

Hammad F. Khan

Weldon School of Biomedical Engineering, Purdue University

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Research Interest

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

Education

PhD in Biomedical Engineering, Purdue University, GPA: 3.95/4.00 May 2026

BS in Electrical Engineering, Montana State University, GPA: 3.7/4.00 May 2020

Research Experience

Graduate Research Assistant, Purdue University August 2020 – Present

Research Advisors: **Dr. Krishna Jayant** (Primary) and **Dr. Tamara L. Kinzer-Ursem** (Co-advised)

Developing scalable bioelectronic interfaces for multimodal mapping of neural activity.

Studying mechanisms underlying volitional movement under healthy and diseased cortical circuits in mice.

Undergraduate Research Assistant, Montana State University June 2018 – June 2020

Research Advisor: **Dr. Anja Kunze**

Developed scalable and biocompatible cell assays to investigate cytosolic calcium signaling during cortical neurite maturation in vitro.

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. 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, Jianguo Mei. “Blood-Catalyzed n-Doped Conducting Polymer for Reversible, Light-Induced Modulation of Neuronal Membranes” *Science (In review)*
3. 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 (In revision)*
4. **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 (accepted in principle)*, 2024.
5. 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.
6. 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.
7. 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.
8. **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.

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.

Research Fellowships

NSF Graduate Research Fellow (DGE-1842166)

July 2022 – July 2027

Project title: Large-scale mapping of somato-dendritic dynamics during memory formation and replay.

NIH Graduate Training Fellow (NIH T32DC016853)

July 2021 – July 2023

Project title: Mapping intracellular rate code in CA1 neurons under auditory spatial cues.

NIH Undergraduate Research Fellow (NIH P20GM103474)

January 2019 – January 2020

Project title: Using Agarose Hydrogel to Mimic Organized Neural Network Response and Mechanical Stimulus In Vitro.

Presentations

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 Tarcay, **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 Micro-magnetic 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.

Awards

1. Society of Neuroscience Professional Development Award, October 2022.
2. Stephan Ash Fellowship, August 2020.

Leadership & Teaching Experience

1. **Purdue BME Graduate Student Association (GSA) Treasurer** *July 2021 – Present*
Responsible for managing the budget, tracking expenditures, and overseeing financial decisions.
 - Organized fundraising events and managed sponsorships for the association.
 - Developed detailed financial reports for department and intercollegiate activities.**First Year Representative** *August 2020 – July 2021*
Assisted in planning events and representing first-year students in organizational meetings.
 - Acted as a liaison between first-year students and the faculty, addressing concerns and suggestions.
 - Facilitated integration and onboarding sessions for new graduate students.
2. **Sophomore Surge Program** *August 2017 – June 2020*
 - Mentored incoming students on academic resources, registration, and class selection.
 - Provided personalized guidance to help students adapt to the academic and social environment.
 - Organized study groups and tutoring sessions to enhance student success.
3. **Biomedical Engineering Journal Club** *May 2018 – May 2019*
 - Member: Presented on various biomedical and neuroengineering topics.
 - Reviewed and discussed new developments in the field.
 - Led group discussions and presented on journal articles.
 - Coordinated guest speakers and special presentations on cutting-edge research topics.
4. **Residence Hall Association (RHA)** *August 2016 – May 2017*
 - Senator: Advocated for community needs within residence halls.
 - Coordinated budgets and activities with other student organizations.
 - Managed logistics for residence hall events, enhancing student engagement and participation.
 - Worked with administration to improve hall community and address student concerns.
5. **Montana State University, University Comm.**
Peer Facilitator; US 101 *September 2018 – December 2019*
Facilitated discussions in a freshman seminar classroom.
 - Developed interactive lesson plans for student discussions.
 - Guided first-year students in adjusting to the academic environment and managing coursework.
 - Conducted group activities to foster collaboration and communication skills among students.
6. **Montana State University, Department of Mathematics**
Co-instructor; M121 *September 2017 – December 2017*
Lectured three times a week in introductory algebra for non-traditional students.
 - Facilitated coursework and quizzes.
 - Provided one-on-one support for students during office hours.
 - Developed supplemental instructional materials.