

# Chen-Wei (Milton) Lin

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## Research Interests

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**Mathematics:** Relative Geometric Langlands, Representation Theory of Metaplectic Groups,  $p$ -Adic Geometry, Higher Category Theory,  $K$ -theory.

**Machine learning:** Interpretability, Memory Networks, Foundations of Deep Learning

## Education

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### Ph.D. of Mathematics, Johns Hopkins University, 2019-2025 (Expected)

Supervisor: David Gepner

Thesis title: Geometric and Categorical Aspects of the Langlands Program.

### Masters of Mathematics, University of Oxford, 2018-2019

Dissertation Topic: Index of Operators and  $KK$ -theory. Supervisor: Dr. Andre Henriques.

*Fourth year examinations*, ranked 4th in cohort

*Best dissertation award in Mathematics Department*

### BA Mathematics, University of Oxford, 2015-2018

Supervisors: Prof. Glenys Luke, Prof. Tom Sanders.

*Preliminary Examinations*, ranked Top 10 of approx. 200 students.

*Third Year Examinations*, ranked Top 10 of approx. 150 students.

## Awards and honors

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### Gibbs Dissertation Prize for Mathematics

Awarded by the Oxford Mathematical Institute.

Best Masters of Mathematics dissertation.

### Alison Sheppard Prize for Mathematics

Awarded by St Hugh's College, Oxford.

Third year mathematician with highest first class in College.

### St Hugh's College Scholarship Award

Awarded by St Hugh's College, Oxford, annually.

*First Class Honors* in each year.

## Invited Talks

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Technical University of Darmstadt, February 7th, 2025.

University of Minnesota Student Number Theory Seminar, November 19th, 2024.

Johns Hopkins University, Topology seminar, September 12th, 2024.

## Seminar Talks

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### 2024

Topology [E-theory seminar](#), JHU, on *Gross-Hopkins Period Map*.

Number theory learning seminar, JHU, motivic periods, two talks on *Chen's Theorem*.

## 2023

Topology Seminar, JHU, on *Dieudonné modules, following Lurie and Hopkins*.

Topics in representation theory seminar, JHU, on *Uniformization of  $G$ -bundles*.

Topological Quantum Field Theory learning seminar, JHU, on *Classical Field Theory and  $\sigma$ -models*.

Topics in representation theory seminar, JHU, on *Affine Grassmanian*.

[Prismatic cohomology](#) Seminar organizer, with Naruki Masuda and David Gepner.

## 2022

Heegner points study group, JHU, on *Selmer structures and duality*.

Derived deformation theory seminar, JHU, three talks on *Calegari-Geraghty Method in Modularity Lifting*.

Jacquet Langlands Correspondence student seminar, JHU, four talks.

## 2021

[eCHT Hermitian  \$K\$ -theory](#), on *Poincaré Categories*.

[Category theory seminar](#), on *Differential Cohomology and Cohesive Topoi*.

Derived deformation theory seminar, JHU, on formal moduli problems.

Seminar on Stack of Langlands Parameter, joint with U Chicago, on *Representation Stacks*.

[Non-archimedean study group](#), on *Formal schemes and Rigid Generic Fiber*.

## 2020

[DaFra Seminar](#) on Condensed mathematics, a talk on *Solid Abelian Groups*.

[Étale homotopy study group](#), Kings College London, a talk on *Étale Homotopy Obstruction*.

Topological Hochschild Homology Seminar, UIC, two talks on *Construction of  $THH$* .

Spectral Algebraic Geometry Seminar, UIC, two talks on *Spectrally Ringed  $\infty$ -Topoi*.

[eCHT Kan Fall Seminar](#), two talks on chapter 1 of *A Survey of Elliptic Cohomology*, J. Lurie.

[Number Theory Seminar](#), Uni. of Melbourne, two talks on *Contragredient representations*.

[Oberseminar](#), Uni. of Regensburg, a talk on *The  $p$ -complete Frobenius*.

## 2019

Masters presentation, University of Oxford. On *The Atiyah Singer-Index Theorem*.

Reading Group, University of Oxford. On *Model Categories*, Dwyer and Sapinski.

## Professional service

*All roles listed below were conducted at Johns Hopkins University.*

### Graduate Mentorship

(2023-2025) Yashi Jain, serving as a secondary advisor. Primary advisor: David Savitt.

### Undergraduate Mentorship

Spring 2024: Viggy Vanchinathan, mentored a DRP project on understanding addition with transformers.

Fall 2023: Spencer Huang, Dev Lalwani, mentored a DRP project on mechanistic interpretability.

Spring 2023: Orisis Zheng, mentored a DRP project on Zariski's lemma in Algebraic Geometry.

Fall 2022: Nick Lombardi: mentored a project on an introduction to the Langlands program.

### Fall 2024

Graduate Algebra, Teaching Assistant.

Introduction to Proofs, Teaching Assistant.

### Spring 2024

[Directed Reading Program](#), Co-organizer.

**Fall 2023**

SOUL Course: Interpretability in AI, Lecturer.

Honors Single Variable Calculus, Lecturer.

Directed Reading Program, Organizer and Mentor.

**Spring 2023**

Calculus III, Head Teaching Assistant.

[Directed Reading Program](#), Co-organizer and Mentor.

**Fall 2022**

Calculus II, Teaching Assistant.

Directed Reading Program, Co-organizer and Mentor.

## AI Projects

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The following are some small personal projects during my free time, reflecting my interests in, 1. Social Impact and Ethical AI, 2. Multilingual Natural Language Processing, focusing on improving low-resource language performance, and 3. AI and Mathematics, exploring the role of language models in mathematical research, education.

**Spoken MASSIVE** joint with Chutong Meng (George Mason University), this project studies synthetic data in the context of spoken language understanding (SLU). We created the first multilingual SLU dataset. The dataset was synthesized from MASSIVE, and SLU models were trained and evaluated.

**Emotion Fine Tuning** This is an experimental project, with Prof. Levine (Cornell University), exploring the role of emotion in AI behavior. The first step is to quantify if emotional feedback can be as useful as RLHF in training data.

**Mitigating Social Biases in Language Models with Adversarial Debate** This project is joint work with Cole Molloy (Johns Hopkins University) and Lois Wang (Johns Hopkins University). We explored how in-context adversarial debates between language models can be structured to mitigate social biases in pretrained language models.

**Some Thoughts on AI and Mathematical Research, in 2023** Written with Sina Hazratpour (Postdoc at Johns Hopkins University), this article surveys the impact of large language models in theorem-proving community.

## Skills

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**Programming Languages:** Python, R, MATLAB

**AI Frameworks:** TensorFlow, PyTorch

**Tools:** Jupyter, Git, LaTeX

**Languages:** Mandarin (native), English (fluent), Ukrainian (elementary proficiency)

# Publications

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## Preprints

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**Mixed characteristic Geometric Casselman Shalika Formula**, arXiv:2408.07953, **submitted**. In this joint work with Ashwin Iyengar (American Mathematical Society) and Konrad Zou (Bonn University), we prove the geometric Casselma–Shalika formula in the setting of Witt vector Grassmanian.

**Integral aspects of Fourier Duality**, arXiv:2407.06184, **submitted**. In this joint work, we prove several results regarding integral versions of Fourier duality for abelian schemes, using Pappas’ work on integral Grothendieck–Riemann–Roch.

## In progress

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**Relative Langlands on the Fargues Fontaine, the Iwasawa Tate case**, joint with Yuta Takaya (Tokyo University). We explicitly compare the period and  $L$ -sheaves under the relative Langlands conjectures of Ben-Zvi-Sakellaridis-Venkatesh.

**Mixed characteristic Iwahori-Whittaker equivalence**, joint with Konrad Zou (Bonn University), this is an application of the previous paper on Casselman-Shalika Formula, where we also prove basic properties of categorical actions in the  $l$ -adic setting.

**Geometric categorical deformations, examples**, joint with Anish Chedalavada (Johns Hopkins University). We are attempting to work on Lurie’s 2010 ICM address on deformations of quantum groups.

**Stacky approach to motivic periods**, We give a ”stacky interpretation” of periods defined by F. Brown and P. Deligne.