

Hammad F. Khan

Weldon School of Biomedical Engineering, Purdue University

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I. Research Interest

Neuroengineering, calcium imaging, electrophysiology, bio-integrated devices, motor cortical circuits.

II. Education

2020–2026 **PhD in Biomedical Engineering, Purdue University**

2016–2020 **BS in Electrical Engineering, Montana State University**

III. Research Experience

Aug 2020 – Present **Graduate Research Assistant, Purdue University**

Research Advisors: Dr. Krishna Jayant

- Developed and optimized scalable thin-film electrodes to combine two-photon microscopy and high-density electrode recordings.
- Developed projects to understand motor circuits underlying skilled movement.
- Identified the first subcellular and cellular functional biomarker for early stage Lewy-pathology.

Jun 2018–Jun 2020 **Undergraduate Research Assistant, Montana State University**

Research Advisor: Dr. Anja Kunze

- Developed scalable and biocompatible cell assays revealing a paradoxical change in cytosolic calcium and mitochondrial interactions during cortical network maturation.
- Presented findings at national BMES conference and published first-author paper.

IV. Teaching and Mentoring Experience

Jul 2021 – Present **Research Mentor, Purdue Biomedical Engineering**

Mentored 13 students including undergraduates, masters, and medical students.

- Led scientific projects on neurotechnology and sensorimotor processing in rodents.
- Mentee projects led to presentations and publications.
- Placed students in competitive graduate and medical programs, and industry positions.

Aug 2021–May 2022 **Graduate Peer Mentor, Purdue Biomedical Engineering**

Mentored two incoming PhD students on developing a plan of study.

- Facilitated transition into PhD programs for incoming students including research labs and classwork
- Provided guidance in student-advisor meetings and navigating stressors

Jul 2021–Apr 2022 **Undergraduate Mentor, Purdue Honors College**

Mentored three undergraduate students from the Honors College.

- Developed scientific projects and milestones related to neurotechnology development and testing.
- Facilitated high-impact research culminating in conference proceedings.
- Helped place students in top engineering graduate programs and Fortune 500 companies.

- Aug 2021–Dec 2022 **Graduate Teaching Assistant, Purdue BME 301 Bioelectricity**
 Managed grading and exams for 150+ students.
- Organized homework and lab content; coordinated with teaching assistants.
 - Maintained weekly office hours for recitations and homework support.
- Sep 2018–Dec 2019 **Teacher Assistant, Montana State University, Communications 201**
 Facilitated freshman seminar discussions.
- Developed interactive lesson plans.
 - Guided first-year students in academic adjustment and coursework management.
- Sep 2017–Dec 2017 **Co-instructor, Montana State University, Department of Mathematics M121**
 Lectured introductory algebra for non-traditional students.
- Facilitated coursework and quizzes.
 - Provided one-on-one support during office hours.
 - Developed supplemental instructional materials.

VIII. Selected Awards and Honors

- Jan 2025 **Max Planck Florida Institute NeuroMEETS trainee**
 One of only six trainees selected nationwide.
- Jan 2025 **Nature Communication Highlight: Top 50 best papers in Brain to Behaviour**
- Oct 2024 **Purdue Institute for Integrative Neuroscience Travel Award**
- Apr 2024 **BME Research Symposium Best Oral Presentation**
- Oct 2022 **Society of Neuroscience Professional Development Award**
- Aug 2020 **Purdue Stephan Ash Fellow**
 Only one student selected in the department.
- Nov 2019 **Montana State College of Engineering Travel Award**
- Aug 2018 **Montana State IM Flash Technology Scholarship**
 One student selected in the department based on scholarly merit.

X. Patents

1. Krishna Jayant, Om T. Kolhe, Daniel L. Gonzales, and **Hammad F. Khan**. “2D and 3D Neural Electrodes and Methods Thereof.” *US Patent #63/542,491*, 2024.
2. Anja Kunze, Connor L. Beck, and **Hammad F. Khan**. “Multi-Curvature Soft Matter Patterns and Methods for Lab-on-Chip Pharmaceutical Testing and Neurobiology Studies.” *US Patent #63/143.701*, 2021.

V. Publications

1. **Hammad F. Khan***, Om Kolhe*, Meiseim Habibimatin, and Krishna Jayant. “Traveling Waves Gate Reliable Volitional Movement” *In preparation*. *Equal contribution by Hammad F. Khan and Om Kolhe.
2. Brendan K. Ball*, **Hammad F. Khan***. “An integrative framework linking molecular signatures and locomotory phenotypes in space-induced sarcopenia” *bioRxiv, In review*. *Equal contribution. Corresponding author.
3. Om T. Kolhe, Alec C. Booth, **Hammad F. Khan**, Krishna Jayant. “A chronic multimodel platform for simultaneous electrophysiology and calcium imaging during motor behaviour.” *24th International Conference on Solid-State Sensors, Actuators and Microsystems, (Accepted)*.
4. Sanket Samal, Shulan Xiao, Samantha Nelson, Om Kolhe, **Hammad F. Khan**, Meiseim Habibimatin, Won-June Lee, Mustafa Ahmed, Decheng Wang, Tianqi Wang, Qing Deng, Elizabeth Parkinson, and Krishna Jayant, Jian-

guo Mei. “Blood-Catalyzed n-Doped Conducting Polymer for Reversible, Light-Induced Modulation of Neuronal Membranes” *Science (In revision)*, 2025.

5. Sayan Dutta, Jennifer Hensel, Alicia Scott, Rodrigo Mohallem, Leigh-Ana M Rossitto, **Hammad F. Khan**, Teshawn Johnson, Christina R Ferreira, Jackeline F. Marmolejo, Xu Chen, Krishna Jayant, Uma K. Aryal, Laura Volpicelli-Daley, Jean-Christophe Rochet. “Synaptic phosphoproteome modifications and cortical circuit dysfunction are linked to the early-stage progression of alpha-synuclein aggregation” *bioRxiv*, 2025.
6. Daniel L. Gonzales, **Hammad F. Khan**, Hayagreev Keri, Saumitra Yadav, Lyle Muller, Scott Pluta, and Krishna Jayant. “A Translaminar Space-Time Code Supports Touch-Evoked Traveling Waves” *Science Advances* 11, 5, 2025.
7. **Hammad F. Khan**, Sayan Dutta, Alicia N. Scott, Shulan Xiao, Saumitra Yadav, Xiaoling Chen, Tamara L. Kinzer-Ursem, Jean-Christophe Rochet, and Krishna Jayant. “Site-Specific Seeding of Lewy Pathology Induces Distinct Pre-Motor Cellular and Dendritic Vulnerabilities in the Cortex” *Nature Communications* 15, 10775, 2024. **Featured in the top 50 best papers published in an area.**
8. A. Booth, **Hammad F. Khan**, Om T. Kolhe, and Krishna Jayant. “Implantation of Flexible Electrodes for Simultaneous In-Vivo Extracellular Recording and Two-Photon Imaging” *Proceedings of IMPRS* 6 (1), 2023.
9. Y. Bari, **Hammad F. Khan**, and Krishna Jayant. “Tracking the Neurodegeneration and Behavioral Changes in Mice Model of Prodromal Phase Alpha-Synucleinopathy” *Proceedings of IMPRS* 5 (1), 2022.
10. C. L. Beck, **Hammad F. Khan**, and Anja Kunze. “Biomechanical Modulation of Calcium Event Rates in Soft Matter Neuro Patterns” *Proceedings of the 25th International Conference on Miniaturized Systems for Chemistry and Life Science*, 2022.
11. **Hammad F. Khan**, C. L. Beck, and Anja Kunze. “Multi-Curvature Micropatterns Unveil Distinct Calcium and Mitochondrial Dynamics in Neuronal Networks” *Lab on a Chip*, 2021.

VI. Fellowships

Jul 2022–Jul 2027	NSF Graduate Research Fellow (DGE-1842166) Project: Large-scale mapping of somato-dendritic dynamics during skilled movement.
Jul 2021–Jul 2023	NIH Graduate Training Fellow (NIH T32DC016853) Project: Mapping intracellular rate code in CA1 neurons under auditory spatial cues.
Jan 2019–Jan 2020	NIH Undergraduate Research Fellow (NIH P20GM103474) Project: Using Agarose Hydrogel to Mimic Organized Neural Network Response and Mechanical Stimulus In Vitro.

VII. Conference Proceedings

1. **Biomedical Engineering Society Annual Meeting (Poster)**, Baltimore, MD, October 2024.
Lorenzo Cacciapuoti, **Hammad F. Khan**, S. Xiao, Krishna Jayant.
Artificial Brains for Artificial Intelligence: Dendritic Integration Inspired Neural Networks.
2. **SfN Barrels Conference (Talk)**, Chicago, IL, October 2024.
Hammad F. Khan*, Om T. Kolhe*, M. Habibimatin, E. F. Tanase, Krishna Jayant.
Traveling waves support dynamic rerouting of communication subspaces across the motor cortical hierarchy.
3. **SfN Conference (Poster)**, Chicago, IL, October 2024.
Om T. Kolhe*, **Hammad F. Khan***, M. Habibimatin, E. F. Tanase, Krishna Jayant.
Traveling waves enable reliable volitional motor movement.
4. **SfN Conference (Poster)**, Chicago, IL, October 2024.
L. Cacciapuoti, **Hammad F. Khan**, S. Xiao, Krishna Jayant.
Artificial Brains for Artificial Intelligence: Dendritic Integration Inspired Neural Networks.
5. **SfN Barrels Conference (Poster)**, Baltimore, MD, November 2023.
Hammad F. Khan*, Om Kolhe*, Meiseim Habibimatin, Krishna Jayant. Traveling waves gate reliable volitional motor movement.

6. **SfN Conference (Poster)**, San Diego, CA, November 2022.
Hammad F. Khan, Sayan Dutta, Saumitra Yadav, Xiaoling Chen, Tamara L. Kinzer-Ursem, Jean-Christophe Rochet, Krishna Jayant. Prodromal phase alpha synucleinopathy-induced motor circuit dysfunction in vivo.
7. **SfN Conference (Poster)**, San Diego, CA, November 2022.
Daniel L. Gonzales, Hammad F. Khan, Hayagreev V. S. Keri, Saumitra Yadav, Scott R. Pluta, Krishna Jayant. Mapping the cellular and sub-cellular circuit motifs underlying sensory-driven traveling waves from the cortical surface.
8. **SfN Conference (Poster)**, San Diego, CA, November 2022.
Nico Masala, Gergely Tarcsay, Hammad F. Khan, Daniel L. Gonzales, Laura A. Ewell, Krishna Jayant. Chronic dual optical-voltage recordings from hippocampus of awake head-fixed mice.
9. **CSHL Neuronal Circuits Conference (Poster)**, Cold Spring Harbor, NY, March 2022.
Hammad F. Khan, Sayan Dutta, Saumitra Yadav, Xiaoling Chen, Tamara L. Kinzer-Ursem, Jean-Christophe Rochet, Krishna Jayant. Examining the coupling between beta oscillations and functional cortical ensembles in an alpha-synuclein mouse model of dementia.
10. **CSHL Neuronal Circuits Conference (Poster)**, Cold Spring Harbor, NY, March 2022.
Daniel L. Gonzales, Hammad F. Khan, Scott R. Pluta, Krishna Jayant. Transparent, flexible electrodes for mapping sensory-driven activity from the cortical surface in awake animals.
11. **Annual NCUR Conference (Talk)**, Montana State University, MT, March 2020.
Hammad Khan, Connor Beck, Anja Kunze. Agarose Microchannels to Study Curvature Effects in Neuronal Calcium Signaling.
12. **Annual BMES Conference (Talk)**, Philadelphia, PA, October 2019.
Hammad Khan, Connor Beck, Anja Kunze. Soft-gel Microchannels to Study Curvature Effects in Neuronal Calcium Signaling.
13. **Annual BMES Conference (Poster)**, Philadelphia, PA, October 2019.
Jeneane Jaber, Hammad Khan, Anja Kunze. Quantifying Magnetic Nanoparticle Movement Under Micromagnetic Field Patterns.
14. **NSF NNCI Convocation (Talk)**, Cornell University, NY, August 2019.
Hammad Khan, Connor Beck, Anja Kunze. Agarose microchannels to study curvature effects in neuronal calcium signaling.
15. **NIH INBRE Convocation (Poster)**, Montana State University, MT, August 2019.
Hammad Khan, Connor Beck, Anja Kunze. Agarose microchannels to study curvature effects in neuronal calcium signaling.
16. **Undergraduate Scholars Research Celebration (Poster)**, Montana State University, MT, May 2019.
Hammad Khan, Anja Kunze. Fine-tuning Agarose Concentrations towards Soft-gel based Neuro-microfluidics.
17. **IEEE Neuroengineering Conference (Poster)**, San Francisco, CA, March 2019.
Derek Judge, Hammad Khan, Anja Kunze. Neural network growth under heterogeneous magnetic gradient patterns.

IX. Leadership & Community Service

Aug 2024–Present	Project Director, Purdue Medical, Innovation, Networking, and Design
Jul 2024–Present	Booth Coordinator, Purdue Institute for Integrative Neuroscience Spring Fest
Jul 2022–Jul 2024	Treasurer, Auditory Neuroscience Association, Purdue Chapter
Jul 2021–Jul 2022	Treasurer, Biomedical Graduate Student Association, Purdue Chapter
Aug 2020–Jul 2021	Graduate Rep., Biomedical Graduate Student Association, Purdue Chapter

Aug 2019–Jun 2020 **Undergraduate Program Lead, Sophomore Surge Program**

Aug 2017–Jun 2019 **Undergraduate Mentor, Sophomore Surge Program**

Aug 2016–May 2017 **Senator, Residence Hall Association**