Rui Xian Siew

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EDUCATION

Ph.D. in Physics, Duke University Aug 2021–Present
Expected completion: Apr 2027.
Advisors: Shailesh Chandrasekharan (Duke) and Ribhu Kaul (Penn State).

B.Sc. in Physics, First Class Honours Aug 2017–Jul 2021
The Chinese University of Hong Kong (CUHK); Enrichment Stream in Theoretical Physics.
Thesis: *A Brief Review of the Penrose Conjecture*.
Advisors: Martin Man-chun Li and Ming Chung Chu.

RESEARCH INTERESTS

Lattice gauge theory; nonperturbative QFT; mathematical physics; quantum gravity; quantum spin systems; condensed matter theory.

PUBLICATIONS AND PREPRINTS

[1] **R. X. Siew**, S. Chandrasekharan, and T. Bhattacharya, *Continuum limit of a qubit-regularized SU(3) lattice gauge theory on a plaquette chain*. Phys. Rev. D **114**, L071504 (2026) (Letter). [arXiv:2603.01215]

[2] **R. X. Siew**, S. Chandrasekharan, and T. Bhattacharya, *Asymptotic freedom and massive glueballs in a qubit-regularized SU(2) gauge theory*. Phys. Rev. D **113**, 114522 (2026). [arXiv:2512.11068]

[3] S. Chandrasekharan, **R. X. Siew**, and T. Bhattacharya, *Monomer-dimer tensor-network basis for qubit-regularized lattice gauge theories*. Phys. Rev. D **111**, 114502 (2025). [arXiv:2502.14175]

[4] **R. X. Siew**, S. Chandrasekharan, and R. K. Kaul, *Transverse field γ-matrix spin chains*. Phys. Rev. D **110**, 094510 (2024). [arXiv:2406.04120]

[5] S. James Gates, Jr., G. Hannon, **R. X. Siew**, and K. Stiffler, *Infinite-dimensional algebraic $\mathfrak{Spin}(N)$ structure in extended/higher dimensional SUSY holoraumy for valise and on shell supermultiplet representations*. JHEP **05** (2022), 173. [arXiv:2010.06124]

SELECTED RESEARCH EXPERIENCE

Research Assistant appointment, Duke University Jun 2023–Present

Qubit Regularization of Lattice Gauge Theories Mar 2024–Present
With Shailesh Chandrasekharan and Tanmoy Bhattacharya.

- Developed a monomer-dimer tensor-network basis for non-Abelian lattice gauge theories with finite-dimensional local Hilbert spaces and exact gauge symmetry.
- Analyzed continuum limits and glueball spectra of SU(2) and SU(3) gauge theories on plaquette chains, using mappings to Ising and three-state clock models.
- Studied the resulting continuum field theories, including the E_8 theory and a massive deformation of the $\mathbb{Z}_3$ parafermion CFT, and computed dimensionless ratios involving string tensions and glueball masses.

Generalized Gamma-Matrix Model Jan 2023–Jul 2024
With Shailesh Chandrasekharan and Ribhu Kaul.

- Proposed a family of lattice models with $\mathrm{Spin}(4)$ symmetry and established a Lieb–Schultz–Mattis constraint for its one-dimensional realization.
- Identified a specific $\mathrm{Spin}(4)$ spin chain with exact, doubly degenerate valence-bond-solid ground states; studied low-energy properties using exact diagonalization and DMRG.

Supersymmetry and Superconformal Algebras Jul 2019–Jul 2021
Advisor: Sylvester James Gates Jr.; Brown University summer research intern, Jun–Aug 2019.

- Studied vector-field realizations and tensorial extensions of ten-dimensional supersymmetry.
- Derived a Grassmann–Bargmann representation and investigated SUSY holoraumy. [Research report]

TALKS AND PRESENTATIONS

Contributed conference talks

43rd International Symposium on Lattice Field Theory (Lattice 2026), College Park, MD, USA — Jul–Aug 2026
Qubit-Regularized Gauge Theories on Plaquette Chains.

Paths to Quantum Field Theory workshop, Simons Center for Geometry and Physics, Stony Brook, NY, USA — Jun 2026
Qubit-Regularized Gauge Theories on Plaquette Chains.

APS Global Physics Summit, Denver, CO, USA — Mar 2026
Qubit-regularized SU(2) and SU(3) Gauge Theories in Various Dimensions.

CUHK Physics Student Conference, The Chinese University of Hong Kong, Hong Kong — Sep 2019
Extending Superconformal Vector Fields on 6D super-Minkowski spacetime to 10D. [Slides]

Dirac Talks, Duke Physics, Departmental lecture series

Coherent States, Their Generalizations, and Classical Limits (3 talks) — Apr 2026
Symmetry as Lie Algebra Extensions (4 talks) — Sep 2025
Introduction to Chern–Simons: classical mechanics as Chern–Simons theory (1 talk) — Mar 2025
What Lies in the Intersecting Kernels: frustration-free spin chains (3 talks) — Feb 2025
The Algebra of GUTs (5 talks) — Apr 2023
Dirac's Conjecture (3 talks) [Notes] — Nov 2022

TEACHING EXPERIENCE

Teaching Assistant, Department of Physics, Duke University

Advanced Quantum Mechanics (PHYSICS 765) — Fall 2025
General Physics I (PHYSICS 141) — Spring 2023
Introductory Electricity, Magnetism and Optics (PHYSICS 152) — Fall 2022
Fundamentals of Physics II (PHYSICS 162) — Spring 2022
Optics and Modern Physics (PHYSICS 264L) — Fall 2021

Tutor, SPIRE Fellows Program, Duke University — 2024–2026 (intermittent)
Tutored undergraduate fellows in differential equations, linear algebra, calculus, and precalculus.

Independent Undergraduate Physics Tutor — 2024–2025
Tutored multiple Duke undergraduates individually and in small groups, including quantum mechanics.

SERVICE AND MENTORING

Sixth-Year Class Representative — Spring 2026–Present
Physics Graduate Student Organization (GSO), Duke University.

Graduate Student Peer Mentor, Duke Physics — 2024–2026
Departmental mentoring program: three graduate students (Fall 2024, Fall 2025, Spring 2026).

SELECTED HONORS AND AWARDS

Conference Travel Award, Duke University — 2026
Henry W. Newson Fellowship, Department of Physics, Duke University — 2023
Prof. Charles K. Kao Research Exchange Scholarship, CUHK — 2019
C. N. Yang Scholarship, Department of Physics, CUHK — 2019
Prof. Dennis Y. K. Lo Physics Award, Department of Physics, CUHK — 2018
Belt and Road Scholarship, HKSAR Government — 2017
National Mathematics Competition (Third Place), Malaysia — 2016

TECHNICAL SKILLS

Methods: Exact diagonalization; density matrix renormalization group (DMRG); quantum Monte Carlo (worm, SSE).
Software: Julia (ITensors); Python (NumPy, Matplotlib); Mathematica; LaTeX.