

SHUVRO CHOWDHURY, PhD

Postdoctoral Scholar | Probabilistic Computing, Quantum Computing & Machine Learning Researcher

📍 Santa Barbara, CA 93106 📞 (765) 426-3931 ✉ schowdhury@ucsb.edu
🌐 shuvrochowdhury.github.io 🎓 Google Scholar 🔗 /in/shuvro-chowdhury

EDUCATION

Doctor of Philosophy in Electrical & Computer Engineering

2016 - 2022

Purdue University, West Lafayette, IN | Advisor: Prof. Supriyo Datta

Dissertation: *Quantum Emulation with Probabilistic Computers*

Master of Science in Electrical & Electronic Engineering

2011 - 2014

Bangladesh University of Engineering & Technology, Dhaka, Bangladesh

Dissertation: *Accurate drain current modeling of long channel junctionless double-gate field effect transistor*

Bachelor of Science in Electrical & Electronic Engineering

2006 - 2011

Bangladesh University of Engineering & Technology, Dhaka, Bangladesh

RESEARCH SUMMARY

- An early-career researcher with over eight years of experience innovating at the intersection of probabilistic computing, quantum systems, and machine learning, recognized with the **2025 Misha Mahowald Prize** and over 20 publications in high-impact venues like Nature Electronics and Nature Communications.
- Expertise in the hardware-software co-design of probabilistic computers, pioneering the use of FPGAs and stochastic nanomagnets to accelerate complex tasks, including the emulation of sign-problem-free quantum Hamiltonians and solving hard combinatorial optimization problems.
- Develops scalable, physics-inspired AI solutions by applying energy-based models to diverse challenges, from training deep sparse Boltzmann networks to investigating algorithmic sparsity and designing energy-efficient edge implementations for Large Language Models (LLMs) and Neural Quantum States (NQS).
- Research is grounded in foundational device physics and quantum information theory, including prior work on analytical modeling for nanoscale semiconductor devices and the synthesis of reversible quantum circuits for multi-valued logic systems.

RESEARCH EXPERIENCE

Postdoctoral Scholar

2022 - Present

University of California Santa Barbara | Supervisor: Prof. Kerem Y. Camsari

- ▶ Led development of probabilistic computing hardware using FPGA and magnetic p-bits, resulting in 3 high-impact *Nature*-branded publications with additional works under review and in preparation
- ▶ Pioneered hardware acceleration techniques for Neural Quantum States (NQS) using probabilistic computing architectures
- ▶ Led development of Generalized Probabilistic Approximate Optimization Algorithm (PAOA)
- ▶ Investigated hardware acceleration techniques for chaotic bits (c-bits).
- ▶ Developed techniques to leverage sparsity in probabilistic algorithms, improving their efficiency for solving large-scale combinatorial optimization problems.
- ▶ Explored hardware-software co-design strategies for deploying Large Language Models (LLMs) on power-constrained edge devices.

Graduate Research Assistant

2016 - 2022

ECE, Purdue University | Supervisor: Prof. Supriyo Datta

- ▶ Developed novel quantum emulation methods using probabilistic computers, achieving up to $1000\times$ acceleration over CPU-based simulations
- ▶ Designed and applied quantum-inspired probabilistic algorithms for classical optimization problems.
- ▶ Published breakthrough research on sign-problem-free Hamiltonian emulation in *Physical Review Applied*

HONORS AND AWARDS

- [1] **The 2025 Misha Mahowald Prize** for the work on *Stochastic Neuromorphic Computing with Probabilistic Bits*.
- [2] **3rd Prize** in Electronics group for undergraduate research work, EEE Undergraduate Project Workshop (EU-ProW) 2011, organized by Dept. of EEE, Bangladesh University of Engineering and Technology.
- [3] **University Merit Scholarship** for good results in term examinations.
- [4] **University Dean's List Award** for 3.75+ CGPA in all levels.
- [5] **Dhaka Board Scholarship** for obtaining GPA 5.00 in Higher Secondary Certificate examination.

PEER-REVIEWED PUBLICATIONS

Journal Papers:

- [1] **Shuvro Chowdhury**, Navid Anjum Aadit, Andrea Grimaldi, Eleonora Raimondo, Atharva Raut, P. Aaron Lott, Johan H. Mentink, Marek M. Rams, Federico Ricci-Tersenghi, Massimo Chiappini, Luke S. Theogarajan, Tathagata Srimani, Giovanni Finocchio, Masoud Mohseni, and Kerem Y. Camsari, "[Pushing the boundary of quantum advantage in hard combinatorial optimization with probabilistic computers](#)", accepted in *Nature Communications*, 2024.

- [2] **Shuvro Chowdhury**, Kerem Y. Camsari, and Supriyo Datta, “Accelerated quantum Monte Carlo with probabilistic computers” in *Communications Physics*, 2023.
- [3] **Shuvro Chowdhury**, Kerem Y. Camsari, and Supriyo Datta, “Emulating Quantum Circuits With Generalized Ising Machines” in *IEEE Access*, 2023.
- [4] **Shuvro Chowdhury**, Andrea Grimaldi, Navid Anjum Aadit, Shaila Niazi, Masoud Mohseni, Shun Kanai, Hideo Ohno, Shunsuke Fukami, Luke Theogarajan, Giovanni Finocchio, Supriyo Datta, and Kerem Y. Camsari, “A full-stack view of probabilistic computing with p-bits: devices, architectures and algorithms” in *IEEE Journal on Exploratory Solid-State Computational Devices and Circuits*, 2023.
- [5] Srijan Nikhar, Sidharth Kannan, Navid Anjum Aadit, **Shuvro Chowdhury**, Kerem Y. Camsari, “All-to-all re-configurability with sparse and higher-order Ising machines”, in *Nature Communications*, 2024.
- [6] Shaila Niazi, Navid Anjum Aadit, Masoud Mohseni, **Shuvro Chowdhury**, Yao Qin, and Kerem Y. Camsari, “Training Deep Boltzmann Networks with Sparse Ising Machines”, in *Nature Electronics*, 2024.
- [7] M. Mahmudul Hasan Sajeeb, Navid Anjum Aadit, **Shuvro Chowdhury**, Tong Wu, Cesely Smith, Dhruv Chinmay, Atharva Raut, Kerem Y. Camsari, Corentin Delacour, and Tathagata Srimani, “Scalable connectivity for Ising machines: Dense to sparse” in *Physical Review Applied*, 2025.
- [8] Abdelrahman S Abdelrahman, **Shuvro Chowdhury**, Flaviano Morone, and Kerem Y Camsari, “Probabilistic approximate optimization: A new variational Monte Carlo algorithm”, in *Nature Communications (Review)*, 2025.
- [9] Saleh Bunaiyan, Corentin Delacour, **Shuvro Chowdhury**, Kyle Lee, and Kerem Y. Camsari, “IsingFormer: Augmenting Parallel Tempering With Learned Proposals”, in *arXiv:2509.23043*, 2025.
- [10] Kyle Lee, **Shuvro Chowdhury**, Kerem Y. Camsari “Noise-augmented Chaotic Ising Machines for Combinatorial Optimization and Sampling” in *Communications Physics*, 2024.
- [11] Kerem Y. Camsari, **Shuvro Chowdhury**, and Supriyo Datta, “Scalable Emulation of Sign-Problem-Free Hamiltonians with Room-Temperature *p*-bits”, in *Physical Review Applied*, 2019.
- [12] Mohammad Asif Zaman, **Shuvro Chowdhury**, “Modified Bézier Curves with Shape-Preserving Characteristics Using Differential Evolution Optimization Algorithm”, in *Advances in Numerical Analysis*, 2013.
- [13] Esmat Farzana, **Shuvro Chowdhury**, Rizvi Ahmed, and M. Khan, “Analysis of temperature and wave function penetration effects in nanoscale double-gate MOSFETs”, *Applied Nanoscience*, 2012.
- [14] Esmat Farzana, **Shuvro Chowdhury**, Rizvi Ahmed, and M. Z. Rahman Khan, “Performance Analysis of Nanoscale Double Gate MOSFETs with High- κ Gate Stack”, *Applied Mechanics and Materials*, 2011.

Conference Papers:

- [1] **Shuvro Chowdhury** and Kerem. Y. Camsari, “Machine Learning Quantum Systems with Magnetic p-bits,” in *2023 IEEE International Magnetic Conference (INTERMAG)*, 2023.
- [2] **Shuvro Chowdhury**, Supriyo Datta and Kerem Y. Camsari, “A Probabilistic Approach to Quantum Inspired Algorithms,” in *2019 IEEE International Electron Devices Meeting (IEDM)*, 2019.
- [3] **Shuvro Chowdhury**, Md. Ziaur Rahman Khan, “Surface potential modeling of Junctionless Double Gate MOSFETs using gradual depletion approximation,” in *2014 International Conference on Electrical and Computer Engineering (ICECE)*, 2014.

- [4] Nihal Sanjay Singh, Shaila Niazi, **Shuvro Chowdhury**, Kemal Selcuk, Haruna Kaneko, Keito Kobayashi, “[Hardware Demonstration of Feedforward Stochastic Neural Networks with Fast MTJ-based p-bits](#)”, in *2023 International Electron Devices Meeting (IEDM)*, 2023.
- [5] Andrea Grimaldi, Kemal Selcuk, Navid Anjum Aadit, Keito Kobayashi, Qixuan Cao, **Shuvro Chowdhury**, Giovanni Finocchio, Shun Kanai, Hideo Ohno, Shunsuke Fukami, Kerem Y. Camsari, “[Experimental evaluation of simulated quantum annealing with MTJ-augmented p-bits](#)” in *2022 International Electron Devices Meeting (IEDM)*, 2022.
- [6] Md. Mahmud Muntakim Khan, Ayan Kumar Biswas, **Shuvro Chowdhury**, Masud Hasan, and Asif Islam Khan, “[Synthesis of GF\(3\) Based Reversible/Quantum Logic Circuits without Garbage Output](#),” in *IEEE International Symposium on Multiple-Valued Logic*, 2009.
- [7] Ayan Kumar Biswas, **Shuvro Chowdhury**, Md. Mahmud Muntakim Khan, Masud Hasan, and Asif Islam Khan, “[Some basic ternary operations using toffoli gates along with the cost of implementation](#),” in *2011 41st IEEE International Symposium on Multiple-Valued Logic (ISMVL)*, 2011.
- [8] Md. Mahmud Muntakim Khan, Ayan Kumar Biswas, **Shuvro Chowdhury**, Mehbuba Tanzid, Kazi Mohammad Mohsin, Masud Hasan, and Asif Islam Khan, “[Quantum realization of some quaternary circuits](#),” in *TENCON 2008 - 2008 IEEE Region 10 Conference*, 2008.

Peer-reviewed Workshop Papers:

- [1] **Shuvro Chowdhury**, Shaila Niazi and Kerem Yunus Camsari, “[Mean-Field Assisted Deep Boltzmann Learning with Probabilistic Computers](#)”, in *Workshop Machine Learning with New Compute Paradigms, NeurIPS 2023*.

Book Chapters:

- [1] Kerem Y. Camsari, **Shuvro Chowdhury**, and Supriyo Datta, “[The Non-Equilibrium Green Function \(NEGF\) Method](#)”, in *Springer Handbook of Semiconductor Devices*, 2021.

INVITED TALKS & SEMINARS

- **Shuvro Chowdhury** and Kerem Y. Camsari, [Pushing the Boundary of Quantum Advantage in Hard Combinatorial Optimization with Probabilistic Computers](#), in *Workshop on Rivals of Quantum Computing*, University of Pittsburgh, May 2025.
- **Shuvro Chowdhury** and Kerem Y. Camsari, [A Full-Stack View of Probabilistic Computing with p-bits: Devices, Architectures, Algorithms](#), IEEE SSCS Open Journal Webinar Series, February 2024.
- **Shuvro Chowdhury**, “[Accelerated quantum Monte Carlo with probabilistic computers](#)”, in *International Network of Quantum Annealing (INQA) Seminar*, October 2023.
- **Shuvro Chowdhury**, “[Probabilistic Computing with p-bits: Co-designing Devices, Algorithms and Architectures](#)”, in *Workshop on Non-conventional Approaches to Hard Optimization (NAHO)*, Sponsored by NSF and University of Notre Dame, USA, June 2023.

TECHNICAL SHORTCOURSES INSTRUCTED

- ▶ **Training on Computer Interfacing and Embedded System**, organized by – IEEE GOLD Bangladesh Section & ITRRC of Jagannath University, Dhaka, Bangladesh in 2013.
- ▶ **Workshop on L^AT_EX and Scientific Writing**, organized by – IEEE GOLD Bangladesh Section in 2013.
- ▶ **Short Course on FPGA Digital Logic Design**, organized by – IEEE ED/SSCS Bangladesh Chapter in 2013.
- ▶ Along with two other colleagues, jointly designed ‘**ATMEGA32 Development Kit**’ - an ATMEGA32 microcontroller based trainer board.

TEACHING EXPERIENCE

Graduate Teaching Assistant

2020–2022

ECE, Purdue University | Supervisor: Prof. Supriyo Datta

- ▶ Co-developed 1 graduate-level course (Boltzmann Law: Physics to Computing) and served as a teaching assistant in two courses: Fundamentals of Current Flow, Introduction to Quantum transport, each supporting over 40 students per semester for 3 years

Assistant Professor

2015–2016

EEE, Bangladesh University of Engineering and Technology

- ▶ Theory Courses Taught: Solid State Devices, Electrical Properties of Materials, Microprocessor and Interfacing – 65 students per course
- ▶ Laboratory Courses Taught: Microprocessor and Interfacing Laboratory, Electronic Circuit Simulation Laboratory, Communication Laboratory, Measurement and Instrumentation Laboratory – 30 student per course

Lecturer

2011–2015

EEE, Bangladesh University of Engineering and Technology

- ▶ Theory Courses Taught: Electrical Circuits I, Electrical and Electronic Technology, Microprocessor and Interfacing, Digital Logic Design – 65 students per course
- ▶ Laboratory Courses Taught: Microprocessor and Interfacing Laboratory, Control System Laboratory, Electrical Circuit Simulation Laboratory, Digital Logic Design Laboratory – 30 students per course

MENTORING EXPERIENCE

- ▶ Successfully mentored 5 graduate students in probabilistic computing, NQS, and FPGA development; this guidance directly contributed to two first-authored publications and a successful PhD placement at UC Santa Barbara for one of the mentees.

PROFESSIONAL AFFILIATIONS

- ▶ Member, Institute of Electrical and Electronics Engineers (IEEE)
- ▶ Member, IEEE Electron Devices and Solid-State Circuits Society (ED/SSCS)

TECHNICAL SKILLS

Programming Languages:

Python, C/C++, MATLAB, CUDA, Verilog, System Verilog

Quantum Computing:

Qiskit, Variational Algorithms, Quantum Monte Carlo, Quantum Annealing

Machine Learning:

TensorFlow, PyTorch, Deep Learning, Energy-based models (Boltzmann Machines)

Hardware & Simulation Tools:

FPGA (Vivado), SPICE, CAD Tools, NEGF Simulators

PROFESSIONAL SERVICE

Journal Referee

- ▶ Nature
- ▶ Nature Communications
- ▶ Nature Computational Science
- ▶ npj Unconventional Computing
- ▶ Electron Device Letters
- ▶ IEEE Transactions on Circuits and Systems
- ▶ NeurIPS Workshop on Machine Learning with new Compute Paradigms

Member

2011 - 2016

Board of Undergraduate Studies, Dept. of EEE, Bangladesh University of Engineering and Technology

Member

2014 - 2016

Bureau of Research, Testing and Consultation, Dept. of EEE, Bangladesh University of Engineering and Technology

Member

2014

Technical Committee, 8th International Conference on Electrical and Computer Engineering (ICECE)

Vice Chair

2013

GOLD Affinity Group, IEEE Bangladesh Section

Secretary

2013

IEEE Electron Devices and Solid-State Circuits Society, Bangladesh Chapter

Secretary and Treasurer

2012

IEEE Electron Devices and Solid-State Circuits Society (ED/SSCS), Bangladesh Chapter

Treasurer

2012

GOLD Affinity Group, IEEE Bangladesh Section

REFERENCES

Dr. Supriyo Datta

Professor

Elmore Family School of Electrical & Computer Engineering

Purdue University, IN, USA

Phone: +1 (765) 414 5633

E-mail: datta@purdue.edu

Dr. Kerem Yunus Camsari

Associate Professor

Department of Electrical & Computer Engineering

University of California Santa Barbara, CA, USA

Phone: +1 (805) 893 2721

Email: camsari@ucsb.edu