition and Rapid-Protoyping Of Infrared Detectors)” MMEC, $1,024,954, 11/2024 – 11/2025.
- PI: “Heterogeneous Integration of Antimonide-Based Semiconductors with Silicon” Ohio State University College of Engineering Seed Grant, $15,000, 10/2024 – 3/2025.
- PI: “STTR (Phase 2): Large area SiGeSn detector arrays” SK Infrared, $352,500, 6/2024-7/2026.
- PI: “Study of impact ionization and valence band dynamics in quaternary multipliers on InP and GaSb substrate” Ohio State University Frontier Center Research Scholar, $15,600, 5/2024 – 5/2026.
- PI: “Single Photon Antimonide Nanowire Engineered Detectors (SPANNED)” Ohio State University College of Engineering Seed Grant, $200,000, 2/2024 – 1/2026.
- Co-PI: “CAFE - Center for advanced semiconductor fabrication research and education” Intel, $182,610, 8/2022 – 8/2025.

Completed:

- PI: “Fundamental TRansport studies of Impact Ionization process in Antimonide Avalanche photodiodes” Ohio State University Frontier Center Research Scholar, $47,000, 8/2022 – 12/2024.
- PI: “DAGSI Fellowship (Mariah Schwartz) 2 µm InGaAs/GaA” Defense Associated Graduate Student Innovators, $144,240, 5/2021- 11/2024
- PI: “STTR: Longwave-infrared Avalanche Detectors with Superlattices (LANDS)” SK Infrared, $167,500, 11/2023 – 5/2024.
- PI: “Brain Infrared Modulation of Pathways for Aging, Cognition, and Movement (Brain IMPACT)” Ohio State University President's Research Excellence (PRE) Catalyst Award, $100,000, 1/2022-12/2023.
- PI: “Bandstructure engineered type-II superlattice” National Aeronautics and Space Administration, $1,200,000, 2/2021 – 4/2024.
- PI: “ALTITUDE: Affordable LIDAR technologies for integration” Parallax Advanced Research Corporation Dec 2021- Nov 2022, $1.8M
- PI: “High performance long-wave infrared detector array” Defense Associated Graduate Student Innovators July 2018- Nov 2020, $135,900
- PI: “Mid-wave infrared (MWIR) dielectric resonator antenna” Army Research Office June 2019- June 2022, $396,400

- PI: “High aspect ratio mesa delineation of antimonide b” SK-Infrared Jan 2020- May 2022, $265,000
- PI: “Short-wave infrared detector arrays for LADAR” SK-Infrared Sep 2020- Jan 2021, $233,650
- PI: “Low excess-noise avalanche photodetectors” Office of Naval Research Sep 2017- Feb 2023, $2.4M
- PI: “Modeling & Simulation for Particle Radiation Damage to Electronic and Opto-Electronic Devices”, Air Force Research Laboratory, Oct 2014-Oct 2017, $450,000
- PI: “Development of Sb Based Semiconductor Material for Next Generation Infrared Detectors” Korea Research Institute of Standards and Sciences, Sept 2013- Aug 2019, $600K
- Co-PI: “MRI: Acquisition of a Photonic Materials Molecular Beam Epitaxy System”, NSF -MRI, 2013 – 2016, $1.08M
- Co-PI:"MRI: Acquisition of Multi-Material Dry Etcher for Nanophotonics", NSF, $553,348, 2015-2017
- "Dual band long-wave infrared p-type InAs/(In)GaSb superlattice focal plane arrays", SkInfrared (MDA STTR subcontract), 05/01/16-11/30/17, $225,000
- "Vertical Transport in InAs/GaSb and InAs/InAsSb Superlattices", ARO, 7/1/16-06/30/18, $589,894 (Recommended for funding, contract under negotiation)
- "Polaratonic Hot-electron Infrared Photodetector", Co-PI JP Maria, NCSU DARPA MTO, 7/1/16-6/30/15 $500K,
- PI: “HOT MWIR Type II Superlattice (T2SL) Infrared Photodetectors” Northrop Grumman Corporation, $50,000, May 2016-Dec 2016
- PI: "Study of Carrier Dynamics In InAs/InGaAs Strain Layer Superlattices and Self-Assembled Quantum Dots” Army Research Office, July 2002-July 2005: $195,000
- PI: "Fabrication of Tunable, Polarization Sensitive QWIPs and Enhanced Coupling Grating Structures" Air Force Research Laboratory, awarded April 2001-July 2005: $550,538
- PI: “Study of Carrier Dynamics Within Quantum Confined Energy Levels In Self-Assembled Quantum Dots”, Basic Energy Sciences, Department of Energy, Sept 2002-Sept 2005 : Total Award: $675,000
- Oak Ridge Associated Universities Ralph E. Powe Junior Faculty Enhancement Award, June 2002-Dec 2003 : Total Award: $10,000
- PI: “Self Assembled Quantum Dot Detectors for Chemical Agent Monitoring from Remote Sensing Platforms”, National Reconnaissance Organization, Performance Period: 10/27/2003 - 07/27/2004, Total Award: $350,000 (PI: Krishna, Co-PI: Hayat and Tyo)
- PI: “High Power Mid Wave Infrared Semiconductor Lasers”, Missile Defense Agency: Period : 09/15/2003 - 09/14/2005 Total Award: $302,122
- PI: “Femtosecond Mid Infrared Pump-Probe Spectroscopy System”, Army Research Office, June 2003-May 2004, Total Award: $211, 235
- PI: “ Development of High Temperature Long Wave Infrared Quantum Dot Detectors For Large Area Focal Plane Arrays”, Sandia University Research Program, Sept 2002-Sept 2004: $70,000
- PI: “ Polarimeter in a Pixel”, Air Force Office of Scientific Research Dec 2003-Nov 2006: Award: $100K
- PI: “Long Wave Difference Frequency Spectroscopy System”, Army Research Office, June 2004-May 2005, Total Award: $127, 805
- PI: “Spectrally Adaptive Smart Sensors Based on Nanoscale Quantum Dots”, National Science Foundation, Performance Period: 05/01/2004 - 04/30/2007, Total Award: $210,000 (PI: Krishna, Co-PI: Hayat and Tyo)
- PI: “Quantum Dot Avalanche Photodiodes”, National Science Foundation, Performance Period: 10/01/2004 - 09/30/2007, Total Award: $400,000 (PI: Krishna, Co-PI: Hayat)
- PI: “Bias Tunable Quantum Dot Detectors for MASINT Applications”, National Science Foundation and Defense Intelligence Agency, Performance Period: 08/01/2004 - 07/31/2007, Total Award: $566,000
- Co-PI: "Advanced Sensors Consortium for Technological Alliance" Army Research Laboratory, June 2001-June 2006: $100K year for my task on “Development of InAs/InGaSb Strain Layer Superlattices for MWIR/LWIR sensors”.
- PI: “Mid Infrared Focal Plane Array Characterization System”, Air Force Office of Scientific Research, May 2005-April 2006, Total Award: $241K
- PI: “Spectrally Adaptive Nanoscale Sensors”, Director of Central Intelligence Program, July 2005-July 2008, Award: $120K/year
- PI: “Mid Wave Infrared Semiconductor Lasers Based on GaAs Substrates”, Missile Defense Agency: Period 10/2005-10/2007 Total Award: $300K

- Co-PI: “High Operating Temperature (HOT) Mid-Wave Infrared Focal Plane Arrays” (Co-PI: Brueck; $865K UNM Award in Phase I, Jan 2006-Jan 2007; Phase II Awarded: Jun 07, $350K)
- PI: "Nanoscale Quantum Dot and Strain Layer Superlattice Based Sensors" Air Force Research Laboratory, awarded Oct 2006 $327K
- Co-PI: Collaborative Research: Impact Ionization Engineered and Nanoscale Quantum-dot Based Avalanche Photodiodes”, NSF, May 2006-Apr2009) $150K
- PI: “Fabrication and Characterization of Quantum Dot Detectors”, Sandia National Laboratories 08/01/06-09/30/07, $150K
- PI: “Astronomical Application of Extended-Wavelength InGaAs Arrays and Development of Multi-Wavelength Vertical InGaAs Structures” University of Virginia and NSF, June 2007-May 2008 $42K
- PI: “Aligner/Bonder for Fabricatio of Nanoscale Spectral and Polarimetric Sensors” AFOSR, 2007-2008 $125K
- PI: “North American Molecular Beam Epitaxy Conference” AFOSR and ARO, May 2008-Feb 2008 $9K
- PI: “Development of Very Long Wave Infrared Detectors Based on Type II Strain Layer Superlattices” MDA-STTR Phase I, Nov 2007-Apr 2008 $35K
- PI: “InAs/GaSb Based Type II Strain Layer Superlattice” MDA-STTR, Feb 2008-Jun 2008 $40K
- PI: “Passivation techniques for InAs/GaSb Based Type II Strain Layer Superlattice” MDA-STTR Phase I, Feb 2008-Jun 2008 $35K
- PI: “Development of Very Long Wave Infrared Detectors Based on Type II Strain Layer Superlattices” MDA-STTR Phase II, Nov 2008-Nov 2010 $300K
- PI: “Hyperspectral Sensors with Nanoscale Quantum Dots and Plasmon Assisted Photonic Crystal Cavities”, AFOSR/Caltech, May 2006-Jan 2010 $361K
- Co-PI: “ Intelligent and Adaptable Spectral Sensing Systems Based on Tunable Infrared Quantum-Dot Focal Plane Arrays” DIA, July 2007-Jan 2010 $411K
- PI: “Nanoscale Based Far Infrared and THz Detectors” Global Research Laboratory Program, 2007-2010 $450K
- PI: “Agile Plasmon Filter Prototype”, Los Alamos National Laboratory, March 2008-Sept 2008: Award: $60K
- PI: “ Mid infrared sensors with Photon Controlling Cavities”, Air Force Research Laboratory, Jan 2007-Jan 2010: Award: $350K
- PI: “ Demonstration of Polarimeter in a Pixel”, Air Force Office of Scientific Research 2006-2009: Award: $550K
- Co-PI: “A Reconfigurable Readout Circuit for Integrated Infrared Spectral Sensing”, NSF, Aug 2009-July 2012, $450K (3 PIs)
- PI: “Plasmon Assisted Nanoscale Sensor Arrays”, IC Postdoc, July 2009-July 2011, $240K
- PI: “ Growth of InAs/GaSb Based Type II Strain Layer Superlattice” IR Nova, Sweden, June 2008-Nov 2009 $55K
- PI: “Novel Heteroengineered Detectors for Multi-Color Infrared Detection” AFOSR, March 2009-March 2012 $300K
- PI: “Adaptive Integrated Multi-Modal Sensing Array” Polaris Sensors, STTR AFOSR, July 2009-July 2010, Phase I $36K
- PI: “ Molecular Beam Epitaxy System For Electronic and Optoelectronic Devices” AFOSR, May 2009-May 2010 $926,800K
- PI: “Advanced ROIC Technology for SLS Photodetectors”, SBIR Phase I, RNET Tech, Jan-Sept 2010, $35K
- PI: “Nanoscale Based Far Infrared and THz Detectors” Global Research Laboratory Program, 2010-2013 $300K
- PI: “Adaptive Integrated Multi-Modal Sensing Array”, SBIR Phase II, 2010-2012: $310K
- PI: “Heterogenous Material Integration and Band Engineering with Type II Superlattices” AFOSR, 2010-2015, $1.4M
- PI: “Development of Quantum Dots in a Well Detectors for Mid wave infrared and Long wave infrared Imaging”, Indian Institute of Technology, Mumbai, $400K
- PI: “InAs/InGaSb Type II Superlattice Based Thermophotovoltaic (TPV) Devices”, Advanced Energy Consortium, 2010-2013, $300K
- PI: “Advanced ROIC Technology for SLS Photodetectors”, RNET Tech, SBIR Phase II, 2011-2013, $350K
- PI: “Development of Low Dark Current SLS Devices for Next Generation Infrared FPAs”, Magnolia Optical Systems, SBIR Phase II, 2011-2013, $500K
- PI: “Optoelectronics Research Center”, AFOSR, 2012-2015, $225K

- PI: “Nanoantenna Enabled Focal Plane Arrays”, Sandia National Laboratory, 2011-2013, $170K
- PI: “Investigation of Carrier Lifetime and Dark Currents in Type II Superlattices”, National Reconnaissance Organization, 2012-2016, $400K
- PI: “Quantum Structures Infrared Photodetector Conference Support”, Utah State, 2014 –2015, $40K.
- PI:"Black Meta-Infrared Detectors Using Type II Superlattices", National Reconnaissance
- Organization, $450,000, 2015
- PI: “HOT MWIR Type II Superlattice (T2SL) Infrared Photodetectors and Focal Plane Arrays” Northrop Grumman Corporation, $100,000, July 2014-Dec 2015
- PI: “Heterogeneous Material Integration and Band Engineering with Type II Superlattices”, AFOSR, July 2010-Oct 2015, $1,599,272
- PI: “Nanoantenna Enabled Focal Plane Array”, Sandia National Lab, Dec 2011-Sept 2014, $170K
- PI: “Investigation of Carrier Lifetime and Dark Current in Type II Superlattices” NRO, Aug 2012-Dec 2015 $400K
- PI: “System for Fabrication and Characterization of Meta-infrared Devices” Army Research Office, Feb 2014-Jan 2015 $486K
- Co-PI: “A Reconfigurable Readout Circuit for Integrated Infrared Spectral Sensing”, NSF, Aug 2009-July 2015, $450K

TEACHING SUMMARY

- **List of Courses Taught:**
    - Spring 2002: ECE 577: Semiconductor Lasers
    - Fall 2002/2003/2004: ECE 570: Semiconductor Optoelectronic Mat and Devices
    - Spring 2003/2004 ECE 321: Analog Electronics
    - Spring 2005/2006/2007: ECE 321: Digital Electronics
    - Fall 2006/Fall 2008: ECE/PHY 463: Advanced Optics-I
    - Spring 2009: ECE 595 Advanced Detector Architectures
    - Spring 2010-2016: ECE 322L: Analog Electronics
    - Fall 2012: ECE 475: Introduction to Optoelectronics
    - Fall 2013: ECE 495-595: Advanced Infrared Detector Architectures
    - Fall 2014: ECE 495-595: Photonics in Medicine
    - Fall 2015: ECE 495-595: Infrared Detectors
    - Spring 2016: ECE 322L Analog Electronics
    - Fall 2017: ECE 3030: Semiconductor Electronic Devices
    - Fall 2018: ECE 5530: Fundamentals of Semiconductors for Microelectronics and Photonics
    - Fall 2019: ECE 3030: Semiconductor Electronic Devices
    - Fall 2020: ECE 6533: Infrared Detectors and Systems
    - Spring 2021: ECE 5078: Empowering the Entrepreneurial Engineer
    - Fall 2021: ECE 5530: Fundamentals of Semiconductors
    - Spring 2022: ECE 5078: Empowering the Entrepreneurial Engineer
    - Fall 2022: ECE 6533 Infrared Detectors and Systems
    - Spring 2023: ECE 5078 Empowering the Entrepreneurial Engineer
    - Spring 2024: ECE 5078 Empowering the Entrepreneurial Engineer
    - Fall 2024: ECE 6533 Infrared Detectors and Systems
    - Spring 2025: ECE 5078 Empowering the Entrepreneurial Engineer

- **Teaching Evaluation Summary:**

Mean Scores, all questions

Courses are listed in order by catalog number, then term. Combined sections are listed together.

Q1: The subject matter of this course was well organized
Q2: This course was intellectually stimulating
Q3: This instructor was genuinely interested in teaching
Q4: The instructor encouraged students to think for themselves
Q5: The instructor was well prepared
Q6: The instructor was genuinely interested in helping students
Q7: I learned a great deal from this instructor
Q8: The instructor created an atmosphere conducive to learning
Q9: The instructor communicated the subject matter clearly
Q10: Overall, I would rate this instructor as

Subject	Course	Class	Term	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
ECE	3030	6801	AU 19	4.43	4.29	4.86	4.71	4.77	4.86	4.31	4.71	4.31	4.86
ECE	5078	32927,32928	SP 21	4.63	4.68	4.89	4.95	4.74	4.89	4.72	4.84	4.74	4.95
ECE	5078	33794,33793	SP 22	4.62	4.85	4.92	4.77	4.69	4.92	4.83	4.85	4.77	5.00
ECE	5078	35493,35492	SP 23	4.50	4.50	4.83	4.83	4.67	4.75	4.67	4.58	4.58	4.67
ECE	5078	12368,12369	SP 24	4.50	4.30	4.60	4.50	4.60	4.60	4.50	4.50	4.40	4.80
ECE	5194.13	33752,33753	SP 19	2.93	4.00	4.67	4.60	3.40	4.53	3.93	3.93	3.80	4.13
ECE	5530	23666,23667	AU 18	4.12	4.52	4.88	4.68	4.48	4.84	4.32	4.64	4.32	4.63
ECE	5530	30591,30592	AU 21	4.39	4.61	4.89	4.72	4.72	4.78	4.65	4.72	4.44	4.78
ECE	5530	37285,37286	AU 21	4.71	4.86	5.00	5.00	4.86	5.00	4.71	5.00	4.86	4.86
ECE	6533	33653	AU 20	4.83	4.83	4.92	5.00	4.92	5.00	4.83	4.83	4.67	4.83
ECE	6533	36872	AU 22	5.00	4.88	4.88	4.88	4.88	4.88	4.88	4.88	4.88	5.00

Response Count and University Comparison

Comparison of the instructor's mean score for Q10 to the University mean for classes in the same size group during the same term

Subject	Course	Class	Term	Size	Resp	Mean, Instr	Mean,Univ
ECE	3030	6801	AU 19	M	35	4.86	4.37
ECE	5078	32927,32928	SP 21	M	19	4.95	4.41
ECE	5078	33794,33793	SP 22	S	13	5.00	4.58
ECE	5078	35493,35492	SP 23	M	12	4.67	4.41
ECE	5078	12368,12369	SP 24	S	10	4.80	4.55
ECE	5194.13	33752,33753	SP 19	S	15	4.13	4.55
ECE	5530	23666,23667	AU 18	M	24	4.63	4.34
ECE	5530	30591,30592	AU 21	M	18	4.78	4.41
ECE	5530	37285,37286	AU 21	S	7	4.86	4.56
ECE	6533	33653	AU 20	S	12	4.83	4.56
ECE	6533	36872	AU 22	S	8	5.00	4.56

- **Novel Pedagogical Initiatives:** Undertook novel pedagogical approaches to teaching such as introduction of cooperative and collaborative active learning techniques in the classroom. Some of the initiatives incorporated in the undergraduate classes are outlined here:
    - *Higher Bloom Level:* Students were taught about Bloom's learning taxonomy and it was emphasized that they would be operating at a higher "Bloom" level i.e. analysis, design and evaluation instead of just memorizing equations and concepts. This was outlined in the learning outcomes of the course and is an important part of the ABET evaluation since it is easy to frame "metrics" for design and analysis rather than trying to "measure understanding".
    - *Team Work in Class:* Incorporated a collaborative learning exercise as a part of the lecture wherein an in-class problem was assigned and the students were expected to do problems as a part of the team.
    - *Team Project:* A "real life" design problem was assigned to the team members. The teams were expected to come up with a team contract designating responsibilities and laying down the ground rules for meetings and conflict resolution etc. This gave them a feel for the industrial environment where they would be expected to work in teams. A peer factor, based on the student's contribution as assessed by his/her team-mates, was used to determine the student's individual project grade.
    - *Feedback:* Developed evaluation metrics feedback tools, such as the 1-minute paper, to assess student understanding

- *Online Teaching:* Actively incorporated online tools (webct) in the course. All the lecture notes, homeworks with their solutions, design problems and study aids were posted on the course website. An open discussion forum was also posted on the website where students posted their questions and the instructor or any other student who knew the answer replied to the posting.
- *Intel Tour:* To give the students a feel for the "real life world", a tour of the Intel facility was arranged where they saw the CMOS fabrication process. In the course evaluation, this was cited as one of the most enriching experiences of the class.
- *Extra Problem Sessions:* Since an electronics course requires solving a lot of problems, the instructor took an extra effort to conduct an additional problem session every two weeks. This was well attended (50-75% of the class) and students seem to get a lot of questions clarified in these sessions.

- *Empowering the Entrepreneurial Engineer:* Developed a new graduate/senior undergraduate course at Ohio State (ECE 5078: Empowering the Entrepreneurial Engineer). The course skill gaps of ECE students and teaches them new skills and abilities at the intersection of engineering, business, social and legal disciplines and their connections. This course teaches entrepreneurial minded engineers the process of value creation from their technology or inventions.

- **Education Workshops:**
  - Participated in the NSF Sponsored Engineering Education Workshop to develop better design tools and learning techniques to improve student understanding
  - Participated in the Doctoral Mentoring Institute organized at UNM;
  - Participated in the minority student mentoring workshop organized by the minority states alliance-minority graduate education (MSA-MGE) to increase the enrolment of minority students in science, mathematics and engineering
  - Attended Better Science Through Better Mentoring Workshop organized by College of Engineering at Ohio State University

Publications (2016-Present)

1. Wriedt, N., L. Meng, D. S. Yu, C. Chae, K. Liddy, A. Dheenan, S. Dhara, R. C. Myers, O. Maksimov, R. Blakeley, S. Krishna, J. Hwang, H. Zhao, J. McGlone and S. Rajan (2025). "Enhanced UV–Vis Rejection Ratio in Metal/BaTiO3/β-Ga2O3 Solar-Blind Photodetectors." Advanced Electronic Materials **11**(1): 2400552.
2. Jung, H., S. Lee, X. Jin, Y. Liu, T. Ronningen, C. H. Grein, J. P. R. David and S. Krishna (2024). "Low Excess Noise, High Quantum Efficiency Avalanche Photodiodes for Beyond 2 µm Wavelength Detection." Communications Materials **Accepted**.
3. Schwartz, M. and S. Krishna (2024). "Advances in infrared linear mode avalanche photodiodes based on antimonide based semiconductors."
4. Muduli, M., N. Gajaowski, H. Jung, N. Nooman, B. Bhardwaj, M. Schwartz, S. Lee and S. Krishna (2024). "Lateral diffusion in 2-micron InGaAs/GaAsSb superlattice planar diodes using atomic layer deposition of ZnO." arXiv preprint arXiv:2409.20406.
5. Liu, Y., X. Jin, H. Jung, S. Lee, F. Harun, J. Ng, S. Krishna and J. David (2024). "Electroabsorption in InGaAs and GaAsSb pin photodiodes." Applied Physics Letters **125**(22).
6. Guo, B., B. Liang, J. Zheng, S. Ahmed, S. Krishna, A. Ghosh and J. Campbell (2024). "Digital Alloy-Grown InAs/GaAs Short-Period Superlattices with Tunable Band Gaps for Short-Wavelength Infrared Photodetection." ACS Photonics **11**(4): 1419-1427.
7. Tempel, S., M. Winslow, S. H. Kodati, S. Lee, T. J. Ronningen, S. Krishna, S. Krishnamurthy and C. Grein (2024). "A comparative study of impact ionization and avalanche multiplication in InAs, HgCdTe, and InAlAs/InAsSb superlattice." Applied Physics Letters **124**: 131105.
8. Abbasi, H. N., S. Lee, H. Jung, N. Gajowski, Y. Lu, L. Wang, D. Kim, J. Zhou, J. Gong, C. Chae, J. Hwang, M. Muduli, S. Nookala, Z. Ma and S. Krishna (2024). "Structural and Electrical Properties of Grafted Si/GaAsSb Heterojunction." Applied Physics Letters **125**(10).

9. Muduli, M., Y. Xia, S. Lee, N. Gajowski, C. Chae, S. Rajan, J. Hwang, S. Arafin and S. Krishna (2024). "Active interface characteristics of heterogeneously integrated GaAsSb/Si photodiodes." Applied Physics Letters **125**(17).
10. Gawron, W., P. Madejczyk, P. Martyniuk and S. Krishna (2024). "Infrared Barrier Detectors With Metamorphic InAsSb Absorbers on GaAs Substrates." IEEE Sensors Journal **24**(9): 14151-14158.
11. Schwartz, M. and S. Krishna (2023). "Advances in Infrared Linear Mode Avalanche Photodiodes Based on III-V Semiconductors." Photonics **10**.
12. Braga, O. d. M., C. A. Delfino, R. M. S. Kawabata, L. D. Pinto, G. S. Vieira, M. P. Pires, P. L. d. Souza, E. Marega, J. A. Carlin and S. Krishna (2023). "Investigation of InGaAs/InP photodiode surface passivation using epitaxial regrowth of InP via photoluminescence and photocurrent." Materials Science in Semiconductor Processing **154**: 107200.
13. Ronningen, T., S. Kodati, X. Jin, S. Lee, H. Jung, X. Tao, H. Lewis, M. Schwartz, N. Gajowski, P. Martyniuk, B. Guo, A. H. Jones, J. Campbell, C. Grein, J. P. R. David and S. Krishna (2023). "Ionization coefficients and excess noise characteristics of AlInAsSb on an InP substrate." Applied Physics Letters **123**(13).
14. Lewis, H. I. J., X. Jin, B. Guo, S. Lee, H. Jung, S. H. Kodati, B. Liang, S. Krishna, D. S. Ong, J. C. Campbell and J. P. R. David (2023). "Anomalous excess noise behavior in thick Al(0.85)Ga(0.15)As(0.56)Sb(0.44) avalanche photodiodes." Sci Rep **13**(1): 9936.
15. Arquitola, A., H. Jung, S. Lee, T. J. Ronningen and S. Krishna (2023). "Assessment of Surface Recombination in Mid-Wave Infrared InAsSb nBn Detectors using Transient Microwave Reflectance." AIP Advances **13**.
16. Bhardwaj, B., U. Bothra, S. Singh, S. Mills, T. J. Ronningen, S. Krishna and D. Kabra (2023). "Suppressing leakage current by interfacial engineering for highly sensitive, broadband, self-powered FACsPbI3 perovskite photodetectors." Applied Physics Reviews **10**(2).
17. Jung, H., S. Lee, Y. Liu, X. Jin, J. P. R. David and S. Krishna (2023). "High Electric Field Characteristics of GaAsSb Photodiodes on InP Substrates." Applied Physics Letters **122**.
18. Arquitola, A., S. Lee, H. Jung, N. Nooman and S. Krishna (2023). "Contactless Measurement of Minority Carrier Lifetime and Background Carrier Concentration in Unintentionally Doped GaAsSb for Short-Wave Infrared Detection." AIP Advances **13**: 085130.
19. Ronningen, T. J., S. H. Kodati, X. Jin, S. Lee, H. Jung, X. Tao, H. Lewis, M. Schwartz, N. Gajowski, P. Martyniuk, B. Guo, A. H. Jones, J. C. Campbell, C. H. Grein, J. P. R. David and S. Krishna (2023). "Investigation of impact ionization of AlInAsSb on an InP Substrate." Applied Physics Letters **123**.
20. Guo, B., M. Schwartz, S. H. Kodati, K. M. McNicholas, H. Jung, S. Lee, J. Bai, X. Guo, T. J. Ronningen, C. H. Grein, S. Krishna and J. C. Campbell (2023). "InGaAs/AlInAsSb Avalanche Photodiodes with Low Noise and Strong Temperature Stability." APL Photonics **8**(11).
21. Lee, S., X. Jin, H. Jung, H. Lewis, Y. Liu, B. Guo, S. H. Kodati, M. Schwartz, C. H. Grein, T. J. Ronningen, J. P. R. David, J. C. Campbell and S. Krishna (2023). "High Gain, Low Noise, Room Temperature 1550 nm GaAsSb/AlGaAsSb Avalanche Photodiodes." Optica **10**: 147-154.
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