

Qingdao Chen
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EDUCATION

Bachelor's in Mathematics, University College London

09/2023 - Present

- GPA: 3.92
- Research Interests: Functional Analysis, and PDE.

RESEARCH

Duality of Banach Spaces

Advisor: Dr. Yan-Long Fang 01/2025 – Present

- Conducted an in-depth study of duality of Banach Spaces, focusing on sequence spaces such as ℓ^p and their duals.
- Demonstrated that $(\ell^p)^* \cong \ell^q$ for $1 < p < \infty$ via an isometric isomorphism constructed using Hölder's inequality, and established $(\ell^\infty)^* \cong ba(\Omega, \mathcal{A})$ for countable Ω , where ba denotes the space of bounded linear charges.
- Applied tools including Hahn–Banach theorem and natural embeddings to analyze reflexivity and structural properties, highlighting the critical role of separability and the limitations of representing functionals in ℓ^∞ .
- Our findings uncover previously unrecognized duality relationships and the geometric structure of Banach spaces.

Hypergeometric & Heun Equation

Advisor: Prof. Rod Halburd 06/2025 – Present

- Investigated Riemann's differential equation—a second-order linear ODE with three regular singular points—and demonstrated its reduction to the hypergeometric equation via Möbius transformation, mapping singularities to 0, 1, and ∞ .
- Derived series and integral representations of its general solutions, and established that the anharmonic group yields 24 distinct solutions expressible in terms of any single solution.
- Extended this framework to the Heun equation, which possesses four regular singularities and introduces an accessory parameter q and the other uncontrollable parameter.
- Applied the Heun equation to separate variables in the Teukolsky equation, contributing to the study of black hole perturbations.
- Study the Teukolsky equation and use separation of variable to decompose it into two ODEs and find the one of them can be transformed into Heun equation.
- Expanding solutions of the Heun equation in terms of hypergeometric functions.

Hadamard's Three-Lines Theorem

Advisor: Prof. Carlo Marinelli 06/2025 – 06/2025

- Proved and applied Hadamard's three-lines theorem to establish convexity properties of analytic functions on vertical strips, demonstrating its use in deriving classical inequalities such as the AM–GM and Hölder's inequality.
- Contributed to a deeper understanding of maximum modulus principles and their extensions in complex analysis.
- Highlights how complex analysis turns extremal problems into boundary questions and reveals unexpected links between analytic inequalities and the geometry of the complex plane.

Sieve of Eratosthenes

Advisor: Dr. Acosta Reche Alberto 06/2024 – 06/2024

- Conducted research on the prime-counting function $\pi(x)$, detailing its computation via the Sieve of Eratosthenes and analyzing its asymptotic behavior through Chebyshev's Inequality and the Prime Number Theorem.

INDEPENDENT READING

Analysis:

- Rudin (1987), Walter. *Real and complex analysis*, 3rd ed.
- Rudin, W. (1991). *Functional Analysis* (2nd ed.).
- Dunford, N. & Schwartz, J. T. (1958). *Linear Operators, Part I: General Theory*.

Algebra:

- Axler, S. (2024). *Linear Algebra Done Right* (4th ed.).

ODE:

- Z. Nasipak. (Dec 2024). *Monodromy eigenvalues of the radial Teukolsky equation and their connection to the renormalized angular momentum*. arXiv:2412.06503 [gr-qc].
- P.-L. Giscard and A. Tamar. (Oct 2020). *Elementary Integral Series for Heun Functions. With an Application to Black-Hole Perturbation Theory*. arXiv:2010.03919 [math-ph].
- R. Halburd. (2017). *Analysis and Mathematical Physics*. (Chapter 4 - Special Functions)

AWARDS & ACTIVITIES

- Highest grade in UCL Math Summer Research (Year2), 06/2025
- Third Prize of 2025 Poster Competition in Math Department, 11/2025
- Founder of Math society in high School, 2021 - 2022
- 200+ hours Math teaching experience (Primary school, Alevel, IB, Ap and some undergraduate courses...), 2021 - Present
- Pro singer! (A band's vocal in London)