Horan **Tsui**

PHYSICS

Wangjiang Campus, Chengdu, Sichuan Province, China

(+86) 157-5648-7821 | L1919159@Gmail.com | Brook Tsui

"...either a clear physical model in mind, or a rigorous mathematical basis."

Summary

I'm an undergraduate student majoring in physics from China, enjoy both mathematics and physics for their beauty and power.

The ongoing investigation of the ineffable world is exciting, which appeals to me to participate in this thrilling march and to wish to contribute a word.

Education

Physics, Sichaun University

Chengdu, China

GPA: 3.61/4.0 *Sep. 2018 - now*

- Changed the major from mechanical engineering to physics in 2019
- Advanced courses with average score 90+/100:
  String Theory and CFT; Quantum Field Theory; General Relativity; Scattering Theory; Group Theory *etc.*
- Latex, Mathematica, Python.

Experience

Black Hole Thermodynamics

Sichuan University, China

UNDER PRO. HAITANG YANG, PENG WANG *Dec. 2020 - Jun.2021*

- Under the instruction of Prof. HaiTang Yang, I learned the curved spacetime QFT and classical black hole thermodynamics and made a Latex note for the latter.
- In the investigation, I was intrigued by the negative temperature physics and studied some related topics. Also, to describe the negative T behavior that potentially appears in energy-restricted S.H.O., I posited an integer partition formula with good accuracy. And found some papers discussing such negative T condition for black holes.
- Under the instruction of Prof. Peng Wang, I studied the chaos behavior of black holes, especially the reaction of null and time-like geodesics of a point-like particle under the phase transition, we found the chaos of these geodesics, which means their free energies undergo a discontinuous change, meanwhile the Lyapunov exponent varies.
- Then investigated the behavior of a classical string in RN-Ads spacetime, and found that this string will oscillate when it approaches the black hole, and its Lyapunov exponent changes completely discontinuously.
- Due to my health issue, I quit the group in Jun. 2021, and the paper about the chaos was published on JHEP on 2022.

Quantum Gravity Phenomenology and Pauli Exclusion Principle Violation (Research Assistant)

Sichuan University, China

UNDER PRO. XINGDE LIN *Apr. 2022 - Now*

- I did the background research about the Pauli Exclusion Principle Violation (PEPV) due to the non-commutative spacetime and have been responsible for the theoretical part.
- Learned some mathematics, including the Hopf algebra, and based on this, I have developed the formalism of the model proposed by Balachandran *et al* to many-body systems.
- Proved some theorems, including the corrected Pauli principle-like theorem, and corrected some mistakes made by others.
- Help to design the experiments.
- In June, I made a report about some parts of my work to professors from Turkey.
- The Paper is in writing now. We anticipate publishing it at the end of the year.

Scalar Particle Spectra from the Hawking Radiation of Primordial Black Holes

University of Notre Dame, USA

UNDER PRO. YUSHIN TSAI *July 2022 - Now*

- I did the background research on the topic and have discussed the possible way of calculating the Hawking radiation.
- During this period, I happen to find a research field called GUP, the generalized uncertainty principle and posited my generalization, which could yield some results more naturally. I collated it into a short paper and shared it with Prof. Tsai, but since it seems hard to explain some by-products, we finally did not try to elaborate on it.
- After studying the works done by Page, Unruh, and others, we have been now trying to reproduce the Hawking radiation spectra for heavy massive scalar particles.

Neutrino Oscillation and Interaction

Institute of Theoretical Physics, Chinese Academy of Sciences, China

UNDER PRO. JIANGHAO YU — *Aug. 2022 - Now*

- I have learned the electroweak theory, the neutrino mass model, including the Seesaw mechanism, and neutrino oscillation processes, including the MSW effect and collective oscillation, from the pendulum aspect and Boltzmann equation aspect.
- Studied the solar neutrino problem, the formation of neutron stars and the role neutrinos play in it.
- We then plan to study the unknown interactions of neutrinos.

Honors & Awards

ACADEMIC

2021	**Silver Prize**, National Students Mathematics Competitions	*Chengdu, China*
2021	**Premier Specialized Prize**, Scholarship	*Chengdu, China*
2022	**Premier Specialized Prize**, Scholarship	*Chengdu, China*
2022	**Outstanding Students**,	*Chengdu, China*

EXTRACURRICULAR

2020	**Gold Prize**, National Students Art Festival-Recitation	*Chengdu, China*
2020	**Silver Prize**, National Students Art Festival-Drama	*Chengdu, China*

Presentation

Black Hole Thermodynamics, Negative Temperature

The Physics Report Hall, Sichuan University

SPEAKER — *Oct. 2021*

- Introduced the evolution of the black hole thermodynamics and recent results.
- The negative temperature and its appearance in the exotic-BTZ black hole.

Non-commutative Spacetime and Pauli Exclusion Principle Violation.

Online

SPEAKER — *Jun, 2022*

- Introduced the non-commutative spacetime and one of the phenomena, PEPV.
- My work about the generalization and the discussion about the model.

Writing

A Note of String Theory and CFT

Chengdu, China

WRITER — *Sep.2020 - May. 2021*

- A Chinese note based on the course I took and has been widespread among my friends.

The Paper about the PEPV

FIRST CO-AUTHOR — *potentially at the end of year*

- The paper is in writing, and the theoretical part for which I am responsible has finished.

Extracurricular Activity

Drama Group (High-level Art Group of the University)

Chengdu, China

PRESIDENT — *Feb. 2020 - Jun.2022*

- Led the group to win a silver prize in drama and a gold prize in recitation in the highest-level national competition.
- Participated the public performance on the campus of original dramas twice.

Archery Association

Chengdu, china

MEMBER — *Sep. 2018 - Oct. 2019*