Isaac Martin

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EDUCATION

The University of Texas at Austin — Austin, TX
Ph.D. in Mathematics, advised by Bernd Siebert. — September 2022 - May 2027 (Projected)

University of Cambridge — Cambridge, UK
MASt in Pure Mathematics — October 2021 - June 2022
Part III Essay: *Algebraic D-modules.* Supervised by Prof. Ian Grojnowski.

University of Utah — Salt Lake City, UT
Honors Bachelors of Science in Mathematics, Bachelors of Science in Physics — Aug. 2017 – May 2021
Honor's Thesis: *The number of torsion divisors in a strongly F-regular ring is bounded by the reciprocal of F-signature.* Supervised by Prof. Anurag Singh.

PUBLICATIONS

[1] Isaac K. Martin et al. *Design of General Purpose Minimal-Auxiliary Ising Machines.* 2023. arXiv: 2310.16246 [math.OC].

[2] Mark J. Hagmann and Isaac K. Martin. "Design and simulations of a prototype nanocircuit to transmit microwave and terahertz harmonics generated with a mode-locked laser". In: *AIP Advances* 12.1 (2022), p. 015014. DOI: 10.1063/5.0070872. eprint: https://doi.org/10.1063/5.0070872. URL: https://doi.org/10.1063/5.0070872.

[3] Marcelo Almora Rios et al. "Almost Abelian Lie Groups, Subgroups and Quotients". In: *Journal of Mathematical Sciences* (2022). URL: https://link.springer.com/article/10.1007/s10958-022-05872-2.

[4] Isaac Martin. "The number of torsion divisors in a strongly F-regular ring is bounded by the reciprocal of F-signature". In: *Communications in Algebra* (2021). DOI: 10.1080/00927872.2021.1986057.

AWARDS AND RECOGNITIONS

- Awarded 2021: *PGEF Grant* PGEF Grant at UT Austin.

- Selected 2021: *Graduation Speaker.* Asked to be the University of Utah College of Science 2021 graduation speaker.

- Awarded 2021: *NSF Graduate Research Fellow.* Five year fellowship for graduate students.

- Awarded 2021: *Churchill Scholarship.* A UK fellowship to earn an MASt at the University of Cambridge.

- Awarded 2020: *UROP Award.* Research funding provided for my positive characteristic research. Renewed December 2020.

- Awarded 2020: *Goldwater Scholar.* Scholarship awarded to recognize outstanding undergraduate researchers.

- Awarded 2020: *Junius John Hayes Endowed Scholarship.* Distinguished mathematics scholarship at the University of Utah.

- Awarded 2020: *Pi Mu Epsilon.* Membership.

- Awarded 2019: *Phi Kappa Phi.* Membership.

- Awarded 2019: *Paul Gilbert Outstanding Undergraduate Research Award in Astronomy and Astrophysics.*

- Awarded 2017: *Eccles Scholar.* A full-ride 4-year scholarship awarded to 25-people annually.

- Awarded 2017 - 2021: *Deans List.* Received every semester.

POST-GRADUATE WORK EXPERIENCE

Probabilistic Computing at the Laboratory of Physical Sciences — June 2022 – Present
Full time during summer; part time fall and spring — Baltimore, MD; Austin, TX

- *Ising Machines:* Ongoing work with the probabilistic computing team at the Laboratory of Physical Sciences on the reverse Ising problem, i.e. on arbitrary function modeling using Ising machines. I have a joint program with Andrew Moore which aims to (1) create a robust mathematical formalism for Ising computation and (2) design algorithms which take as input an arbitrary function and output a feasible Ising Hamiltonian modeling this function. We draw from several disparate fields of mathematics, including pseudo boolean analysis, machine learning, TDA, polyhedral geometry and optimization. The best writeup of our results is currently [1].

Teaching Appointments — Aug. 2023 - Dec. 2023
Austin, TX.

- Fall 2023: TA for Differential and Integral Calculus, M408C.

OUTREACH

Directed Reading Program Mentor — Various dates
University of Texas at Austin, 2-4 hours weekly — *Remote Work*
- Jan. - Apr. 2023: Directed reading project on introductory algebraic geometry and Bezout's Theorem, following *Ideals, Varieties and Algorithms* by Cox, Little and O'Shea.
- Sept. - Dec. 2022: Direct reading project on prime characteristic commutative algebra and F-singularities, following *F-Singularities: A Commutative Algebra Approach* by Polstra and Ma.
- May - July 2022: Directed reading project on commutative algebra and elementary local fields. Covered localization, valuations, DVRs, and Hensel's lemma.
- Sept. - Dec. 2021: Directed a reading project on elementary group and ring theory and ended with a description of the group law on elliptic curves. Used Artin's *Algebra* and Silverman's *Rational Points on Elliptic Curves*.

Mentor for the University of Chicago Apprentice Program — June 2021 – August 2021
University of Chicago, 6 hours weekly — *Remote Work*
- Helped run problem sessions and grade for the apprentice program at UChicago. Personally mentored two students on projects concerning matrix Lie groups and positive characteristic commutative algebra. Final student papers will be linked once available online.

UNDERGRADUATE RESEARCH/WORK EXPERIENCE

Positive Characteristic Commutative Algebra Research — February 2020 – May 2021
University of Utah — *Salt Lake City, UT*
- Research on F-singularities funded by UROP grant from the University of Utah. Resulted in [4], an undergraduate thesis, and several presentations (see below).

Hodge Theory at the University of Chicago REU — June 2020 – August 2020
University of Chicago — *Chicago, IL*
- Expository project regarding a result of Deligne. Wrote about how prime characteristic techniques can be used to prove the equivalence of algebraic de Rham cohomology and Hodge cohomology for complex varieties. Expository paper available here: *Algebraic de Rham Cohomology*.

Lie Theory at UCSB REU. — June 2019 – August 2019
University of California Santa Barbara — *Santa Barbara, CA*
- Proved several results regarding almost Abelian Lie groups UC Santa Barbara's NSF REU under Zhirayr Avetisyan. Presented findings at three conferences, published in Journal of Mathematical Sciences [3]. ArXiv: *arXiv:2004.04369 [math.GR]*

Contractor for Newpath Research — May 2021 – August 2021
Part time, 20 hours weekly — *Salt Lake City, UT*
- Data analysis, simulation and modeling work performed for Newpath Research in Excel and Python. Coauthored [2].

University of Utah High School Number Theory TA — June 2021 – July 2021
University of Utah, Full time — *Salt Lake City, UT*
- TA'ed the University of Utah's number theory summer program for advanced high school students. Delivered lectures on LaTeX and Python, supervised/graded for a group of five students, and generally assisted with teaching.

Theoretical Dark Matter Dark Photon Research. — September 2018 – December 2018
University of Utah — *Salt Lake City, UT*
- Helped develop numerical methods in Mathematica and Python to simulate a dark matter plane wave signal, overlay the signal with simulated noise from LIGO's simulation package, and analyze the signal.

Experimental Condensed Matter Lab. — May 2018 – September 2018
University of Utah — *Salt Lake City, UT*
- Worked as an undergraduate assistant studying the electronic properties of the Topological Insulator BSTS through a BSTS/hBN/Graphite Van der Waals heterostructure. Assisted with device fabrication and testing.

Teaching Assistant, Tutor, Computer Lab Aid and Grader — January 2018 – May 2021
University of Utah, 10 hours a week — *Salt Lake City, UT*

- September 2019 - May 2021: Teaching assistant for Professor Henryk Hecht's Foundation of Analysis two-semester class sequence. Graded homework, held office hours, created supplementary videos.
- January 2018 - May 2021: Tutored standard undergraduate mathematics courses in the student mathematics center.
- January 2018 - March 2020: Helped run the mathematics computer lab at the University of Utah. Assisted students with Python, Java, C++, and Maple projects.

Talks, Presentations, Workshops and Conferences

Graduate School (Doesn't include seminar talks) — May 2021 – Present

- **June 2023, Homological Mirror Symmetry Workshop in EYAM**   Attended a week long workshop on homological mirror symmetry and the Gross-Siebert program in EYAM, hosted by the University of Edinburgh.
- **Oct. 2022, TAGS (Texas Algebraic Geometry Symposium)**   Attended TAGS 2022, hosted by Texas A&M.
- **Oct. 2022, KUMUNU 2022**   Attended KUMUNU, an annual commutative algebra conference, hosted by the University of Nebraska, Lincoln.
- **Sept. 2022, COMBS in CAM**   Attended a week-long workshop on combinatorial algebraic geometry at the University of Cambridge.
- **December 2021, Michaelmas Part III Seminar Series:** 30-minute talk titled "Measuring F-Singularities with F-Signature" presented at Cambridge
- **July 2021, Hybrid Conference:** Attended BRIDGES, a conference for early Ph.D. students interested in algebraic geometry, representation theory, number theory and commutative algebra.

Undergraduate — April 2017 - May 2021

- **April 2021, Online Conference:** Delivered a talk on F-singularities at the Western Regional Honors Council's 2021 Conference
- **April 2021, Graduate Commutative Algebra Seminar:** Summarized Anurag Singh's paper "F-signature of an affine semigroup ring," in a 50-minute talk.
- **March 2021, Brown University:** Delivered a talk titled "Two Invariants of Strongly F-Regular Rings" in SUMS at Brown University. I discussed the interplay between commutative algebra and algebraic geometry in characteristic p.
- **September 2020, Graduate Commutative Algebra Seminar:** "F-signature in the study of F-singularities," a 50-minute talk.
- **August 2020, YMC:** 20 minute talk, "The number of torsion divisors in a strongly F-regular ring is bounded by the reciprocal of F-signature".
- **August 2020, University of Chicago:** Delivered a talk titled "Algebraic de Rham cohomology and the Hodge spectral sequence" summarizing the results of my project at the conclusion of the University of Chicago REU.
- **July 2020, University of Utah:** Delivered a talk titled "The number of torsion divisors in a strongly F-regular ring is bounded by the reciprocal of F-signature" at the Utah's virtual summer symposium. Targeted at a general audience.
- **April 2020, Graduate Commutative Algebra Seminar:** Summarized Craig Huneke's paper "A Remark on Multiplicities" in a 50-minute talk.
- **November 2019, Graduate Commutative Algebra Seminar:** "Arithmetic rank and cohomological dimension," a 50-minute talk.
- **August 2019, YMC:** Poster on representations and automorphisms of almost Abelian Lie groups.
- **August 2019, UC Santa Barbara:** Presented a poster on representations and automorphisms of almost Abelian Lie groups at the *UCSB Summer Poster Conference.*
- **July 2019, University of Notre Dame:** Delivered a 20 minute talk, "Almost Abelian Lie groups, subgroups and representations", at the *Geometry and Topology RTG Undergraduate Summer Workshop* hosted by the University of Notre Dame.
- **May 2019, University of Notre Dame:** Attended week-long undergraduate workshop at the University of Notre Dame, the *Notre Dame Thematic Program in Commutative Algebra and its Interaction with Algebraic Geometry.*
- **April 2017, Salt Lake Community College:** Presented exploratory research on novel detection techniques of space debris in Low Earth Orbit at the *Salt Lake Community College Science Symposium.*

Miscellaneous

Winter/Summer Schools
- July 2021: *PCMI 2021.* Participated in the 3-week long PCMI program for undergraduates on quadratic forms and p-adic numbers.
- January 2021 - May 2021: *Arizona Winter School.* Participated in the Arizona Winter School on modular forms, modular groups, p-adic numbers, and quadratic forms. Course found here.

Outreach and Volunteering
- Fall 2019 - May 2021: *AWM Volunteering.* I helped plan and run outreach events for AWM as an undergraduate. This included providing free tutoring services at the Salt Lake Center for Science Education and organizing outreach events at local schools. My favorite experience thus far was visiting a local 6th grade classroom to talk about "different sizes of infinity."

Seminars and Colloquiums
- Fall 2019 - Spring 2021: *Graduate Commutative Algebra Seminar, BIKES.* A weekly commutative algebra seminar for graduate students. I delivered several talks over multiple semesters.

- January 2020 - September 2020: *Category Theory Seminar.* A weekly category theory seminar targeted at seniors and early graduate students. I help run the seminar and present every other week. We had a long pause from March to September as everyone adjusted to COVID-19.

Technical Skills

- *Languages:* Python, C#, C, C++, PHP, HTML/CSS.
- *Software:* LaTeX, Macaulay2, Unity, Emacs, Maple, Mathematica, Blender, Xcode.