Di Pan

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EDUCATION

Tsinghua University   Sept. 2020 - Jul. 2025 (expected)

Bachelor of Science in Physics

Minor in Astronomy

- **Graduate Courses:**
  Group Theory (A-)
  Quantum Field Theory (1) (A)
  Quantum Gravity and Quantum Information (A)
  Physical Cosmology (A-)
  Basic Topology (P)
  Quantum Field Theory (2) (A-)
  Topics in Gravity (P)
  String Theory (*2024 Fall*)
  Supersymmetry and Supergravity (*2024 Fall*)
  Quantum Information and Quantum Computation (*2024 Fall*)
- **Academics:** Overall GPA: 3.75/4.00
- **Language:** TOEFL: 102/120 (R30/L28/S23/W21)

RESEARCH EXPERIENCE

Zero Modes Contributions in BPS/Near-BPS Asymptotic AdS_5 Black Hole   Jul. 2024 - present

Advisor: Prof. Mukund Rangamani, University of California Davis

- Recent advances in the study of ground state degeneracy in extremal black holes were achieved using dimensional reduction on the AdS_2 sector in the near-horizon geometry, yielding effective JT-gravity which is easier for quantization. These approaches were also validated for BPS black holes in asymptotic AdS_5.
- Our research aims to reproduce these results by directly including zero mode contributions in the gravitational path integral. Challenges include handling parameters to do different scaling limits to reach extremal-BPS condition. We have determined the forms of the Schwarzian and rotational zero modes and are trying to calculate their contributions to the path integral. We also expect to incorporate fermionic zero modes in out calculation.

The Missing Rotational Zero Mode in Logarithmic Correction to Near-Extremal Kerr   Jul. 2023 - present

Advisor: Prof. Wei Song, Tsinghua University

- Recent calculations using rational IR-regulators for zero mode contributions to the one-loop determinant in NHEK geometry revealed a logarithmic correction to the extremal entropy at small finite temperature. However, a physically meaningful rotational zero mode was not identified, contrary to expectations based on non-extremal calculations as well as the full-geometry result.
- We want to use appropriate boundary conditions in NHEK geometry, inspired by AdS_3 boundary condition analysis, to find the missing rotational zero mode. We also want to show how the failure of harmonic gauge fixing for Kerr case that is revealed in recent paper affects path integral calculations.

Cosmic Strings and Their Observational Effects   Sept. 2023 - Jan. 2024

Advisor: Prof. Dandan Xu, Tsinghua University

- Cosmic strings, predicted as stable topological defects formed during phase transitions in the early universe, are potential targets for observational cosmology.
- Investigated detection methods such as gravitational lensing effects and cosmic microwave background anisotropies, aiming to identify potential traces of cosmic strings in modern astrophysical observations.

Exoplanet Detection in Microlensing Events Through Grid Search Feb. 2022 - Jul. 2022

Advisor: Prof. Shude Mao, Tsinghua University

- General relativity predicts that massive objects bend light, leading to gravitational lensing. For microlensing events, involving smaller-scale lenses like stars or planets, we can only detect the variations of luminosity for background light source.
- Apply grid search techniques to light curves data from KMT-Net, we try to identify exoplanet candidates and estimate their masses and orbital periods.

RESEARCH PUBLICATION

TEACHING EXPERIENCE

Physics Teaching Assistant Jul. 2023 - Aug. 2023

Department of Engineering Physics, Tsinghua University

- Prepared weekly coding problems and TA sessions, graded problems, helped professors to assign final grades

LEADERSHIP AND SERVICE

Secretary Jul. 2023 - Jul. 2024

Information Technology Department, Student Association for Science and Technology,
Department of Physics, Tsinghua University

- Organized computer technology lectures and maintained the association's information infrastructure, including server management.

President Jul. 2024 - present

Student Association for Science and Technology,
Department of Physics, Tsinghua University

- Coordinated the operations of various departments within the association, promoting collaboration and scientific activities.

Organizer Sept. 2024 - present

Student Conformal Field Theory Seminar,
Department of Physics, Tsinghua University

- Served as lead organizer and presenter for student seminars on conformal field theory.

SKILLS

Computer & Programming   C, C++, Python, Mathematica, and LaTeX.

Linux user with 3 years of experience, familiar with Python for data analysis and numerical computation. Proficient in Mathematica and experienced with tensor analysis tools like xAct and diffgeo.

DECLARATION

I hereby declare that all the details furnished above are true to the best of my knowledge and belief.