

Weijun Li 利伟君

Employment

Quantum Computing Associate | Horizon Quantum Computing | Singapore *2020 - 2021*

- Realized the complicated Quantum Signal Processing algorithm in MATLAB for the first time.

Research Assistant | Centre for Quantum Technologies | Singapore *2017 - 2019*

Supervisor: Prof. Berge Englert, Prof. Ng Hui Khoon (National University of Singapore)

Project 1 | Sequentially Constrained Monte Carlo Sampler for Quantum States [2]

- Applied the sequentially constrained Monte Carlo (SCMC) sampler to generate quantum samples in high dimension, making 4-qubit sampling practical for the first time.
- Extended SCMC to produce samples with various desired properties, e.g. bound entanglement, producing a bound-entangled sample of dimensions 3×5 for the first time

Project 2 | Efficient and reliable independent sampling of quantum states [3]

- Helped to construct and implemented in MATLAB a two-step algorithm for sampling from the quantum state space, efficiently producing samples of uncorrelated quantum states.

Project 3 | Very strong evidence in favor of quantum mechanics and against local hidden variables from a Bayesian analysis [4]

- Developed the entire analysis efficiently in MATLAB, containing likelihood maximization, sample generation for relative belief ratios evaluation, and bias check via mock data simulations, to demonstrate very strong evidence supporting quantum mechanics.
- Parallelized the sampling algorithm, reducing runtime by several times.

Project 4 | Open quantum system process tomography

- Developed a system-bath tomography simulation in Python to aid analytical study.
- Discovered and analytically proved that a new quantity associated with the quantum channel determines the possibility for complete channel tomography with only input system states and complete Positive Operator Valued Measurements.

Education

DPhil Candidate in Particle Physics - University of Oxford, UK *2021 - Current*

- First-year result: 90%, ranked 2nd (joint) among the cohort of 11.

MASt in Physics - University of Cambridge, UK *2019 - 2020*

- Graduated with First class marks (70.7%).

BSc (Hons) in Physics - National University of Singapore (NUS), Singapore *2013 - 2017*

- Graduated with Highest Distinction (GPA 4.84/5).
- Exchange Semester - Ludwig-Maximilians-Universität München, Germany *2016*

Grants & Awards

The Great Britain Sasakawa Foundation (GBSF) Grant, GBSF, £5000 *2022 - 2023*

The Denys Wilkinson Prize, University of Oxford *2022*

Bateman Scholar, Trinity Hall, University of Cambridge, £425 *2020*

Science & Technology Undergraduate Scholarship, NUS, £120000 *2013 - 2017*

5 Dean's Lists (top 5% of the cohort), NUS *2013 - 2017*

The CRISP Award (best semester-long research project), NUS *2015*

Collaborations

GENIE, neutrino event generator *since Jul 2023*

T2K, neutrino oscillations and interactions *since Oct 2021*

Research Experiences

DPHil Thesis | Next-Generation Measurements of Transverse Kinematic Imbalance (TKI) with the T2K Upgraded Near Detector

Supervisor: Prof. Xianguo Lu (University of Warwick) and Prof. Dave Wark (University of Oxford)

Topic 1 | Constraining models of neutrino interactions with data from existing TKI measurements:

- Invented a new variable to probe FSI free from nuclear modelling effects.

Topic 2 | Invented novel algorithms to reconstruct particles detected in the T2K Upgraded Near Detector, enabling new neutrino interaction measurements:

- 50% improvement on resolution of proton momentum and TKI variables.
- Lowered pion reconstruction threshold to 50 MeV/c in SFGD beyond its tracking limit.
- Potential 30% improvement on the hydrogen δp_{TT} resolution.

Topic 3 | Measuring TKI with the T2K Upgraded Detector with new data:

- Major contribution to the assembly of SFGD.
- Trained as a Data Acquisition expert and carried out hardware fixes.

Master Project | A comparative study of Monte Carlo Generators and Fixed Order Calculations for extraction of the top quark mass at the Large Hadron Colliders

Supervisor: Dr. Alexander Mitov (University of Cambridge)

- Analyzed uncertainties in the top quark mass measurement and demonstrated that hadronization and multi-parton interaction constitutes the largest uncertainty.
- Parallelized the parton shower process, reducing the run time by about 7 times.

BSc Final Year Project | A General Free Plane Wave Ansatz to The Classical $SU(2)$ Yang-Mills Theory: with Application to Gravity [1]

Supervisor: Prof. Chan Aik Hui & Prof. Oh Choo Hiap (National University of Singapore)

- Imposed the free plane wave conditions on the gauge field to derive a new general Ansatz with clear physical meaning.

Conference & Seminar

Parallel Talk - The XX International Workshop on Neutrino Telescopes, "Assembly, test and analysis development of the T2K upgrade", 26 Oct. 2023 (Proceedings in preparation)

Parallel Talk - The 29th International Workshop on Weak Interactions and Neutrinos, "T2K latest neutrino oscillation results", 5 Jul. 2023

Seminar - SPeCial4Young: SYSU-PKU Collider Physics forum For Young Scientists, "Recent Oscillation Results and Upgrade of the T2K Experiment", 08 Mar. 2023

Poster [4] - XLVIII International Symposium on Multiparticle Dynamics, Sept. 2018

Publications

[1] Li, W., Chan, A. H., & Oh, C. H., A general free plane wave ansatz to the classical $SU(2)$ Yang-Mills theory: with application to gravity. EPJ Web of Conferences, 206:09011 (2019).

[2] Li, W., Han, R., Shang, J., Ng H. K., & Englert B.-G., Sequentially constrained Monte Carlo sampler for quantum states. arXiv:2109.14215 (2021).

[3] Han, R., Li, W., Bagchi, S., Ng H. K., & Englert B.-G., Uncorrelated problem-specific samples of quantum states from zero-mean Wishart distributions. arXiv:2106.08533 (2021).

[4] Gu, Y., Li, W., Evans, M., & Englert B.-G., Very strong evidence in favor of quantum mechanics and against local hidden variables from a Bayesian analysis. Phys. Rev. A 99, 022112 (2019).

Skills

Languages: Cantonese Chinese & Mandarin Chinese (native), English (proficient), German (intermediate), Japanese (beginner)

Programming: Proficient in: C++, Python, MATLAB, LaTeX, Linux