

# Jiakai Wang

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## Education

### University of Wisconsin-Madison, M.S.

M.S. IN PHYSICS-QUANTUM COMPUTING, 50% GRADUATE RESEARCH ASSISTANCESHIP W/ PROF. MAXIM VAVILOV.

Madison, WI

September 2024 - May 2025

- **Courses:** High Performance Computing, Quantum Comp Lab, Solid-State Phys, Electrodynamics.

### University of Wisconsin-Madison, B.A.

B.A. IN DATA SCIENCE, GPA: 3.67/4, RESEARCH INTERN JANUARY 2024 - AUGUST 2024 W/ PROF. MAXIM VAVILOV.

Madison, WI

September 2021 - December 2023

- **Courses:** Quantum Mech, Atomic Structure, Grad. Stochastic Processes, Artificial Intelligence, Combinatorics, Optimization, Time Series.
- **Extracurricular:** Wisconsin Quantum Computing Club, Peer TA for CS 540 Intro to AI.
- Undergraduate study in Software Engineering @ South China University of Technology 2019-2021 (transferred to UW)
- **Courses:** Computer Architecture, Operating Systems, Computer Network, Algorithms, Data Structures.

## Publications & Presentations

### Perlin MA, Premakumar VN, Wang J, Saffman M, Joynt R. Fault-tolerant measurement-free quantum error correction with Multiqubit Gates. *Physical Review A*. 2023;108(6). doi:10.1103/physreva.108.062426

PRESENTED AT APS MARCH MEETING 2024, MINNEAPOLIS, MN

March 2024

### Wang J, Mencia RA, Manucharyan VE, Vavilov MG. Erasure conversion in integer fluxonium qubits (In preparation)

PRESENTED AT APS MARCH MEETING 2024, MINNEAPOLIS, MN, "LEAKAGE DETECTION IN INTEGER FLUXONIUM QUBITS"

March 2024

PRESENTED AT IMSI QUANTUM HARDWARE WORKSHOP POSTER SESSION, CHICAGO, IL, "DETECTING LEAKAGE IN INTEGER FLUXONIUM QUBITS"

November 2024

## Research

### GPU-based Pauli Frame QEC simulation

ADVISOR: PROF. TSUNG-WEI HUANG

UW-Madison ECE

October 2024- present

- Maximizing compute efficiency by using multiple CUDA cores in the same streaming multiprocessor to parallelize instructions, keeping most of the active data in shared memory (L1 cache). Fast simulation generates enough data for training ML models.
- Delivers **C++ executable** linked with static library compiled from a subset of Stim source code (C++20) and custom GPU code (C++17).

### QEC with dual-species superconducting qubits

ADVISORS: PROF. CHEN WANG, PROF. MAXIM VAVILOV

UMass-Amherst Physics

November 2024- present

- Numerically evaluating the fault-tolerance and error propagation of a novel implementation of surface code.

### Erasure Conversion Methods and Erasure-Biased Gates in Fluxonium

MENTORS: PROF. MAXIM VAVILOV, DR. RAYMOND MENCIA, PROF. VLADIMIR MANUCHARYAN

UW-Madison Physics

June 2023- present

- Analytically derived the coherence and incoherent dephasing rates in qubit subspace during resonator readout. Designed leakage detection protocols that preserve qubit coherence via harmonic and anharmonic resonator. Performed Monte Carlo simulations to characterize SNR.
- Estimated fluxonium lifetimes. Proposed gates that preserve the erasure-dominant error structure. **Established integer fluxonium as an erasure qubit for hardware-efficient FTQC.**
- Developed **FlexibleQECsim** to streamline gate-level noise simulation with vectorized computation of posterior probabilities for decoding erasure conversion using distributed computing. Enables deterministic injection of errors for importance sampling and simulating correlated error. Importance sampling with heuristic ansatzes or landscape reconstruction techniques can significantly enhance the efficiency of logical error rate estimation compared to traditional Monte Carlo simulations.
- Developed **CoupledQuantumSystems** to parallelize and streamline Hamiltonian simulation workflows.

### Hardware-Tailored Measurement-free Quantum Error Correction

MENTORS: PROF. ROBERT JOYNT, DR. MICHAEL PERLIN, PROF. MARK SAFFMAN

UW-Madison Physics

September 2022- March 2023

- We explored combinatorial design-inspired circuits to enable fault-tolerance of measurement-free QEC under noise model derived from Hamiltonian simulation. Evaluated the applicability of fault-tolerance techniques like flag scheme, logical ancilla, concatenation using transversal gates, and approximately bias-preserving gadgets.

### Measurement Error Detection/Correction in NISQ

ADVISOR: PROF. SWAMIT TANNU

UW-Madison CS

April 2022- August 2022

- Designed a NISQ compiler subroutine to use repetition codes to mitigate measurement error.

## Other Research

- DNN for brain disease prediction, PyTorch | Mentor Prof. Kai Wu, SCUT

March 2021- May 2021

## Work Experience

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### PricewaterhouseCoopers (PwC)

RISK ASSURANCE INTERN

- Data wrangling and analysis (Python, SQL) for data auditing.

Guangzhou, China

June 2021- August 2021

## Honors & Awards

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### SOUTH CHINA UNIVERSITY OF TECHNOLOGY

2020 **2nd-Class University Level Scholarship (5/60)**, 2019-2020 Academic Year

Guangzhou, China

2020 **Completion Award**, 37 Interactive Programming Contest, (used Dart, Flutter, PHP, MySQL)

Guangzhou, China

## Skills

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Blender, Final Cut Pro, logic pro, C++ (CUDA, OpenMP), Python, Mathematica  
L<sup>A</sup>T<sub>E</sub>X, Bash, Julia, JavaScript, HTML/CSS, English, Chinese, Cantonese