Sai Kanth Dacha

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Education

Doctor of Philosophy (Ph.D.), Physics
University of Maryland, College Park *(2016 - 2022)*

- Dissertation advisor: Prof. Thomas E. Murphy

Bachelor of Technology (B.Tech.), Engineering Physics[#] *(GPA: 8.52/10)*
Indian Institute of Technology (IIT) Madras *(2012 - 2016)*

- Senior thesis advisor: Prof. Deepa Venkitesh

[#] *Minor stream: Nanoscience and Nanotechnology*

Awards & Fellowships

- Dean's Fellowship at the University of Maryland (2016-2018)
- Awarded the prestigious Summer Undergraduate Research Fellowship at the California Institute of Technology (2015)
- Merit Scholarship at IIT Madras (2012-2016)

Publications, Conference Presentations and Summer Schools

Journal Articles

- **Sai Kanth Dacha**, Henry F. Elder, Phillip A. Sprangle, Wenqi Zhu, Amit Agrawal and Thomas E. Murphy, "Nonlinear generation of orbital angular momentum modes in ring-core fibers", Upcoming (2022)
- René-Jean Essiambre, **Sai Kanth Dacha**, Alexei Ashikhmin, Andrea Blanco-Redondo, Nicolas Fontaine, Yuanhang Zhang, Ellsworth Burrows and Roland Ryf, "Multiple bits-per-photon communication using pulse position modulation in the photon-starved regime", Currently under submissions process at *Science* (2022)
- **Sai Kanth Dacha**, Wenqi Zhu, Amit Agrawal, Kenneth J. Ritter, and Thomas E. Murphy, "Nonlinear rotation of spin-orbit coupled states in hollow ring-core fibers," Opt. Express 30, 18481-18495 (2022)
- **Sai Kanth Dacha** and Thomas E. Murphy, "Spatiotemporal characterization of nonlinear intermodal interference of selectively excited modes of a few-mode fiber", *Optica* 7, 1796-1803 (2020)
- **Sai Kanth Dacha**, Gabriele Vajente, Rana Adhikari, *"Ultra-precise Sensing and Control of Suspended Optics Breadboard in the Crackle Experiment"*, Caltech Undergraduate Research Journal (CURJ), 2016

Conference Presentations & Proceedings

- **S. K. Dacha**, W. Zhu, A. Agrawal, and T. E. Murphy, "Ker-induced Rotation of Mixed Orbital Angular Momentum States in Hollow Ring-Core Fibers", in Optical Fiber Communication Conference (OFC) 2022, paper W2A.13
- **S. K. Dacha** and T. E. Murphy, "(2+1)D Spatiotemporal Characterization of Nonlinear Interactions between Selectively Excited Spatial Modes of a Few-Mode Fiber", Conference on Lasers and Electro-Optics, OSA Technical Digest (Optical Society of America, 2020), paper FTh3A.6
- **S. K. Dacha** and T. E. Murphy, "Time-Domain Interference of Nonlinearly Interacting Spatial Modes in a Multimode Fiber", Conference on Lasers and Electro-Optics, OSA Technical Digest (online) (Optical Society of America, 2018), paper STh3K.4
- **SK Dacha**, AN Iyer, A Sobhanan, D Venkitesh, *"Regeneration of 10 Gbps BPSK Signals Through Phase Sensitive Amplification coupled with Injection Locking"*, 2017 Twenty-third National Conference of Communications (NCC), IEEE Xplore

International Summer Schools

- Subsea Optical Fiber Communications 2020 "Mini-Dive", organized by OSA and Google *(August 2020)*
- Inaugural Subsea Optical Fiber Communications 2019 International Summer School, organized by OSA and Google in Polvijärvi, Finland *(August 2019)*

Skills & Expertise

- **Topics of Expertise**: Nonlinear optics, multimode fibers, orbital angular momentum (OAM) of light, spatial multiplexing, pulse position modulation, single photon experiments
- **Experimental**: Design and implementation of free-space and fiber optical experiments, high-speed detection systems, instrument control and automated data acquisition, focused-ion beam, scanning electron microscopy, single photon detection systems
- **Numerical**: Data analysis and visualization, numerical modeling and simulation of optical systems and processes using MATLAB and Python
- **Software**: MATLAB, Python, Mathematica, Lumerical MODE Solutions, Adobe Illustrator, Adobe Photoshop

Research Experience

1. Deep-Space Optical Communication using Pulse-Position Modulation ***(Jun'21-Dec'21)***
Research Internship, Nokia Bell Labs | Advisor: Dr. René-Jean Essiambre

- Developed an end-to-end communications testbed for deep-space applications using pulse position modulation (PPM) and **superconducting nanowire single-photon detectors** (SNSPDs)
- *Details of this project are currently confidential, due to company policy, until manuscript/patent submissions conclude.*

2. Nonlinear Optics in Multimode Optical Fibers ***(Jan'17-present)***
Doctoral Research | Advisor: Prof. Thomas E. Murphy, University of Maryland

- Pioneered a novel spatiotemporal measurement technique that brings together near-field scanning optical microscopy and high-speed detection
- Discovered and demonstrated in vortex fibers the spatially generalized version of the well-known nonlinear polarization rotation effect (which occurs in single-mode fibers)
- Demonstrated the first-reported complete spatiotemporal measurements of multimode nonlinearity
- Developed a new FIB milling-based method for selective mode excitation using direct-written phase masks
- Currently investigating nonlinear generation of initially unexcited orbital angular momentum (OAM) modes in vortex fibers

3. Phase Sensitive Amplification in Semiconductor Optical Amplifiers ***(Sep'15-May'16)***
Senior Thesis | Advisor: Dr. Deepa Venkitesh, IIT Madras

- Developed a phase sensitive amplification (PSA) scheme based on a semiconductor optical amplifier
- Numerically demonstrated, using MATLAB, PSA-based quadrature phase squeezing for 10 Gbps BPSK signals
- Designed a compact PSA module that, when coupled with an injection locking stage, is capable of achieving active squeezing of optical amplitude and phase noise in long haul optical communication systems

4. Sensing and Control of Suspended Optics Breadboard in the Crackle Experiment ***(May-Aug'15)***
Summer Undergraduate Research Fellowship (SURF), LIGO Laboratory, Caltech

- Worked on the Crackling Noise detection experiment, aimed at detecting crackling noise arising in Maraging Steel blade springs used in the **Advanced LIGO**[1] suspension systems
- Spearheaded the design, development and implementation a feedback damping control system for the suspended optics breadboard
- Enhanced the sensitivity of the crackling noise measurement setup by a factor of 10

5. Design and Development of Semi-Autonomous Transwheel Omnidirectional Robot ***(Apr'13-Mar'14)***
Student-led Project at Centre for Innovation (CFI[2]*), for IIT Madras' ABU Robocon*[3] *team*

- Designed and developed robotic system with sensors, actuators and omnidirectional wheels, capable of performing complex tasks while moving in any direction without changing its orientation
- Designed and implemented integrated electronics circuitry consisting of microcontrollers, rotary encoders, actuators, motor controllers and power electronics
- Devised algorithms for and achieved autonomous omnidirectional motion

Technical & Case Competitions

1. Emory Global Health Case Competition 2021 - *(UMD's first participant team)*

- Designed a comprehensive case solution for addressing vaccine hesitancy and increasing vaccine uptake in Bangaldesh. (*Link to our team's presentation*)

2. ABU Robocon 2014 - *(Participant)*

- Represented IIT Madras as part of a team of 20. Designed, built and operated a semi-autonomous robot capable of performing complex pre-defined tasks

3. Texas Instruments India Design Challenge (IDC) 2015 - *(Semi-finalist)*

- As part of a team of 5, developed a portable, low cost 12-lead ECG machine using solely TI components

Science & Technology Policy

- Advocated for increased Federal R&D funding for optics and photonics research as part of the National Photonics Initiative's Congressional Visits Day *(July 2021)*
- Certified 'Climate Reality Leader' by the Climate Reality Project *(March 2021)*

Teaching and Mentorship

- **Student Mentor** as part of the Graduate Student Mentorship Program at UMD's Department of Physics
- **Teaching Assistant** for PHYS270: General Physics III (Fall 2016). Taught and conducted tutorial sessions on a wide range of topics – from mechanics and vector algebra to electromagnetism and relativity
- **Student Mentor** for freshmen at IIT Madras: Mentored freshmen in academics, research and social activities
- Mentored a team of 15 students working on student-led robotics projects at the Centre for Innovation (CFI)

Leadership & Service

- Member of the Plan of Organization Committee at UMD's Institute for Research in Electronics and Applied Physics (IREAP) *(Jan'22-present)*
- Founding member of the **racial equity and justice committee** at UMD's IREAP *(2020-present)*
- **Student Executive Head** of the Centre for Innovation (CFI[2]): *(2015-2016)*
  - Chaired a team of 100+ students to run all aspects of the student-led innovation center that gave birth to prominent Indian startups such as Ather, HyperVerge Inc., Planys Technologies and Terero Mobility Inc.
  - Oversaw operation of 13 student clubs involving 1500+ IIT Madras students, 50+ student-driven projects and internal workshops annually, at a budget of $**85,000**
- **Head of Workshops** department at **Shaastra**[4], IIT Madras *(2014-2015)*:
  - Orchestrated a team of 60+ students to conduct 26 workshops on topics ranging from biotechnology to aerial robotics, to a footfall of over 2500 undergraduate students from across India
  - Generated a revenue exceeding $**55,000**
- Served as a member of the **Core Managerial Team** at the Centre for Innovation *(2014-2015)*
- **Founded the Physics Club** at Centre for Innovation, IIT Madras, which now attracts 500+ students annually
- Led a team of 12 to create educational science magazines for underprivileged kids via the National Service Scheme in India *(2013-2014)*

Interests

- Avid photographer: Nature, culinary, wildlife, bird and insect photography (*Link to portfolio*)
- **Published and featured writer** in popular Medium journals such as 'The Faculty' and 'Being Well' (*Link to blog*)
- Chess: Self-taught player rated 2150 on lichess.org

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[1] *LIGO: Laser Interferometer Gravitational-Wave Observatory*

[2] *Centre for Innovation (CFI) is the student-run innovation laboratory of IIT Madras*

[3] *ABU Robocon is a prestigious Robotics competition for undergraduate students in the Asia-Pacific Region*

[4] *Shaastra is the annual student-run technical festival of IIT Madras*