

Leif Lui 吕尚沅

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EDUCATION

- The Chinese University of Hong Kong (Department of Physics)** August 2018-December 2022
Bachelor of Science in Physics
- The University of Hong Kong (Department of Physics)** Expected August 2025
Master of Philosophy in Physics
- Peking University (Kavli Institute for Astronomy and Astrophysics)** Expected September 2025
Doctor of Philosophy in Physics

HONOR, AWARDS AND SCHOLARSHIPS

- Postgraduate Scholarship** September 2023
The University of Hong Kong
- Awarded to selected students who have attained good academic qualifications to study full-time for the degree of MPhil or PhD.
 - This scholarship is awarded on the recommendation of the appropriate Faculty Higher Degrees Committee (FHDC)
 - The value of this scholarship is HK\$18,760 per month, is tenable on an annual basis, and is renewable.
- Innovation and Technology Scholarship** April 2022
Hong Kong Federation of Youth Groups, Innovation and Technology Commission, and HSBC
- Awarded for my contribution to research on particle physics, gravitational waves, and black holes.
 - This scholarship is awarded to 25 outstanding undergraduate students for their passion, commitment, and contribution to science and technology.
 - Awardees are first nominated by the student's faculty, the university scholarship committee, and the university president. Then, they are selected by the Awardee Selection Committee which consists of reputable members from different sectors of Hong Kong.
 - Awardees receive HK\$150,000 each to participate in a series of initiatives, including Overseas/ Mainland Attachment Programme, Mentorship Programme, Local Internship Programme, and Service Project Programme.
 - The Scholarship is jointly sponsored and supported by the Innovation and Technology Commission and HSBC, while The Hong Kong Federation of Youth Groups is the organizer. This scholarship is also supported by a group of reputable academics, personalities, and several sciences and technology-related companies.
- Outstanding Students Award for Innovation and Invention** September 2022
The Chinese University of Hong Kong
- The Chinese University of Hong Kong awards five outstanding students for their achievements and contributions to Innovation and Invention, Sports, Arts, Social Service, and Special Achievement.
 - Nominated by faculties, successful students are invited to join an award ceremony in recognition of students' significant contributions and their continual positive impact on society.
 - Awarded for my contribution to research on particle physics, gravitational waves, and black holes.

RESEARCH EXPERIENCE

- Graduate Researcher** June 2021 - Present
University of Hong Kong Pokfulam Road, Hong Kong
- Conduct research on various topics in gravitational-wave and black-hole physics with Prof. Jane Lixin Dai, Dr. Alejandro Torres-Orjuela, Dr. Rudrani Kar Chowdhury, and Dr. Jin-Hong Chen.
 - The objective of our projects is to develop theoretical/mathematical models for the gravitational-wave signatures of astrophysical sources like quasi-periodic eruptions and tidal disruption events.
 - The computation of the gravitational-wave signatures requires the use of complex analytical approximations (i.e. black-hole perturbation theory, post-Newtonian expansion, and augmented analytic kludge), numerical simulations (i.e. geodesic ray tracing and general-relativistic-magnetohydrodynamic simulations, and even some machine learning algorithms (i.e. reduced-order models and reinforcement learning)).
 - Apart from the theoretical/mathematical modeling, we use some Markov-Chain-Monte-Carlo simulations combined with Bayesian data analysis techniques to estimate the detectability of these gravitational waves via the mismatch and the signal-to-noise ratio.
 - The ambitious goal is to extract more intricate physics for quasi-periodic eruptions and tidal disruption events, such as the orbital dynamics of extreme-mass-ratio-inspirals and the stellar equation of states.
 - The eventual goal is to provide a theoretical framework for observers to reference when analyzing data from future space-based gravitational-wave detectors (i.e. LISA and TianQin).

- The paper on gravitational wave signatures of quasi-periodic eruptions is near completion and will be submitted to the arXiv preprint server soon.
- The project on gravitational signatures of tidal disruption events and extracting the stellar equation of states is in the planning stage, and the grant proposal is subject to approval.

Undergraduate Researcher

January 2022 - Present

California Institute of Technology

Pasadena, California 91125, United States

- Conduct research on various topics in gravitational-wave physics with Prof. Alan Jay Weinstein and Mr. Rico Ka-Lok Lo as part of the LIGO consortia.
- The rationale of this project is to understand the physical degrees of freedom in a parameterized test of general relativity and determine a quantitative method of measuring beyond general relativity corrections.
- The objective of this research project is to understand how the dephasing coefficients of the IMRPheomPv2 waveform affect physical parameters, such as power radiated and rate of angular momentum.
- In the conventional Test Infrastructure for GEneral Relativity (TIGER) formalism, we only consider amplitude corrections when analyzing a gravitational wave signal.
- Therefore, the ultimate objective of this project is to generalize the TIGER formalism to include both the amplitude and the phase corrections, as we conjecture that this will yield additional physics.
- Apart from data analysis, we are responsible for editing and reviewing the paper in preparation for publication.
- The paper is in the editing stage.¹
- Presented my work to the other members of the LIGO SURF.²

Undergraduate Researcher

September 2021 - December 2022

CERN

Geneva, Switzerland

- Conduct research on various topics in theoretical particle physics under the supervision of Prof. Luis Roberto Flores-Castillo as part of the ATLAS collaboration.
- The objective of this research project is to analyze data to test lepton universality in beauty-quark decays and calculate two different branching fractions using the data from ATLAS.
- The first branching fraction is for the decay of beauty quarks into a kaon, a muon, and an anti-muon. The second branching fraction is for the decay of a beauty quark into a kaon, an electron, and a positron.
- If the ratio between the two branching fractions is unity, then this implies that Lepton universality holds. However, if the ratio between the two branching fractions is not unity, this implies that lepton universality is broken.
- Thus, our research could indicate physics beyond the standard model.
- Apart from data analysis, we are responsible for editing and reviewing the paper in preparation for publication.
- The paper is in the editing stage.

Undergraduate Researcher

December 2020 - June 2021

The Chinese University of Hong Kong

Shatin, New Territories, Hong Kong

- Conducted research on various topics in gravitational-wave physics under the supervision of Prof. Tjonnie Li and Mr. Adrian Ka Wai Chung.
- Utilized Bayesian inference and likelihood re-weighting to extract gravitational-wave reflectivity from the echoes of exotic compact objects (ECOs).
- To corroborate our model, we analyzed real gravitational-wave signals detected by LIGO (i.e. GW150914, GW190521, GW190814, etc.).
- The significance of this research is to show that physical properties like reflectivity can be extracted from gravitational-wave signals using Bayesian statistics.

MEMBERSHIPS

LIGO

December 2020 - January 2023

California Institute of Technology

Pasadena, California 91125, United States

- Joined the LIGO scientific collaboration at CUHK and Caltech to do research on gravitational wave echoes and beyond general relativity gravitational-wave corrections.

ATLAS

August 2022 - December 2022

CERN

Geneva, Switzerland

- Joined the ATLAS collaboration at CUHK to do research on lepton universality.

PUBLICATIONS

Under Review

- L. Lui, R. K. L. Lo, A. J. Weinstein, T. G. F. Li, *Understanding the Physical Degrees of Freedom in a Parameterized Test of General Relativity*. LIGO Number [T2100267-v1](#)

In Preparation

- L. Lui, A. Torres-Orjuela, R. K. Chowdhury, and L. Dai, *Gravitational-Wave Signatures from Quasi-Periodic Eruptions*.

¹LIGO SURF manuscript can be found [here](#), and the source codes for the project can be found [here](#).

²LIGO SURF presentation can be found [here](#) and video recordings can be found [here](#).