

Kyle Sherbert

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OBJECTIVE

A theoretical position studying the fundamental role of information in physics.

STATEMENT

Expert in multi-disciplinary sciences (▼ quantum physics, ♥ biochemistry, ♦ information theory); algorithm development with ♣ classical and ■ quantum computers; communicating arcane concepts through teaching and writing; and in walking to unwalkable places.

EDUCATION

Ph.D - Physics

University of North Texas, Denton, TX

exp. May 2022

MS - Physics

University of North Texas, Denton, TX

Dec 2020

MS - Computer Science

Towson University, Towson, MD

May 2017

BS *cum laude* - Physics; Molecular Biology, Biochemistry and Bioinformatics

Towson University, Towson, MD

Aug 2015

PRESENTATIONS

- ♦ ■ - Quantum compressive sensing. Talk, VTQ Internal Seminar. 2022
- ▼ ■ - Band theory on a quantum computer. Talk, SCA_N Breakout Intern Seminar. 2021
- ▼ ♥ ♦ ■ - Band theory and beyond. Talk, NASA/NRO Intern Symposium. 2021
- ▼ ■ - Band structure in a quantum computer. Talk, SCA_N Intern Symposium. 2021
- ▼ ♥ ♦ ■ - Implementing Trans. Quantum Subspace Expansion with fewer qubits. Invited Talk, ES22. 2022
- ▼ ♥ ■ - Applying present-day quantum computers to materials science. Poster, UNT MRS Poster Competition. 2022
- ▼ ■ - A tutorial in variational quantum computing. Talk, Sandia National Labs. 2022
- ♥ - Seeking complexity in a nonlinear equilibrium chemical potential. Talk, Lawrence Berkeley National Labs. 2022
- ▼ ♦ ♣ - Information reconciliation for erasure channels. Talk, Dartmouth College. 2022
- ▼ ♦ ♣ - Information entropy of 1D quantum systems. Talk, Virginia Tech. 2022
- ♥ ♣ - Exploring natural product formation with structural biology. Dissertation defense. 2022
- ▼ ♣ - Computational simulation of electron diffraction. Talk, APS March Meeting. 2022
- ♦ ■ - Quantum compressive sensing: mathematical machinery... Dissertation proposal. 2021
- ▼ ♥ ♦ ■ - Band theory and beyond: ... quantum algorithms for quantum chemistry. Talk, APS March Meeting. 2021
- ▼ ■ - Quantum algorithm for ... band structures with local tight-binding orbitals. End-of-term presentation. 2019
- ▼ ■ - A systematic ... band theory in a quantum computer. Student lecture. 2019
- ♥ ■ - Band structure in a quantum computer. End-of-term presentation. 2019
- ▼ ♥ ■ - Applying present-day quantum computers to materials science. Thesis defense. 2017
- ▼ ■ - A tutorial in variational quantum computing. Poster, TU Research Expo. 2015
- ♥ ■ - Seeking complexity in a nonlinear equilibrium chemical potential. Poster, TU Honors College Expo. 2015
- ▼ ♦ ♣ - Information reconciliation for erasure channels. Talk, MB3 Club Seminar. 2015
- ▼ ♦ ♣ - Information entropy of 1D quantum systems. Poster, CTRC Summer Research Colloquium. 2014
- ♥ ♣ - Exploring natural product formation with structural biology. Talk, HWI Weekly Seminar. 2014
- ▼ ♣ - Computational simulation of electron diffraction. Poster, TU Research Expo. 2014
- ▼ ■ - Band theory on a quantum computer. Poster, APS March Meeting. 2014

PUBLICATIONS

- ♦ ■ - Quantum compressive sensing: mathematical machinery... *Appl. Sci.* (12): 15). 2022
- ▼ ♥ ♦ ■ - Band theory and beyond: ... quantum algorithms for quantum chemistry. Poster and dissertation.* 2022
- ▼ ■ - Quantum algorithm for ... band structures with local tight-binding orbitals. *Scientific Reports* (12). 2022
- ▼ ■ - A systematic ... band theory in a quantum computer. *RSC Adv.* (11). 2021

▼	■	- Quantum computation of silicon ... band structure.	<i>Phys. Chem. Chem. Phys.</i> (22). 2020
♥		- Seeking complexity in a nonlinear equilibrium chemical potential.	Report.* 2019
		- Music theory: methods for mathematical music.	Report.* 2018
♣		- Hello, World!—Code Responsibly.	<i>IEEE Security & Privacy</i> (16: 1). 2018
♦♣		- Information reconciliation for erasure channels.	Master's thesis.* 2017
▼♦♣		- Information entropy of 1D quantum systems.	Poster and report.* 2015
		- Surviving abroad without a smartphone.	Poster.* 2015
▼		- An analysis of the PLAST model for quasars.	Term paper.* 2014
♦		- The Circus Game.	Pedagogical short story.* 2014
▼		- Scarlet's Letters.	Pedagogical short story.* 2014
♥		- Exploring natural product formation with structural biology.	Poster and report.* 2014
▼♣		- Computational simulation of electron diffraction.	Poster.* 2014

* Available on my personal website, kmsherbert.neocities.org

RESEARCH EXPERIENCE

Post-doctoral Researcher

Fall 2022-Present

Department of Physics, University of North Texas, Denton, TX

Faculty Mentors: Nick Mayhall, Sophia Economou, Ed Barnes

- ▼♥♣■ - Implemented optimized Julia code to simulate ctrl-VQE experiments.

Doctoral Dissertation

Fall 2019-Spring 2022

Department of Physics, University of North Texas, Denton, TX

Faculty Mentor: Marco Buongiorno Nardelli

- ▼♥♦■ - Adapted quantum algorithms for quantum chemistry to solve problems in materials science (band structures) and information theory (compressive sensing).
- ▼■ - Developed novel strategy to locate excited states in variational quantum algorithms.
- ♦■ - Developed quantum circuits and protocols for compressive sensing in a quantum computer.
- ▼■ - Developed three distinct quantum algorithms for band structure calculations using qiskit, cirq.
- ▼■ - Validated quantum algorithm using IBMQ Experience quantum computers.
- ▼■ - Derived statistical error for quantum variational excitation algorithm.
- **Presented work** at *UNT MRS Poster Competition* and numerous academic seminars.

Virtual Intern

Summer 2021-Spring 2022

NASA Goddard Space Flight Center, Greenbelt, MD

Mentor: Harry Shaw

- ♥♣ - Simulated molecular candidates for quantum oscillator in GAMESS.
- ♦■ - Designed quantum compressive sensing protocol for LIDAR imaging with Born machines.
- ♦♣■ - Implemented classical approximation to quantum compressive sensing protocol using tensor networks in Python.
- ♦■ - Developed quantum circuits and protocols for compressive sensing in a quantum computer.
- **Presented work** in *VTQ Internal Seminar* and multiple NASA seminars.
- **Published article** in *Appl. Sci.* (12).

Research Assistant

Fall 2019-Spring 2022

Department of Physics, University of North Texas, Denton, TX

Faculty Mentor: Marco Buongiorno-Nardelli

- ▼■ - Developed novel strategy to locate excited states with variational quantum algorithms.
- ▼■ - Developed systematic quantum algorithm for band structure calculations using qiskit, cirq.
- ▼■ - Validated quantum algorithm using IBMQ Experience quantum computers.
- ▼■ - Calculated band structure of silicon with variational quantum eigensolver.
- ▼■ - Derived statistical error for quantum variational excitation algorithm.
- **Presented work** at *APS March Meeting 2021, 2022* and *ES22 Invited Talk*.
- **Published articles** in *Scientific Reports* (12), *RSC Adv.* (11) and *Phys. Chem. Chem. Phys.* (22).

Research Assistant

Spring 2019

Department of Physics, University of North Texas, Denton, TX

Faculty Mentor: Paolo Grigolini

- ♥♣ - Modeled and simulated non-linear Langevin dynamics of model enzyme reaction using Python.

- ♥ - Studied temporal complexity by approximating reaction wait-time distribution using stochastic calculus.
- **Presented work** in student lecture for PHYS 6500.

Research Assistant

Fall 2018

Department of Physics, University of North Texas, Denton, TX

Faculty Mentor: Marco Buongiorno-Nardelli

- ▼ ♣ - Investigated metamolecular dynamics of small Lennard-Jones clusters using Python.
- ▼ ■ - Surveyed existing libraries for developing quantum algorithms.
- ▼ ♣ - Verified validity of Fourier differentiation in PAOFLOW electronic structure software.

Master's Thesis

Fall 2016-Spring 2017

Department of Computer and Information Sciences, Towson University, Towson, MD

Faculty Mentor: Marius Zimand

- ♦ - Reviewed literature on Slepian-Wolf coding, information erasure reconciliation.
- ♦ ♣ - Simulated information erasure reconciliation using various protocols using Python.
- ♦ ♣ - Proposed novel probabilistic protocol for reconciling erasures.
- ♦ ♣ - Measured protocol's empirical error-rate and optimal communication efficiency.
- ♦ - Approximated theoretical error-rate and optimal communication efficiency.

Graduate Assistant

Fall 2015-Spring 2017

Department of Computer and Information Sciences, Towson University, Towson, MD

Faculty Mentors: Siddharth Kaza, Blair Taylor

- ♣ - Created Data Hiding module for Security Injections repository.
- ♣ - Designed and supervised development of Security Injections 3.0.
- ♣ - Maintained web resources for Towson University's Cyber4All initiative.
- Wrote NSF Grant Report assessing progress and project outlook.
- **Published article** in *IEEE Security and Privacy* article.

Research Assistant

Spring 2015

Dept. of Physics, Astronomy, and Geosciences, Towson University, Towson, MD

Faculty Mentor: Jia-An Yan

- ▼ ♦ ♣ - Studied information entropy of scattering quantum systems using Matlab.
- ▼ ♦ - Analytically solved information entropy of free particle as a function of time.
- ▼ ♦ ♣ - Replicated *Phys. Rev. Lett.* work studying fractional revivals in bound quantum systems.
- **Presented work** at 2015 Towson University Research Expo.

Research Intern

Summer 2014

Univeristy at Buffalo, Hauptman-Woodward Medical Research Institute, Buffalo, NY

Principal Investigator: Andrew Gulick

Laboratory Mentor: Geoffrey Lippa

- ♥ - Performed site-directed mutagenesis to introduce point mutations in *E. coli* plasmid.
- ♥ - Mutated, expressed, and purified a bacterial enzyme for crystallization.
- ♥ - Conjectured reaction pathway based on product/byproduct elution patterns.
- ♥ ♣ - Proposed deletion experiment based on predicted structure to test conjecture.
- **Presented work** at *HWI Weekly Seminar*, *CTRC Summer Research Colloquium*, and *MB3 Club Seminar*.

Capstone Project

Winter 2014

Dept. of Physics, Astronomy, and Geosciences, Towson University, Towson, MD

Faculty Mentor: Jia-An Yan

- ▼ ♣ - Numerically solved Schrödinger's wave equation for a diffracting electron using Matlab.
- ▼ ♣ - Calculated reflection and transmission coefficients from energy transformation.
- ▼ ♣ - Compared optical Talbot effect with electron-beam analogue.
- **Presented work** at *APS March Meeting 2014* and *TU Research Expo*.

TEACHING EXPERIENCE

Instructor

Summers 2022-2023

Center for Talented Youth, Johns Hopkins University

- ♣ - Developed curriculum for intensive summer course on *Data Structures and Algorithms*.
- ♣ - Delivered lectures, activities, and assignments for intensive and engaging three-week summer course.
- Mentored a teaching assistant in developing communication and organization skills.

- Tracked student progress in content, critical thinking, and engagement, for end-of-session evaluations.

Online Instructor

Summer 2020-Spring 2022

Center for Talented Youth, Johns Hopkins University

- ♣ - Guided students through asynchronous *Programming in Python for Middle-school Students* online course.
- ♣ - Tutored students all around the globe one-on-one in programming concepts and Python syntax.
- ♣ - Executed, debugged, graded, and provided feedback on programming assignments.
- Tracked student progress in content, critical thinking, and engagement, for end-of-course evaluations.

Teaching Assistant

Fall 2018-Spring 2020

Department of Physics, University of North Texas, Denton, TX

- ▼ - Assisted lecturer in *Musical Acoustics* course with 100+ students.
- Laboriously graded daily quizzes and quarterly exams.
- Learned every student's name so they knew they were loved.
- Adapted course format to online learning when global pandemic struck mid-semester.
- ▼ - Facilitated labs for *General Physics I*.
- ▼ ♣ - Supervised students in *Computational Physics* and provided guidance as needed.

Teaching Assistant

Summers 2015-2019

Center for Talented Youth, Johns Hopkins University

- ▼ ♥ ♦ ♣ - Assisted instructor in intensive summer courses for middle- and high-schoolers over many subjects: *Astrophysics, Fundamentals of Computer Science, Cryptography, Data Structures and Algorithms, Genomics, Investigations in Engineering*.
- ▼ ♥ ♦ ♣ - Organized "lunchtime lessons" for introducing students to non-curricular scientific topics of interest.
- Tracked student progress in content, critical thinking, and engagement, for end-of-session evaluations.

Substitute Teacher

Spring 2018

Archdiocese of Washington

Schools: St. Mary of the Assumption Catholic School, Cardinal Hickey Academy

- ▼ ♥ ♣ - Taught Pre-K to 8th grade, all grades and all subjects, over four months.
- Awakened Kindergarten students to world geography following the story of Jonah.
- ▼ ♥ - Designed curriculum for three-day stint as SMA middle-school math and science teacher.
- Substituted long-term for Spanish, all grades, at CHA.

Graduate Assistant

Fall 2018-Spring 2020

Department of Computer and Information Sciences, Towson University, Towson, MD

- ♣ - Assisted lecturer in *General Computer Science* and *Introduction to Computer Science I* courses.
- ♣ - Supervised students in lab and provided guidance as needed.
- ♣ - Executed, debugged, graded, and provided feedback on programming assignments.
- ♣ - Tutored online high-school students enrolled in SPLASH program.

Grader

Spring 2014

Dept. of Physics, Astronomy, and Geosciences, Towson University, Towson, MD

- ▼ - Graded homeworks for *Introductory Mathematical Physics*.
- ▼ - Traced students' mistakes and provided consistent feedback.

ADDITIONAL EXPERIENCE

Church Choir - Accompanist

2011-Present

- Accompanied choir on clarinet, piano for weekly Catholic Mass.

Denton Community Band, Blacksburg Community Band - Clarinetist

2018-Present

- Played clarinet in an ensemble for seasonal concerts and Santa Serenades.

Christian Graduate Fellowship - President

2018-2022

University of North Texas, Denton, TX

- Organized weekly bible study and community night.

Senior Software Developer

Fall 2017

Department of Computer and Information Sciences, Towson University, Towson, MD
Supervisor: Siddharth Kaza

- ♣ - Designed database for CLARK cybersecurity curriculum management system using MongoDB, Angular.
- ♣ - Developed CLARK microservice to suggest and search for learning outcomes.

Society of Physics Students

2012-2016

Dept. of Physics, Astronomy, and Geosciences, Towson University, Towson, MD

- ▼ - Taught physics to young (age 6-10) students in Hampden Family Center.
- ▼ - Demoed "Shoot the Monkey" station at 2016 *Physics of Superheroes!* event.
- ▼ - Magician's assistant in 2013 *Physics is Magic!* Saturday Science show.

College Scholarship Committee - Student Representative

2015

Jess and Mildred Fisher College of Science and Mathematics, Towson University, Towson, MD

- Selected 2015 recipients of Jess Fisher FCSM and Pre-Engineering Scholarships.

Honors College Leadership Council

2012-2014

Honors College, Towson University, Towson, MD

- Organized college-prep event hosting AVID middle-schoolers at Honors College.
- Organized "Sweets, Stars, and Structure of the Universe" planetarium event.
- Redesigned Honors College Community page on Blackboard Learn.

AWARDS

U.S. Department of Energy Grant: DE-SC0019432 (Research Assistantship)	2019-2022
UNT College of Science Travel Award	2020
Maryland Space Grant Consortium Scholar	2014-2015
Edward L. Rubendall Outstanding Physics Student	2012-2014
Jess Fisher FCSM Scholar (Full Tuition)	2011-2015
Maryland Distinguished Scholar	2011-2015
Towson University Honors Scholar	2011-2015

COMPUTER SKILLS

Languages: Julia, Python (Anaconda), Java, JavaScript (Angular), Perl, Matlab, C/C++/C#

Quantum: Cirq (Google), Qiskit (IBMQ Experience), PyQuil (Rigetti Computing)

Chemistry: GAMESS, MacMolPlt

Other: Unix, LaTeX, Git, HTML5, CSS3