YAMUNA PHAL

Contact Information

Address: Brown Hall, 1610 Illinois St Golden, CO 80401 *E-mail:* yphal@mines.edu
Google Scholar: [Link] *Web-site:* `http://yamunaphal.com`

Academic Appointments

Colorado School of Mines, Golden, USA
Assistant Professor, Department of Electrical Engineering — *July 2023 – Present*
Affiliate Professor, Quantitative Biosciences & Engineering — *September 2023 – Present*

Colorado Clinical & Translational Sciences Institute (CCTSI), Aurora, USA
Affiliate Member — *August 2023 – Present*

Education

University of Illinois Urbana-Champaign (UIUC), Urbana, USA — *May 2016 – June 2023*
Ph.D. in Electrical & Computer Engineering (ECE)

California Institute of Technology (Caltech), Pasadena, USA — *October 2012 – October 2014*
M.S. in Electrical Engineering (EE)

Indian Institute of Technology (IIT) Roorkee, Roorkee, India — *August 2007 – May 2011*
B.Tech. in Electrical Engineering (EE)

Key Accomplishments

Built a chirality mapping microscope | *Patented* | *Featured in Optics & Photonics News 2021*
Research featured on four journal covers | *Anal. Chem.* | *App. Spec.* | *J. Phys. Chem. C*

Research Interests

Infrared Imaging, Sensors, Optical Instrumentation, Spectroscopic Imagers, Chirality, Space Instrumentation & Technology Development, Deep Learning Algorithms & Methods, CubeSAT

Academic Awards & Fellowships

Uranus Flagship Workshop 2024 Travel Grant, *Early career travel grant recipient* — *2024*
Outer Planets Assessment Group 2023 Travel Grant, *Early career travel grant recipient* — *2023*
Chirality 2022 Best Poster Award, *Best poster amongst postdocs and graduate students* — *2022*
William G. Fateley & Coblentz Society Student Awards, *Society student awards for exemplary contributions to the field of vibrational spectroscopy* — *2022*
Ernest A. Reid Fellowship, *Demonstrated interest in engineering education at UIUC* — *2022*
NYU Tandon School of Engineering Faculty First Look Program, *Invited participant* — *2022*
Global Young Scientists Summit, *Invited to represent UIUC* — *2022*
Cadence Women in Technology Program, *Scholarship recipient* — *2022*
FACSS SciX 2021 Best Poster Award, *International conference recognition* — *2021*
MIT EECS Rising Stars, *Invited participant* — *2021*
Harriett & Robert Perry Fellowship, *Graduate student award (1/1500) at UIUC* — *2020*
Nadine Barrie Smith Memorial Fellowship, *Beckman Institute fellowship for research* — *2020*
Harold L. Olesen Undergraduate Teaching Award, *Outstanding effort in teaching at UIUC* — *2019*
List of Teachers Ranked as Excellent, *Excellence in teaching at UIUC* — *2017 & 2018*
James M. Henderson Fellowship, *Outstanding first-year graduate student at UIUC* — *2017*
NASA Jet Propulsion Laboratory (JPL) Graduate Fellowship, *Fellowship recipient* — *2013*
Dr. Jai Krishna & Director's Gold Medals, *Best graduating senior (1/600) at IIT Roorkee* — *2011*
The President of India, Dr. Shankar Dayal Sharma Gold Medal — *2011*

Grants & Funding

NASA Planetary Instrument Concepts For The Advancement Of Solar System Observations (PICASSO) [$0.9M]

Role: Principal Investigator | *Mid-Infrared Rapid Advanced Chiroptical Life-detection Explorer (MIRACLE)* — *November 2024 – October 2027*

Funding Agency: NASA | Individual Contribution: $342K

Mines Early Career Startup Fund

Role: PI | *Development of Chirality Mapping Instrument* — *August 2023 – July 2029*

ESA JUICE Mission, Radio and Plasma Wave Investigation (RPWI) Instrument

Role: Analog Design Engineer | *Development of RPWI Instrument* *May 2015 – April 2016*

NASA Center Innovation Fund (CIF)

Role: Analog Design Engineer | *Development of Organic FET (OFET)-Based Flexible Integrated Controller for Deformable Mirrors* | Phase II [Link] *October 2013 – September 2014*

NSF (AM) [$2.9M], co-PI *Spring 2024*
with individual contribution $510K *(Pending)*

NSF (STTR) [$200K], co-PI *Spring 2024*
with individual contribution $100K *(Pending)*

NSF Research Partnership for Innovation (RP-PFI) [$1M], PI *Fall 2023*
with individual contribution $499K *(Pending)*

Industry Experience

Swedish Institute of Space Physics (IRFU), Uppsala, Sweden

Analog Research Design & EMC Engineer | Radio & Plasma Wave Investigation (RPWI), Jupiter Icy moons Explorer (JUICE) & Solar Orbiter (SO) Missions *February 2015 – April 2016*

Finisar Malaysia Pvt. Ltd., Ipoh, Malaysia

Failure Analysis Engineer, Quality Analysis Department *July 2011 – August 2012*

Research Experience

University of Illinois, Urbana-Champaign, Urbana-Champaign, USA

Graduate Research Assistant, Biomedical Imaging *May 2019 – June 2023*
PI: Dr. Rohit Bhargava, Beckman Institute

Graduate Research Assistant, Remote Sensing & Space Sciences *May 2016 – May 2019*

Johns Hopkins University Applied Physics Laboratory (APL), Laurel, USA

Visiting Researcher *June 2017 – August 2017*
PI: Dr. Larry Paxton, Head Geospace & Earth Science Group

NASA Jet Propulsion Laboratory (JPL), Pasadena, USA

Graduate Fellow *October 2013 – December 2013*
PI: Dr. Karl Rittger, Scientist Water and Carbon Cycles Group

Graduate Research Assistant *June 2013 – October 2014*
PI: Dr. Keith Patterson, Senior Engineer Microdevices Lab

Patents

Vibrational Circular Dichroism Infrared Spectroscopic Imaging Microscope *Filing Date: July 2021*
U.S. Patent US2022018759A1 [Google Patents Search Link]

Peer-reviewed Publications

Y. Jeong, P-H. Hsieh, **Y. Phal**, R. Bhargava, J. Irudayaraj, Label-Free Monitoring of Coculture System Dynamics: Probing Probiotic and Cancer Cell Interactions via IR Spec. Imaging *June 2024*
Analytical Chemistry, DOI:10.1021/acs.analchem.4c00894 | [Link]

Y. Phal, Quantum cascade laser-based mid-infrared spectroscopic imaging systems with polarization capabilities *August 2023*
Doctoral Dissertation, University of Illinois at Urbana-Champaign

K. Yeh, .. **Y. Phal**, .. R. Bhargava, Infrared Spectroscopic Laser Scanning Confocal Microscopy for Whole-slide Chemical Imaging *September 2023*

Nature Communications, DOI:s41467-023-40740-w | [Link]

P-H. Hsieh, **Y. Phal**, K. V. Prasanth, R. Bhargava, Cell Phase Identification in a Three-Dimensional Engineered Tumor Model by Infrared Spectroscopic Imaging *December 2022*
Analytical Chemistry, DOI:10.1021/acs.analchem.2c04554 | [Link]

Y. Phal, L. Pfister, P.S. Carney, R. Bhargava, Resolution Limit in IR Chemical Imaging *May 2022*
Journal of Physical Chemistry C, DOI:10.1021/acs.jpcc.2c00740 | [Link]
Featured, Cover Image

L. Lux[+], **Y. Phal**[+], P-H. Hsieh, R. Bhargava, Parametric Approach to Determine Pixel-Wise Limit of Detection in Infrared Imaging *January 2022*
Invited Paper for Special Issue, Applied Spectroscopy, DOI:10.1177/00037028211050961 | [Link]
[+] *Equal Contributions*

Y. Phal, K. Yeh, R. Bhargava, Chirality Mapping in Microscopy Format *December 2021*
Optics and Photonics News | [Link]

Y. Phal, K. Yeh, R. Bhargava, Design Considerations for DFIR Microscopy Systems *April 2021*
Focal Point Review, Applied Spectroscopy, DOI:10.1177/00037028211013372 | [Link]
Featured, Cover Image [Laser Focus World]

Y. Phal, K. Yeh, R. Bhargava, Concurrent Vibrational Circular Dichroism Measurements with Infrared Spectroscopic Imaging *December 2020*
Analytical Chemistry, DOI:10.1021/acs.analchem.0c00323| [Link]
Featured, Cover Image [Drug Target Review] [Photonics]

P. Joshi, **Y. Phal**, L. Waldrop, Quantification of the Vertical Transport and Escape of Atomic H in the Terrestrial Upper Atmosphere *August 2019*
Journal of Geophysical Research: Space Physics, DOI:10.1029/2019JA027057 | [Link]

Book Chapter

R-J. Ho, **Y. Phal**, L. Lux, R. Bhargava, Infrared Spectroscopy and Imaging Using QCLs *August 2022*
Molecular and Laser Spectroscopy: Advances and Applications, Volume 3,
DOI: 10.1016/B978-0-323-91249-5.00012-0

Invited Talks

Vibrational Optical Acitvity Conference *August 2024*
Lightning Talk, Bio@Mines Workshop *May 2024*
Quantitative Biosciences & Engineering Seminar, Colorado School of Mines *January 2024*
Electrical Engineering Department Seminar, Colorado School of Mines *November 2023*
Electrical Engineering Department Seminar, Colorado School of Mines *November 2023*
Faculty Candidate Seminar Series, Ohio State University *February 2023*
Faculty Candidate Seminar Series, Washington University in St. Louis *February 2023*
2023 Beckman Graduate Seminar Series *February 2023*
Faculty Candidate Seminar Series, Colorado School of Mines *January 2023*
Faculty Candidate Seminar Series, Western Kentucky University *January 2023*
Faculty Candidate Seminar Series, Lafayette College *December 2022*
Faculty Candidate Seminar Series, University of Maine [Virtual] *December 2022*
FACSS SciX 2021: Structure Elucidation of Chiral and Biological Molecules *Sept. 2021*
2021 OSA Biophotonics Congress: Optics in the Life Sciences [Virtual] *April 2021*
European Meeting in Optical Sensors (EuMOS): Special Colloquium [Virtual] *March 2021*
Analytical Chemistry Seminar Series [Virtual] *September 2020*

Conference Proceedings

Y. Phal, K. Yeh, R. Bhargava, Discrete Frequency Infrared VCD Spectroscopy *&* Imaging *April 2021*
2021 OSA Biophotonics Congress: Optics in the Life Sciences, ISBN: 978-1-943580-85-9

Y. Phal, K. Yeh, R. Bhargava, Polarimetric Infrared Spectroscopic Imaging Using QCL *March 2020*
Proc. SPIE 11252, Advanced Chemical Microscopy for Life Science and Translational Medicine,

1125210, DOI: 10.1117/12.2544392

Y. Phal *et al.*, Use of Fiber Optic Interconnects for Signal Integrity *May 2016*
2016 ESA Workshop on Aerospace EMC, pp. 1-3. IEEE, DOI: 10.1109/AeroEMC.2016.7504561

J. Soucek, **Y. Phal** *et al.*, EMC Aspects of Turbulence Heating Observer (THOR) S/C *May 2016*
2016 ESA Workshop on Aerospace EMC, pp. 1-3. IEEE, DOI: 10.1109/AeroEMC.2016.7504544

Conference Presentations

Y. Phal, Exoplanet Exploration Using Mid-Infrared Technology *November 2023*
Lightning Talk, Outer Planets Analysis Group (OPAG) Meeting

R. Bhargava, K. Yeh, S. Kenkel, **Y. Phal**, K. Falahkheirkhah, Uncovering New Utility in IR Spectroscopic Imaging by Pushing the Limits of Accuracy, Speed, and Resolution *January 2023*
SPIE Photonics West 2023: Optical Biopsy – Toward Real-Time Spectroscopic Imaging and Diagnosis

Y. Phal, K. Yeh, R. Bhargava, QCL-Based VCD Imaging for Biological Applications *July 2022*
Chiroptical Spectroscopy CD 2022 [Poster]

Y. Phal, K. Yeh, R. Bhargava, Vibrational Circular Dichroism Spectroscopy & Imaging *July 2022*
Chirality 2022 [Poster] | ***Poster Award Winner***

R-J. Ho, **Y. Phal**, R. Bhargava, Understanding Polarization Effects On Absorption Spectra Measured Using A Quantum Cascade Laser-Based Spectrometer *June 2022*
International Symposium on Molecular Spectroscopy 2022

Y. Phal, K. Yeh, R. Bhargava, VCD Imaging: New Tool to Examine Biological Materials *Sept. 2021*
FACSS SciX 2021 [Poster] | ***Poster Award Winner***

Y. Phal, R. Bhargava, R-J. Ho, K. Yeh, Vibrational Circular Dichroism Measurements Using IR Microscopes: Opportunities and Challenges *September 2021*
FACSS SciX 2021: Structure Elucidation of Chiral and Biological Molecules

L. Lux, **Y. Phal**, P-H. Hsieh, R. Bhargava, Parametric Approach to Determine Pixel-Wise Limit of Detection in Infrared Imaging *September 2021*
FACSS SciX 2021 [Poster]

Y. Phal, K. Yeh, R. Bhargava, Mid-IR Laser-Based Polarimetric Imaging for Polymeric and Biological Applications *March 2021*
SPIE Photonics West 2021: Advanced Chemical Microscopy for Life Science and Translational Medicine

R. Bhargava, S. Kenkel, **Y. Phal**, K. Yeh, Pushing the Limits of Spatial and Temporal Capability of Infrared Spectroscopic Imaging: a Theory-Based Approach *March 2021*
SPIE Photonics West 2021: Advanced Chemical Microscopy for Life Science and Translational Medicine

K. Yeh, **Y. Phal**, R. Bhargava, Infrared Chemical Imaging with Scanning Quantum Cascade Laser Microscopy Systems *March 2021*
SPIE Photonics West 2021: Advanced Chemical Microscopy for Life Science and Translational Medicine

R. Bhargava, K. Yeh, **Y. Phal**, S. Kenkel, Next generation infrared spectroscopy for micro and nanoscale chemical imaging *April 2020*
SPIE Defense & Commercial Sensing 2020: Advanced Sensing & Imaging

R. Bhargava, K. Yeh, **Y. Phal**, S. Kenkel, Infrared Spectroscopic Imaging with QCLs *March 2020*
Pittcon Conference 2020

Y. Phal, K. Yeh, R. Bhargava, Polarimetric Infrared Spectroscopic Imaging Using QCLs *Feb. 2020*
SPIE Photonics West 2020: Advanced Chemical Microscopy for Life Science and Translational Medicine

K. Yeh, **Y. Phal**, R. Bhargava, Design of QCL Microscopes for IR Chemical Imaging *February 2020*
SPIE Photonics West 2020: Advanced Chemical Microscopy for Life Science and Translational Medicine

Unpublished Completed Works

R-J. Ho, **Y. Phal**, K. Falahkheirkhah, K. Yeh, M. Gillette, J. Sweedler, R. Bhargava, Whole-brain Structural and Chemical Mapping with Infrared Spectroscopic Imaging *In Review*

Y. Phal, R-J. Ho, R. Bhargava, Polarization Anisotropy Effects in QCL-Based IR systems *In Progress*

Teaching Experience

Colorado School of Mines, Golden, USA

Instructor, EENG-411 Digital Signal Processing *Spring 2024*

Guest Lecturer, PHGN-480 & PHGN-581 Laser Physics *October 2023*
Spectral Line Profiles & Measurements Using Interferometric Design

University of Illinois, Urbana-Champaign, Urbana-Champaign, USA
Harold L. Olesen Undergraduate Teaching Award & Ernest A. Reid Fellowship

Guest Lecturer, BIOE-570 Seminar Series *October 2021*
Seeing things in a different light

Guest Lecturer, BIOE-507 Advanced Bioinstrumentation *April 2021*
Design & Development of Infrared Spectroscopic Imaging Systems [Virtual]

Graduate Teaching Assistant, ECE 445 Senior Design Project Lab *Fall 2017 – Summer 2018*
Award Winning Projects: [Link]

- ☐ ***The Lextech Senior Design Best Engineered Project Award:*** Prosthetic Control Board
  Caleb Albers *(Engineering Lead, Pliancy)* & Daniel Lee *(Systems Engineer, Texas Instr.)*
- ☐ ***Area Award for Courage:*** Cell Phone Transmission Detector
  Anish Bhattacharya *(Recipient of NSF GRFP, M.S./PhD., University of Pennsylvania)*, Anthony Schroeder & Shandilya Pachgade *(Machine Learning Engineer, Bloomberg)*
- ☐ ***Area Award for Recreation & Entertainment:*** RC Boat Power & Signal Level Indicator
  Sanchit Anand, Vaibhav Mittal & Sho Harisawa
- ☐ ***Area Award for Research:*** Autonomous Motorized Mount for PATHS Sensor
  Brandon Bogue, Marvin Hernandez & Quoc Pham

Selected Notable Projects:

- ☐ Noninvasive PoC Anemia Detection Mythri Anumula *(Electrical Engineer, Borrego Solar Systems)* & Jeremy DeJournett *(Chief Technology Officer, Ideal Medical Technologies)*
- ☐ Conductive Fabric Gesture-Control Sleeve
  Guneev Lamba *(Associate, HGGC)*, Mrunmayi Deshmukh *(GPU Firmware Engineer, NVIDIA)* & Stephanie Wang

Graduate Teaching Assistant, ECE 468 Optical Remote Sensing *Spring 2018*

- Designed and organized laboratory experiments for the class. Introduced and implemented a ***LIDAR section*** that used Garmin sensor for depth estimation and 3D mapping of the room.

California Institute of Technology

Graduate Teaching Assistant, ACM 100A Introductory Methods of Applied Mathematics *Fall 2013*

- Conducted recitation sessions for topics such as Complex Analysis & Ordinary Differential Equations

Graduate Teaching Assistant, CH 1A-B General Chemistry *Fall 2012 – Winter 2013*

- Graded exams and assignments for an undergraduate Chemistry course

Student Advising Experience

Colorado School of Mines

Advisor, Phal Lab — *Fall 2023 – Present*

☐ Design & Implementation of Novel Chiroptical System
Michael Le *(Ph.D. in Electrical Engineering, Colorado School of Mines)*
Viviana Arrunategui Norvick, ***Carle Booth Luce Fellow*** *(Ph.D. in Electrical Engineering, Colorado School of Mines)*
Raina Majumder *(FIRST scholars, B.S. in Applied Mathematics, Colorado School of Mines)*
Roya Akrami *(FIRST scholars, B.S. in Electrical Engineering, Colorado School of Mines)*
#3 Best Oral Presentation, Mines Undergraduate Research Symposium 2024
Sing Piper, Angela Gabay & Spencer Groth *(B.S. in Electrical Engineering, Colorado School of Mines)*

University of Illinois, Urbana-Champaign

Student Mentor, Chemical Imaging & Structures Lab — *Summer 2019 – Present*

☐ Limit of Detection in IR imaging instrument
Laurin Lux *(M.S., Technical University of Vienna)* | ***Student Award, SciX 2021***
☐ Laser scanning IR microscope monitoring and control assembly
Andres Orr, Kevin So *(M.S., University of Wisconsin-Madison)* & Nathan Chung *(COO & Co-founder, Ferritiva)*
☐ Standalone VCD spectroscopic instrument
Eric Modesitt, Ru-Jing Ho *(Ph.D., University of Illinois, Urbana-Champaign)*

Student Mentor, ECE 445 Senior Design Project — *Fall 2019*

☐ Active Feedback Control for Laser Pointing Stability
Ruomu Hao *(M.S./Ph.D., Georgia Institute of Technology)*, Sean White & Hao Yan

Student Mentor, Promoting Undergraduate Research in Engineering (PURE) — *Spring 2017*
Best Project Award for Promoting Undergraduate Research

☐ Real Time Spectrum Sensing using SDR for Radio Frequency Interference (RFI) Analysis
Min Kue Kim & Haozhong Guan *(M.S./Ph.D., University of Illinois, Urbana-Champaign)*
☐ RFI in Radar Data using DSP: A Software Approach
Brian Chen & Amber Sahdev *(Software Engineer, Salesforce)*

Mentor, Spectrometer SmallSat of Illinois & Indiana (SASSI) CubeSAT — *Fall 2016 – Spring 2018*

☐ Characterizing and Calibration of Imaging Spectrometer for Re-entry and Airglow
Nicholas Zuiker *(M.S./Ph.D., University of Illinois, Urbana-Champaign)*

Leadership Experience

President & Founding Member, SAS, Illinois Chapter — *July 2021 – June 2023*
President, SPIE, Illinois Chapter — *July 2020 – May 2022*
Air and Space Volunteer, California Science Center, Los Angeles — *July 2014 – January 2015*
Caltech Grad-Undergrad Mentoring Program, Pasadena — *September 2013 – August 2014*

Professional Service & Outreach

2024 Student Award Nominations Committee, Coblentz Society — *April 2024*
Editorial Board Member, Technology in Cancer Research & Treatment — *October 2023 – Present*
IEEE Kickoff Event, CO Mines | Speaker, *Undergraduate Research* — *September 2023*
SPARK, UIUC | Panelist, *Research Statement* — *June 2023*
Scientific Reviewer, Physica Scripta, 2D Materials, Journal of Biological Chemistry — *June 2023 – Present*
Scientific Reviewer, Analytical Chemistry, Macromolecules, Biosensors — *June 2019 – Present*
Career Center 2023, UIUC | Panelist, *Success Story Panel* — *April 2023*
International Career Festival 2023, UIUC | Panelist, *Alumni Panel* — *March 2023*
researcHStart 2022, UIUC | Summer Workshop, *Light+Electronics* — *July-August 2022*
2022 Undergraduate Research Symposium, UIUC | Judge — *April 2022*
ECE Pulse Conference 2022, UIUC | Panelist, *Women in Academia* — *February 2022*
2021 Optics and Photonics News: Image Contest | Honorable Mention [Link] — *December 2021*
Graduate College Image of Research, UIUC | Semifinalist, *Bonds of Strength* [Link] — *March 2021*

Engineering Career Services, UIUC | Panelist, *Ask Me Anything: Graduate School* *February 2019*
Seminars & Talks Series, IIT Indore | Invited Speaker, *Space Electronics* *January 2015*
Career in Engineering, Girijabai Sail Inst. of Tech. | Invited Speaker, *Emerging Tech.* *Sept. 2014*

Colorado School of Mines
Undergrad Research Symposium Judge, Mines *Spring 2024*
Colorado Engineering Council Mines Committee, Mines *Spring 2024*
AWC TT Hiring Committee, Department of Electrical Engineering *Fall 2023*
Electrical Engineering Representative, Graduate Council *Fall 2023*
Graduate Committee, Department of Electrical Engineering *Fall 2023*

Thesis Committee Member
☐ Anna Titova, Doctoral Committee, Electrical Engineering *Spring 2024*
☐ Patrick Barringer, Master Committee, Electrical Engineering *Fall 2023*