Suhas Vittal

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Education

Georgia Institute of Technology, GA, USA Jan. 2023 - Present
Ph.D. Candidate, Computer Science
Advisor: Moinuddin Qureshi
Research Area: Efficient Quantum Computer Architecture

Georgia Institute of Technology, GA, USA Aug. 2019 - Dec. 2022
B.S. Computer Science, Summa Cum Laude
Concentrations: Theory, Systems and Computer Architecture

PhD Dissertation Research

Title: Efficient Quantum Computer Architecture

Summary: Quantum computers could solve important problems that are beyond the reach of today's most powerful computers, but current systems are constrained by frequent hardware errors. Quantum error correction is the most promising path towards realizing useful *fault-tolerant* quantum computers. But error correction requires support from the system to suppress hardware errors encountered during program execution. Furthermore, the error correction procedure introduces substantial complexity that can extend program runtime to days or even months in the worst case. *My research tackles the architectural and system bottlenecks that limit the performance and reliability of fault-tolerant quantum computers.* My research specifically studies how improvements in the control processor, real-time decoding subsystem, or end-to-end applications can improve performance and reliability for systems at scale.

Awards and Honors

- Best Paper Award for "Moveless: Minimizing QEC Overhead on QCCDs via Versatile Execution and Low Excess Shuttling" in the Systems Track at IEEE QCE 2025.
- NSF Graduate Research Fellowship Honorable Mention (2024).
- IEEE Micro Top Picks Honorable Mention in 2023 for "Astrea: Accurate Quantum Error-Decoding via Practical Minimum-Weight Perfect-Matching" – *Among the top 24 architecture papers accepted at HPCA, ASPLOS, ISCA, and MICRO in 2023.*
- Graduated from Georgia Tech with Highest Honors (Summa Cum Laude)
- Second place in the MICRO 2022 Student Research Competition for "MIDAS: Multi-Candidate Evaluation with Delayed Selection for Reducing SWAPs in NISQ Programs".

Publications

1. ASPLOS'27 — Gunagya Singh Mamak, ***Suhas Vittal***, Kabir Dubey, Kaitlin N. Smith, and Moinuddin K. Qureshi
Trident: Efficient Load Verification for Yoked Surface Codes using a Three-Level Memory Hierarchy
ACM International Conference on Architectural Support for Programming Languages and Operating Systems (**ASPLOS**) 2027, To appear.
- *Trident was a collaboration between Georgia Tech and Northwestern that I led. It is also the first paper that mitigates the "load verification" bottleneck in yoked surface codes.*
- *Artifact badges: Artifacts Available; Artifacts Evaluated & Functional; Results Reproduced.*

2. MICRO'26 — ***Suhas Vittal*** and Moinuddin K. Qureshi
HINT: Mitigating Latency Overheads in a Disaggregated Quantum Memory Hierarchy
IEEE/ACM International Symposium on Microarchitecture (**MICRO**) 2026.
- *First paper to tackle the memory wall present in disaggregated memory hierarchies.*

3. HPCA'26 — ***Suhas Vittal*** and Moinuddin K. Qureshi
BARD: Reducing Write Latency of DDR5 Memory by Exploiting Bank-Parallelism
IEEE International Symposium on High-Performance Computer Architecture (**HPCA**) 2026.
- *Demonstrated that the traditionally accepted strategy of maximizing DRAM row buffer hit rate is suboptimal for minimizing DRAM write overheads in modern DDR generations.*
- *Artifact badges: Artifacts Available; Artifacts Evaluated & Functional; Results Reproduced.*

4. QCE'25 — Sahil Khan, ***Suhas Vittal***, Kenneth R. Brown, and Jonathan M. Baker
Moveless: Minimizing QEC Overhead on QCCDs via Versatile Execution and Low Excess Shuttling
IEEE International Conference on Quantum Computing and Engineering (**QCE**) 2025.
- *One of the first papers to study syndrome extraction bottlenecks in trapped ion quantum computers.* ***Received Best Paper Award at QCE 2025 in the Systems Track.***

5. ISCA'25 — Siddharth Dangwal, ***Suhas Vittal***, Lennart Maximilian Seifert, Frederic T. Chong, and Gokul Subramanian Ravi
Variational Quantum Algorithms in the Era of Early Fault Tolerance
Annual International Symposium on Computer Architecture (**ISCA**) 2025.
- *One of the first papers to study whether first-generation fault-tolerant quantum computers can provide benefits for applications of interest. This was also a multi-institution collaboration initiated by Siddharth and me.*

6. ISCA'25 — ***Suhas Vittal***, Salman Qazi, Poulami Das, and Moinuddin K. Qureshi
MoPAC: Efficiently Mitigating Rowhammer with Probabilistic Activation Counting
Annual International Symposium on Computer Architecture (**ISCA**) 2025.
- *One of the first papers to propose a solution which retains PRAC-level protection while avoiding the associated 7% to 10% performance overhead.*
- *Artifact badges: Artifacts Available; Artifacts Evaluated & Functional; Results Reproduced.*

(7) MICRO'24 ***Suhas Vittal***, Ali Javadi-Abhari, Andrew W. Cross, Lev S. Bishop, and Moinuddin K. Qureshi
Flag-Proxy Networks: Overcoming the Architectural, Scheduling and Decoding Obstacles of Quantum LDPC Codes
IEEE/ACM International Symposium on Microarchitecture (**MICRO**) 2024.
- *First paper to introduce high-rate quantum LDPC codes to the architecture community.* ***IBM and Iceberg Quantum have used our research, or a variant of it, to implement syndrome extraction circuits for their Tour de Gross and Pinnacle architectures.***
- *Artifact badges: Artifacts Available; Artifacts Evaluated & Functional.*

(8) ASPLOS'24 Narges Alavisamani, ***Suhas Vittal***, Ramin Ayanzadeh, Poulami Das, and Moinuddin K. Qureshi
Promatch: Extending the Reach of Real-Time Quantum Error Correction with Adaptive Predecoding
International Conference on Architectural Support for Programming Languages and Operating Systems (**ASPLOS**) 2024.
- *Artifact badge: Artifacts Available.*

(9) MICRO'23 ***Suhas Vittal***, Poulami Das, and Moinuddin K. Qureshi
ERASER: Towards Adaptive Leakage Suppression for Fault-Tolerant Quantum Computing
IEEE/ACM International Symposium on Microarchitecture (**MICRO**) 2023.
- *First paper to propose adaptive mechanisms for suppressing leakage errors.*
- *Artifact badges: Artifacts Available; Artifacts Evaluated & Functional; Results Reproduced.*

(10) ISCA'23 ***Suhas Vittal***, Poulami Das, and Moinuddin K. Qureshi
Astrea: Accurate Quantum Error-Decoding via Practical Minimum-Weight Perfect-Matching
Annual International Symposium on Computer Architecture (**ISCA**) 2023.
- *First demonstration of a real-time decoder with MWPM-level accuracy beyond trivial code distances.* ***Received an IEEE Micro Top Picks Honorable Mention in 2023. IEEE Micro Top Picks highlights a select few papers in computer architectures each year.***
- *Artifact badges: Artifacts Available; Artifacts Evaluated & Functional; Results Reproduced.*

(11) ASPLOS'23 Fei Hua, Yuwei Jin, Yanhao Chen, ***Suhas Vittal***, Kevin Krsulich, Lev S. Bishop, John Lapeyre, Ali Javadi-Abhari, and Eddy Z. Zhang
CaQR: A Compiler-Assisted Approach for Qubit Reuse through Dynamic Circuit
International Conference on Architectural Support for Programming Languages and Operating Systems (**ASPLOS**) 2023, pp. 59–71.
- *One of the first papers to optimize the fidelity and runtime of dynamic circuits.*

Research Internships

- **IBM Research** Yorktown Heights, New York
  Research Intern, Mentors: Andrew Cross, Ali Javadi-Abhari, Lev Bishop May 2023 to August 2023
  - *Real-Time Decoding Infrastructure:* Contributed to building real-time decoding infrastructure by integrating real-time decoders.
  - *Syndrome Extraction Tooling:* Developed a greedy algorithm that produces low-depth and functionally correct syndrome extraction circuits for irregular quantum error correcting codes. *This algorithm is currently used by IBM researchers to design syndrome extraction circuits for extractor systems in their Tour de Gross architecture.*

– Our research on fault-tolerantly implementing QLDPC codes with 4-ary connectivity resulted in a MICRO 2024 paper on *Flag-Proxy Networks*: . This was the *first* paper on QLDPC codes to appear in a top-tier computer architecture conference.

- **IBM Research** — Yorktown Heights, New York
  Research Intern, Mentors: Ali Javadi-Abhari, Lev Bishop — May 2022 to August 2022
  – *QAOA Circuit Cutting:* Studied methods of improving fidelity of QAOA circuits using circuit cutting.
  – *Optimization of Dynamic Circuits:* Contributed to research on optimizing fidelity in dynamic circuits, resulting in our paper *CaQR* on qubit reuse in dynamic circuits.

Research Talks

- **Tackling Bottlenecks in the Decoding and Memory Subsystems of Fault-Tolerant Quantum Computers**
  Intel Quantum — Hillsboro, Oregon
  Host: Anne Matsura — Aug 2026

- **Tackling Write Overheads in Modern DRAM Memory**
  Ampere Computing — Portland, Oregon
  Host: Mahesh Madhav — Aug 2026

- **The Quantum Memory Wall**
  Iceberg Quantum — Sydney, Australia
  Host: Samuel C. Smith — Feb 2026

- **Challenges in Implementing and Operating with Quantum LDPC Codes** [video]
  GT Quantum Computing Association — Atlanta, Georgia
  Host: Zhixin (Jack) Song — Sep 2024

- **Astrea: Accurate Quantum Error-Decoding [...]**
  IBM Research — Yorktown Heights, New York
  Host: Drew Vandeth — July 2023

- **HINT: Mitigating Latency Overheads in a Disaggregated [...]** — MICRO 2026

- **BARD: Reducing Write Latency of DDR5 Memory [...]** — HPCA 2026

- **MoPAC: Efficiently Mitigating Rowhammer [...]** — ISCA 2025

- **Flag-Proxy Networks: Overcoming the Architectural, Scheduling [...]** — MICRO 2024

- **ERASER: Towards Adaptive Leakage Suppression [...]** — MICRO 2023

- **Astrea: Accurate Quantum Error-Decoding [...]** — ISCA 2023

Teaching Experience

- **Head Teaching Assistant** — Fall 2024
  Graduate Computer Architecture (CS 6290 or ECE 6100)

- *Managed a team of four TAs across a class of sixty students and taught material at an hour-long recitation for thirty to forty students every week.*

- **Teaching Assistant** Fall 2022, Fall 2023
  Special Topics: Quantum Computing (CS 4803 or CS 8903)
- **Teaching Assistant** Fall 2021
  Automata Theory and Complexity (CS 4510)

Research Mentoring Experience

Pawan Kashyap (Ph.D. at UT Austin) Fall 2026 to Present

- *Research topic:* Real-Time Decoding for Bivariate Bicycle Codes

Pragya Bhadani (M.S. at Georgia Tech) Fall 2026 to Present

- *Research topic:* Memory controller scheduling policies to reduce write-related slowdowns

Dongwhee Kim (Ph.D. at UT Austin) Spring 2026 to Present

- *Research topic:* Fast and reliable syndrome extraction for superconducting and trapped ion qubits
- Has a paper in submission that proposes adaptively alternating between short and long readout pulses to balance fidelity and speed.

Gunagya Singh Mamak (M.S. at Georgia Tech → Ph.D. at University of Wisconsin, Madison) Fall 2024 to Summer 2026

- *Research topic:* Memory-related overheads in a quantum memory system using yoked surface codes
- Trident accepted to ASPLOS 2027:
- Joined the University of Wisconsin, Madison to pursue a Ph.D. in Fall 2026

Aryan Shah (B.S. at Georgia Tech → Technical Staff at Etched) Fall 2023 to Spring 2025

- *Research topic:* Adaptive syndrome extraction for the surface code
- Successful undergraduate thesis:

Apoorva Sinha (M.S. at Georgia Tech) Spring 2024 to Fall 2024

- *Research topic:* Defect management for bivariate bicycle codes

Sahil Khan (B.S. at Georgia Tech → Ph.D. at Duke University) Fall 2022 to Fall 2024

- Successful undergraduate thesis on magic state distillation:
- Moveless at QCE 2025 (Best Paper in Systems Track):
- Joined Duke University to pursue a Ph.D. in Fall 2024

Academic Service

- **Program Committee Member** MICRO 2026
- **Program Committee Member** HPCA 2026
- **Journal Reviewer** ACM TQC since 2023, PRX since 2025
- **Mentor for uArch Workshop** ISCA 2026
- **Mentored two junior Ph.D. students for Meet a Senior Student (MaSS)** ISCA 2026
- **Life in Graduate School Panel Member for uArch Workshop** ISCA 2025

- **Managed GT Computer Architecture Seminar, Invited Guest Speakers:** Fall 2025
  - Tamara Schmitz (Director of Product Security at Micron)
  - Joshua Viszlai (UChicago; now at UC Boulder and Infleqtion)
  - Ted Younis (Lawrence Livermore National Laboratory (LLNL))

Proposal Writing Experience

- **Designing Resource-Efficient and Fast Architectures for Fault-Tolerant Quantum Computing**
  NSF Proposal ($1,000,000) in 2026
  - Lead PI: Prof. Poulami Das (UT Austin)
  - My collaborative research with Prof. Das on readout and real-time decoding, currently under submission, influenced the proposal's direction.

- **Securing Multi-Tenant Fault-Tolerant QPUs: Policies, New Attacks, and Defenses**
  Google Research Award ($100,000) in 2026
  - Lead PI: Prof. Poulami Das (UT Austin)
  - My collaborative research with Prof. Das in security (e.g. MoPAC in ISCA 2025) and my own expertise in quantum memory systems (e.g., HINT in MICRO 2026 and Trident in ASPLOS 2027) influenced the proposal's direction.