PRASAD P. IYER

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OVERVIEW

Expertise in autonomous scientific discovery, semiconductor quantum dots and reconfigurable metamaterial systems with a strong background in optoelectronic design, applied machine-learning and nano-fabrication of active III-V and liquid crystal phased-array devices for beam steering, imaging and display optics.

EDUCATION

PhD in Electrical and Computer Engineering Sept'12 - Mar'18
Electronics and Photonics Major
University of California Santa Barbara

MS in Electrical and Computer Engineering Sept'12 - Apr'14
Electronics and Photonics Major
University of California Santa Barbara

B.Tech in Materials and Metallurgical Engineering Aug'08 - July'12
Indian Institute of Technology Kanpur

WORK EXPERIENCE

Senior Member of Technical Staff at Sandia National Labs Nov'20-Present

- Principal Investigator on multiple research projects related to scientific-ML, quantum optics and reconfigurable metasurfaces for scientific computation at scale.
- Centre for Integrated Nanotechnologies (CINT) Affiliate Scientist
- Leading a group of 3 post-docs and projects with 8-10 staff scientists

Technical Advisor for Metamaterial Startups May '21-June '22

- **Neurophos** - Productization of the reconfigurable metasurfaces for Optical computing
- **Lumotive** - Design and development of beam steering liquid crystal metasurfaces for Lidars

Senior Lidar Systems Engineer at Lumotive Apr'18-Oct'20

- Lead the design team for the beam steering metasurface using CMOS and LCOS technology platforms
- System architect with link budget management and read-out architecture development
- Algorithm development for denoising and optimising point-cloud data

SELECTED PUBLICATIONS

26. **Sub picosecond steering of ultrafast incoherent emission from semiconductor metasurfaces**
Prasad. P. Iyer,..., M.B. Sinclair, and Igal Brener: **Nature Photonics**, *2023*

· Demonstration of dynamic steering of emission from InAs quantum dots embedded in a GaAs metasurface
· Novel method to steer $140fs$ incoherent light pulses over 70^o field of view

25. **Unidirectional photoluminescence from InGaN/GaN Quantum well metasurfaces**
Prasad. P. Iyer, Ryan DeCrescent,..., Claude Weisbuch, Shuji Nakamura, Steven P DenBaars, and Jon A Schuller: **Nature Photonics**, *June 2020*

· Demonstration of uni-directional photo-luminescence from quantum wells embedded in a dielectric metasurface
· Novel method to engineer the light density of states in the system to direct the PL from 10^o-80^o

24. **AutoSciLab: A Self-Driving Laboratory for Interpretable Scientific Discovery**
Saaketh Desai, S Addamane, JY Tsao, I Brener, L.P. Swiler, R Dingreville, and Prasad P. Iyer: **Talk at AAAI**, *2025*

· Developed a generalizable machine-learning framework to autonomously drive experiments to realize human interpretable discoveries
· Selected among the top 5% of submission among nearly 13,000 submission for year of 2025

23. **Learning incoherent emission steering from Metasurfaces using generative models**
Prasad. P. Iyer,..., Remi Dingreville, and Igal Brener: **WACV**, *2023*

· We leverage the combination of a variational auto-encoder and active learning module running a closed loop experiment to steer ultrafast pulses

22. **Control of Quantized Spontaneous Emission from Single GaAs Quantum Dots Embedded in Huygens' Metasurfaces**
Prasad. P. Iyer,..., Oleg Mitrofanov, and Igal Brener: **Nano Letters**, *2024*

· Demonstration of position independent single-photon emission from isolated GaAs quantum dots in an AlGaAs Metasurface

21. **High-Q, size-independent, and reconfigurable optical antennas via zero-index material dispersion engineering**
Prasad. P. Iyer, Mihir Pendharkar,..., Shuji Nakamura, Steven P DenBaars, Stacia Keller, Chris Palmstrom, and Jon A Schuller: **Under Review ACS Nano**, *February 2025*

· Demonstration of high quality factor resonances within isolated optical antennas embedded with phononic (AlN and SiO_2) and plasmonic (n-InSb) epsilon-near-zero media
· First experimental demonstration of epitaxial n-InSb regrowth and void-antenna formation in AlN

20. **Self-driving lab discovers principles for steering spontaneous emission**
Saaketh Desai, S Addamane, JY Tsao, I Brener, R Dingreville, and Prasad P. Iyer: **Under Review Nature Communications**, *2024*

· Discovered a novel method to steer spontaneous emission from reconfigurable metasurfaces using a machine-learning driven ultrafast pump-probe experimental platform

19. **Orchestrating spontaneous emission with metasurfaces**
Hyosim Yang, Wesley Mills, Sathwik Bharadwaj, Saaketh Desai, Tom´as Santiago-Cruz, Samuel Prescott, Oleg Mitrofanov, Igal Brener, Jon Schuller, Zubin Jacob, and Prasad P Iyer: **Accepted Advanced Optical Materials**, *2024*

· *Invited review on the topic of controlling spontaneous emission with metasurfaces*

18. **Efficient single-photon emission via quantum-confined charge funneling to quantum dots**
Sanghyeok Park,... Prasad P. Iyer,Igal Brener and Oleg Mitrofanov: **Under Review Nature Communications**, *2025*

· Discovered a unique epitaxial growth condition leading to natural quantum -confied charge carrier funneling GaAs quantum dots leading to efficient single-photon sources

17. **Ultrawide thermal free-carrier tuning of dielectric antennas coupled to epsilon-near-zero substrates**
Prasad. P. Iyer, Mihir Pendharkar, Chris Palmstrom and Jon A Schuller: **Nature Communications**, *2017*

· Realized a large refractive index change ($\Delta n > 1.5$) due to the electron effective mass shifts in doped InSb
· Resulted in the reconfigurability of the antenna resonances over $1.5\mu m$ in the mid-infrared wavelengths

16. **Mie metasurfaces for enhancing photon outcoupling from single embedded quantum emitters**
Samuel Prescott, Prasad. P. Iyer,..., Igal Brener and Oleg Mitrofanov,: **Nanophotonics**, *2024*

· Design paradigm for utilizing Mie resonant metasurfaces for enhancing outcoupling from position independent single-photon emitters

15. **AI for Technoscientific Discovery: A Human-Inspired Architecture**
JY Tsao, Robert G Abbott, Douglas Cale Crowder, ... PP Iyer, ... Curtis Martin Johnson and David John Stracuzzi: **Journal of Creativity**, *2024*

· High-level architecture for how artificial intelligence might advance and accumulate scientific and technological knowledge

14. **Light-emitting metalenses and meta-axicons for focusing and beaming of spontaneous emission**
Y Mohtashami, RA DeCrescent, LK Heki, Prasad. P. Iyer,..., Shuji Nakamura, Steven P DenBaars, and Jon A Schuller: **Nature Communications**, *June 2021*

· First demonstration of lensing of incoherent emission from a dielectric metasurface

13. **Electrically Reconfigurable Metasurfaces using Heterojunction Resonators**
Prasad. P. Iyer, Mihir Pendharkar and Jon A Schuller: **Advanced Optical Materials**, *2016*

· Demonstrating beam steering ($\pm 72^{\circ}$) metasurfaces with the voltage tunable spatial phase profile
· Selected among the **Top 10 papers of 2016** published in the journal

12. **Reconfigurable Semiconductor Phased-Array Metasurfaces**
Prasad. P. Iyer, Nikita Butakov and Jon A Schuller: **ACS Photonics**, *2015*

· Tunable (0 to 2π) phase shift with less than 3dB loss in the transmitted beam through a dielectric metasurface
· Selected among the **Top 1% papers** in Americal Chemical Society journals as the ACS Editors' Choice

11. **Uniform Thermo-optic tunability of dielectric metalenses**
Prasad. P. Iyer, Ryan A. DeCrescent,..., and Jon A Schuller : **Physical Review Applied**, *2018*

· Thermo-optic vs thermal-free carrier tuning of InSb resonators is experimentally demonstrated
· $45\mu m$ focal length change using thermo-optic tuning of an InSb metalens operating at $9\mu m$

10. **III–V Heterojunction Platform for Electrically Reconfigurable Dielectric Metasurfaces**
Prasad. P. Iyer, Mihir Pendharkar, Chris Palmstrom and Jon A Schuller: **ACS Photonics**, *2019*

· Designed the epitaxial III-V stack for maximum free-carrier based refractive index change in optical antennas
· Developed the fabrication process flow for the optical antennas to demonstrate π phase shift

9. **Widely Tunable Infrared Antennas using free-carrier refraction**
Tomer Lewi, Prasad. P. Iyer, Nikita Butakov, Alexander Mihailovsky and Jon A Schuller: **Nano Letters**, *2015*

· Fabrication and measurement of Semiconductor Mie resonators in the Infrared ($2 - 14\mu m$) regime
· Demonstrated the geometric and Drude dispersion of the first 6 multipolar resonances in Si and Ge antennas
· Highlighted in the literature review section in **Nature Photonics**

8. **Beam engineering for selective and enhanced coupling to multipolar resonances**
Tanya Das, Prasad. P. Iyer, Ryan A DeCrescent and Jon A Schuller: **Physical Review B**, *2015*

· Derived an analytical method to calculate the scattering properties of resonators based on the local field
· Selected among the Editors' suggestions in the Rapid Communications of PRB

7. **Broadband Electrically Tunable Dielectric Resonators Using Metal-Insulator Transitions**
Nikita Butakov, Mark Knight, Prasad. P. Iyer, ... Ivan Schuller and Jon A Schuller : **ACS Photonics**, *2018*

· Fabry-Perot resonances from $1 - 10\mu m$ were tuned based on VO_2 thin film transitions

· Amplitude and Phase only modulators were demonstrated using interferometry measurements

6. **Thermally reconfigurable meta-optics**
Tomer Lewi, Nikita A Butakov, Hayden A Evans, Mark W Knight, Prasad P Iyer,..., and Jon A Schuller: **IEEE Photonics Journal**, *2019*

· Invited review article summarizing the state of the art in the field of thermally reconfigurable meta-optics

5. **Widely Tunable Optical and Thermal Properties of Dirac Semimetal** Cd_3As_2
Hamid T Chorsi, Shengying Yue, Prasad P Iyer,..., and Jon A Schuller: **Advanced Optical Materials**, *2020*

· Demonstrated large thermal free carrier based refractive index tuning of Cd_3As_2

4. **Gate-tunable metafilm absorber based on indium silicon oxide**
Hongwei Zhao, ..., Prasad P Iyer, Jon A Schuller, Luca Dal Negro, Jonathan Klamkin : **Nanophotonics**, *2020*

3. **Terahertz pulse generation with binary phase control in nonlinear InAs metasurface**
Hyunseung Jung, Lucy L Hale, Sylvain D Gennaro, Jayson Briscoe, Prasad P Iyer,...,Oleg Mitrofanov: **Nano Letters**, *2022*

2. **Cascaded Second Order Optical Nonlinerities in a Dielectric Metasurface**
SD Gennaro, C Doiron, N Karl, PP Iyer, MB Sinclair, I Brener: **ACS Photonics** , *2021*

1. **A brief review of Badger-Bauer rule and its validation from a first-principles approach**
Ram S. Bhatta, Prasad P. Iyer, Ali Dhinojwala and Mesfin Tsige: **Modern Physics Letter B** , *2014*

PATENTS

8. **All optical non-reciprocal spin resonances reconfigurable with metasurfaces**
Prasad Iyer, Tzu-Ming Lu: **U.S. Patent App No. 63/788,529**, *2025*

· Plasmonically resonant spin-ice metasurfaces form energy efficient systems for solving Ising-type problems.

7. **Liquid Crystal Metasurfaces with cross-backplane optical reflectors**
Gleb Akselrod, Erik Josberger, Mark Weidman, Prasad. P. Iyer: **U.S. Patent No. 11,429,008**, *2022*

· CMOS architecture of beam steering metasurfaces

6. **Tunable optical device configurations and packaging**
Gleb Akselrod, Erik Josberger, Mark Weidman, Prasad. P. Iyer: **US Patent No. 11,487,183**, *2022*

· LCOS and CMOS packaging configurations

5. **Tunable Optical Devices with Extended Depth tunable dielectric cavities**
Prasad. P. Iyer, Gleb Akselrod, Erik Joseberger, Laura M.P. Mancera, Larry Zhao : **U.S. Patent App. No. 18/329,526**, *2023*

· Efficiency improvements on tuanble liquid crystal metasurfaces

4. **Reconfigurable light-emittng holographic metasurfaces**
Prasad. P. Iyer, Igal Brener, Micheal B. Sinclair, Nicholas J. Karl : **U.S. Patent App. No. 18/103,595**, *2023*

· D̂ynamically tunable light emitting devices

3. **MutliCoated Tunable Optical Devices**
Prasad. P. Iyer, Gleb Akselrod, Erik Joseberger, Larry Zhao : **U.S. Patent App. No. 18/305,572**, *2023*

· Enabling CMOS processes to fabricate tuanble metasurfaces at scale

2. **Lidar systems based on tunable optical metasurfaces**
Prasad. P. Iyer, Gleb Akselrod, Ross Uthoff : **U.S. Patent No. 17/098,213**, *2021*

· Lidar system architecture defining the role of beam steering metasurfaces

1. **Sidelobe suppression in metasurface devices**
Prasad. P. Iyer, Gleb Akselrod, **U.S. Patent No. 10,727,601**, *2020*

· Â novel method to minimize the effects of sidelobes from metasurfaces used in a transceiver system

INVITED TALKS AND CONFERENCE PRESENTATIONS

Self-driving lab discovers principles for steering spontaneous emission (**Invited)**	Argonne National Lab	2024
Controlling spontaneous emission from semiconductor metasurfaces: reconfigurability to single photon sources (**Invited)**	SPIE Photonics West	2024
Active Control of Spontaneous Emission from Semiconductor Metasurfaces **(Invited Talk)**	Northrup Grumman	2024
Self-driving lab discovers high-efficiency directional incoherent emission from reconfigurable semiconductor metasurfaces (**Highlighted Talk)**	CLEO Fundamental Science	2024
Controlling Spontaneous Emission from Semiconductor Metasurfaces (**Invited)**	MRS Fall EL08	2023
Active Control of Spontaneous Emission from Semiconductor Metasurfaces (**Invited)**	UNM OSE Seminar	2023
Ultrafast Steering of Incoherent Emission from Semiconductor Metasurfaces (**Invited)**	Optica Imaging Congress	2023
Metasurface beam steering enables scalable solid-state high-performance LiDARs (**Invited Talk)**	Envision Zemax conference	2020
Reconfigurable Optical Metasurfaces **(Invited Talk)**	Northrup Grumman	2018
Time Domain Phase Engineering of Metasurfaces Enables Passive Ultrafast Photonic Streaking	CLEO Fundamental Science	2024
Ultrafast non-reciprocal spin resonances		

in frustrated plasmonic metasurfaces	CLEO Fundamental Science	2024
Machine learning discovers parsimonious equations governing incoherent emission steering from semiconductor metasurfaces	CLEO Fundamental Science	2024
Enhancement of non-classical radiation from quantum dots embedded within semiconductor Huygens' metasurfaces	CLEO Fundamental Science	2024
Ultrafast reconfigurability of circular dichroism from bound-states-in-the-continuum metasurfaces	CLEO: App. and Technology FTh4D	2023
Ultrafast beam steering of photoluminescence from dielectric metasurfaces	CLEO: App. and Technology JTu5Q.6	2022
Unidirectional Luminescence from InGaN/GaN Quantum-Well Metasurfaces	CLEO: QELS Fundamental Science	2020
Light-Emitting Metasurfaces: A Metalens Approach for Focusing Spontaneous Emission	CLEO: QELS Fundamental Science	2020
Tunable and reconfigurable high-index semiconductor meta-optics	SPIE High Contrast Metastructures IX	2020
Tunable metasurface based on silicon doped indium oxide	OSA Novel Optical Materials and Applications	2019
Topological Dirac semi-metals: a dynamic platform for tunable optical metasurfaces	SPIE Optical Components and Materials XVI	2019
Unidirectional Luminescence from InGaN/GaN Quantum-Well Metasurfaces	Gordon Plasmonics and Nanophotonics Conference	2018
Electrically Switchable Infrared Nanophotonic Devices with VO2	76th Device Research Conference	2018
Reconfigurable Mie resonators embedded in a tunable ENZ cavity	SPIE Metamaterials, Metadevices and Metasystems	2017
Ultra-wide thermal tuning of semiconductor metasurface resonators on ENZ media	Nanometa : Topical Meeting on Nanophotonics	2017
Reconfigurable Dielectric Metasurfaces using Free carrier Refraction (Poster)	Gordon Plasmonics and Nanophotonics Conference	2016
Widely tunable infrared semiconductor Mie resonators	SPIE Metamaterials, Metadevices and Metasystems	2016
Reconfigurable Phased Array Metasurfaces	MRS Applications: Devices and Metamaterials	2015
Properties of infrared doped semiconductor Mie resonators	SPIE Metamaterials, Metadevices and Metasystems	2015

Dynamically Reconfigurable Metasurfaces	SPIE Metamaterials, Metadevices and Metasystems	2015
Dynamic Beam Steering Optical Antenna	MRS Resonant Optics	2014

TECHNICAL SKILLS

Material Design	Epitaxially strain-balanced device growth stack for band-structure engineering Finite element method device solvers for III-V Quantum well LEDs and modulators
Optical Design	Phased-array optical systems for diffractive & refractive imaging optics using FDTD Optical coatings, Holographic gratings, Display packaging
Numerical Modelling	Nanophotonic Adjoint optimizaitons, System link budget calculations, Display driver optimization using Bayesian optimization methods
Nano-fabrication	Photo-lithography, wet and dry etching required for III-As,Sb & III-N devices, Metal and Oxide deposition (CVD, ALD and E-beam), Au-Au flip-chip wafer bonding
Measurements	FTIR microscopy, Interferometric phase detection, Ultrafast pump-probe spectroscopy Fourier-space visible spectroscopy, SEM, Ellipsometry, IV-CV & Hall measurements
Programming Tools	Python, Lumerical FDTD, MEEP, Silvaco Atlas, Klayout

VOLUNTARY ACTIVITIES

1. Program committee member for CLEO conference for nanophotonics (FS8 Session) 2025
2. Program committee member for IEEE IPC conference for nanophotonics (NANO) 2021
3. Peer-reviewer for Science, Physical Review Letters, Nano-letters, Nature Journals, IEEE Journals etc.