

# Shi Jie Samuel Tan

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## EDUCATION

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### University of Maryland, College Park

Ph.D. in Computer Science (Advisor: Daniel Gottesman)

College Park, MD

*Aug 2023 - Present*

### Haverford College

B.S. in Computer Science & Physics, *magna cum laude*

Haverford, PA

*Aug 2019 - May 2023*

**Graduate Courses:** Concentration Inequalities, Intro to Quantum Information Processing, Quantum Algorithms (Spring 2025), Quantum Control & Metrology, Quantum Error Correction and Fault Tolerance, Quantum Mechanics, Randomized Algorithms

**Relevant Undergraduate Courses:** Abstract Algebra, Analysis of Algorithms, Real Analysis, Probability, Scientific Computing, Statistical Physics, Theory of Computation

## RESEARCH EXPERIENCE

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### University of Maryland

*Quantum Computing Research Assistant*

College Park, MD

*Nov 2023 - Present*

- Under the supervision of Prof. Daniel Gottesman, I am exploring ways to implement practical fault-tolerant protocols with quantum LDPC codes in low-dimensional architectures. I also worked with Prof. Murphy Yuezhen Niu on quantum metrology strategies using quantum signal processing.

### Los Alamos National Laboratory

*Quantum Research Fellow*

Los Alamos, NM

*Jun 2023 - Present*

- Working under Dr. Yiğit Subaşı and Dr. Andrew Sornborger, I derived the optimal ancilla state for quantum phase estimation using classical signal processing techniques and analytically proved its average-case optimality. Under the supervision of Dr. Subaşı and Dr. Samuel Slezak, I am exploring how we can fix the quantum metropolis sampling algorithm for Gibbs state preparation and quantize the classical parallel tempering algorithm.

### California Institute of Technology

*Quantum Computing Research Fellow*

Pasadena, CA

*May 2022 - June 2024*

- Under the supervision of Prof. John Preskill and Chris Pattison, I studied the resilience of surface codes against error bursts caused by cosmic rays and global control noise. We attempted to prove the existence of an accuracy threshold for the Union-Find decoder algorithm.

### University of Maryland

*Quantum Computing Research Assistant*

College Park, MD

*May 2021 - May 2023*

- Under the supervision of Prof. Matthew Coudron, we developed a classical algorithm to approximate output probabilities for low-depth quantum circuits that have any constant number of dimensions. We attempted to design a quasi-polynomial time algorithm for  $AC^0$  postprocessing of 2D geometrically-local low-depth quantum circuits for decision problems.

### Haverford College

*Algorithms Research Assistant*

Haverford, PA

*May 2020 - May 2023*

- Working under Prof. Sara Mathieson and other collaborators, we validated *thread*, the algorithm to reconstruct ancestral haplotypes from endogamous Amish population and improved the algorithm's accuracy rate to 90%. We designed a KNN algorithm to reduce false positives from the identical-by-descent (IBD) segments identified by IBD detection software.

## PUBLICATIONS AND PRE-PRINTS

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- [1] N. Berthussen, **S.J.S. Tan**, E. Huang and D. Gottesman. Adaptive Syndrome Extraction. *arXiv preprint arXiv:2502.14835*, 2025
- [2] **S.J.S. Tan** and L. Stambler. Effective distance of higher dimensional hgps and weight-reduced quantum ldpc codes. *arXiv preprint arXiv:2409.02193*, 2024
- [3] **S.J.S. Tan**, C. A. Pattison, M. McEwen, and J. Preskill. Resilience of the surface code to error bursts. *arXiv preprint arXiv:2406.18897*, 2024
- [4] **S.J.S. Tan**, H.T. Dang, S. Keim, M. Bucan, and S. Mathieson. Identity-by-descent (ibd) segment outlier detection in endogamous populations using pedigree cohorts. *bioRxiv*, pages 2024–08, 2024
- [5] D. Patel, **S.J.S. Tan (co-first author)**, Y. Subaşı, and A. Sornborger. Optimal coherent quantum phase estimation via tapering. *arXiv preprint arXiv:2403.18927*, 2024
- [6] **(alphabetical)** Y. Deng and **S.J.S. Tan**. Random walks on the generalized symmetric group: Cutoff for the one-sided transposition shuffle. *arXiv preprint arXiv:2211.10462*, 2022
- [7] S. Dontha, **S.J.S. Tan (co-first author)**, S. Smith, S. Choi, and M. Coudron. Approximating Output Probabilities of Shallow Quantum Circuits Which Are Geometrically-Local in Any Fixed Dimension. In *Proceedings of the 17th Conference on the Theory of Quantum Computation, Communication and Cryptography (TQC 2022)*, 2022. <https://doi.org/10.4230/LIPIcs.TQC.2022.9>
- [8] K. Finke, M. Kourakos, G. Brown, H.T. Dang, **S.J.S. Tan**, Y. Simons, S. Ramdas, A. Schäffer, R. Kember, M. Bućan, and S. Mathieson. Ancestral haplotype reconstruction in endogamous populations using identity-by-descent. *PLOS Computational Biology*, 2021. <https://doi.org/10.1371/journal.pcbi.1008638>

## ORAL PRESENTATIONS

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- [1] “Effective Distance of Higher-Dimensional HGPs and Weight-Reduced Quantum LDPC Codes.” Gottesman Group Meeting, December 04, 2024.
- [2] “Effective Distance of Higher-Dimensional HGPs and Weight-Reduced Quantum LDPC Codes.” Invited talk at the University of Maryland Communication, Control and Signal Processing (CCSP) Seminar, October 17, 2024.
- [3] “Signal-Processing Phase Estimation against Time-dependent Errors.” Contributed talk at the 19th Conference on the Theory of Quantum Computation, Communication and Cryptography (TQC 2024), September 9-13, 2024. **(Presented by co-author)**
- [4] “Tapered Quantum Phase Estimation.” Contributed talk at the APS March Meeting 2024, March 4-8, 2024. **(Presented by co-author)**
- [5] “Proving the existence of an accuracy threshold for the Union-Find decoder.” Contributed talk at the Caltech SFP Summer Seminar Day, August 18, 2022.
- [6] “Approximating Output Probabilities of Shallow Quantum Circuits which are Geometrically-local in any Fixed Dimension.” Contributed talk at the 17th Conference on the Theory of Quantum Computation, Communication and Cryptography (TQC 2022), July 11-15, 2022. **(Presented by co-first author)**
- [7] “Simulation of Low-Depth Quantum Circuits.” Contributed talk at the University of Maryland Research Experience for Undergraduates Combinatorics and Algorithms for Real Problems (REU-CAAR) Research Presentation, August 13, 2021. **(Co-presented)**

## POSTER PRESENTATIONS

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- [1] “Effective Distance of Higher-Dimensional HGPs and Weight-Reduced Quantum LDPC Codes.” 28th Annual Conference on Quantum Information Processing (QIP 2025), February 24-28, 2025.
- [2] “Tapered Quantum Phase Estimation.” 19th Conference on the Theory of Quantum Computation, Communication and Cryptography (TQC 2024), September 9-13, 2024.
- [3] “Resilience of the surface code to error bursts.” 6th International Conference on Quantum Error Correction (QEC 2023), October 30-November 3, 2023.
- [4] “Comparison of cohort-based identical-by-descent (IBD) segment finding methods for endogamous populations.” In Proceedings of the 13th ACM International Conference on Bioinformatics, Computational Biology and Health Informatics (ACM-BCB 2022), August 7-10, 2022.  
<https://doi.org/10.1145/3535508.3545104>
- [5] “Approximating Output Probabilities of Shallow Quantum Circuits which are Geometrically-local in any Fixed Dimension.” 25th Annual Conference on Quantum Information Processing (QIP 2022), 2022.
- [6] “Improvements to ancestral haplotype reconstruction in pedigrees.” 7th-8th International Conference on Algorithms for Computational Biology (AlCoB 2020 & 2021), November 9-11, 2021.
- [7] “Improvements to ancestral haplotype reconstruction in pedigrees.” Research in Computational Molecular Biology - 25th Annual International Conference (RECOMB 2021), August 29-September 1, 2021.
- [8] “Validating Ancestral Haplotype Reconstruction In Endogamous Populations using Identical-by-Descent.” Haverford College Marian E. Koshland Integrated Natural Sciences Center (KINSC) Undergraduate Science Research Symposium, 2020.

## AWARDS AND FELLOWSHIPS

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2024	National University of Singapore Development Grant
2023	MathQuantum Graduate Fellowship (University of Maryland)
2023	QuICS Lanczos Graduate Fellowship (University of Maryland)
2023	Louis B. Green Prize in Physics and Astronomy (Haverford College)
2023	Phi Beta Kappa
2023	Los Alamos National Laboratory Quantum Computing Summer School Fellowship
2023	Singloh Hsu Scholarship (Haverford College)
2023	Computing Research Association (CRA) Outstanding Undergraduate Researcher Award Finalist
2022	Caltech Summer Undergraduate Research Fellowship
2022	Marian E. Koshland Integrated Natural Sciences Center Summer Scholarship (Haverford College)
2021	An Zhu-Google University of Maryland REU-CAAR Fellowship
2020	Brian Kovaric Fellowship (Haverford College)
2016	Prime Minister’s Book Prize (Ministry of Education, Singapore)

## WORK EXPERIENCE

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<b>Haverford College</b>	Haverford, PA
<i>Teaching Assistant</i>	<i>Aug 2020 - May 2023</i>
<ul style="list-style-type: none"><li>• Hold office hours and grade for analysis of algorithms, quantum mechanics and theory of computation</li><li>• Run Math Question Center &amp; tutor multivariable calculus, real analysis, linear &amp; abstract algebra</li></ul>	
<b>Innospark</b>	Singapore
<i>Junior Software Developer</i>	<i>Jul 2018 - Jan 2019</i>
<ul style="list-style-type: none"><li>• Built APIs for prototype submitted to Singapore’s Ministry of Health &amp; National University Hospital</li></ul>	
<b>BigBulb Studio</b>	Singapore
<i>Co-founder and Software Developer</i>	<i>Nov 2017 - Apr 2019</i>
<ul style="list-style-type: none"><li>• Offered tech consulting and developed company websites for small and medium enterprises</li></ul>	
<b>Singapore Armed Forces</b>	Singapore
<i>Assistant Platoon Commander (1st Lieutenant)</i>	<i>Jan 2016 – Nov 2017</i>
<ul style="list-style-type: none"><li>• Trained over 100 officer cadets into logistics officers and planned local and overseas military exercises</li></ul>	

## OUTREACH AND COMMUNITY SERVICE

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### **CodeForPhilly**

Philadelphia, PA

*Co-lead and Software Engineer (MATchmapper)*

*Feb 2020 – May 2023*

- Co-founded [MATchmapper](#) to offer data insights on the opioid crisis for Health Federation Philadelphia and the Department of Public Health
- Constructed Django web application and data pipeline to scrape public databases and built PostgreSQL database and interactive map on Heroku for more than 500 healthcare providers

### **Haverford College**

Haverford, PA

*Co-head of HaverCode*

*Nov 2019 - May 2023*

- Organize computer science-related academic, industry and social events for faculty and students