

# Debanjana Kundu

*Curriculum Vitae*

Last Updated: January 2, 2023

## PERSONAL DETAILS

Birth	January 6, 1993
Address	PIMS, 4176-2207 Main Mall, Vancouver, BC, V6T 1Z4 Canada
Mail	<a href="mailto:dkundu@math.toronto.edu">dkundu@math.toronto.edu</a>

## EDUCATION

<b>BS-MS Dual Degree</b> <i>Indian Institute of Science Education and Research, Mohali, India</i> CGPA 9.7	2010-2015
<b>MA PhD</b> <i>University of Toronto, Toronto, Canada</i>	2015-2020

## EMPLOYMENT

<b>Université de Montréal</b> <i>CRM-ISM PostDoc, Thematic Program: Cohomology in Arithmetic</i>	Fall 2020
<b>University of British Columbia, Vancouver</b> <i>PIMS PostDoc Fellow</i>	January 2021– December 2022
<b>Fields Institute, Toronto</b> <i>Visiting Researcher</i>	January– June 2023

## PUBLICATIONS

1. Growth of Fine Selmer Groups in Infinite Towers  
*Canadian Mathematics Bulletin* (2020) Volume 63 / Issue 4 pp. 921-936.
2. Growth of  $p$ -Fine Selmer Groups and  $p$ -Fine Shafarevich-Tate Group in  $\mathbb{Z}/p\mathbb{Z}$ -Extensions  
*Journal of the Ramanujan Math Society* (2021) Volume 36, No. 1.
3. Growth of Fine Selmer Groups in Uniform pro- $p$  Extensions  
*Annales Mathématiques du Québec* (2021) Volume 45, pp. 347-362.
4. Perfect Powers that are Sums of Squares of an AP (with V. Patel)  
*Rocky Mountain Journal of Mathematics* (2021) Volume 51 / No. 3 pp. 933-949.
5. On an Analogue of Kida's Formula for Fine Selmer Groups  
*Journal of Number Theory* (2021) Volume 222; pp. 249-261.
6. Anticyclotomic  $\mu$ -Invariants of Residually Reducible Galois Representations (with A. Ray)  
*Journal of Number Theory* (2022) Volume 234, pp. 476-498.
7. Statistics for Iwasawa Invariants of Elliptic Curves (with A. Ray)  
*Transactions of the American Mathematical Society* (2021) Volume 374/ Issue 11; pp. 7945-7965
8. Arithmetic Statistics and Non-Commutative Iwasawa Theory (with A. Lei and A. Ray)  
*Documenta Mathematica* (2022) Volume 27, pp. 89-149

9. On the fine Selmer groups of modular forms and duality (with J. Hatley, A. Lei, and J. Ray)  
*accepted for publication (Ramanujan Journal)*  
<https://doi.org/10.1007/s11139-022-00560-w>
10. Iwasawa Invariants for elliptic curves over  $\mathbb{Z}_p$ -extensions and Kida's Formula (with A. Ray)  
*Forum Math.* 34 (2022), no. 4, 945–967
11. Control Theorems of Fine Selmer Groups (with M. F. Lim)  
*accepted for publication (Journal de Théorie des nombres de Bordeaux)*
12. Structure of fine Selmer Groups in  $p$ -adic Lie Extensions (with R. Sujatha and F. Nuccio)  
*accepted by the referee (Osaka Journal of Math)*  
*preprint available on HAL*

## PREPRINTS

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1. Non-vanishing modulo  $p$  of Hecke  $L$ -values over imaginary quadratic fields (with A. Lei)  
*pre-print available upon request, submitted*
2. Statistics for anticyclotomic Iwasawa invariants of elliptic curves (with J. Hatley and A. Ray) *pre-print available on arXiv, submitted*
3. Statistics for Iwasawa Invariants of Elliptic Curves II (with A. Ray) *pre-print available on arXiv, submitted*
4. Rank jumps and growth of Shafarevich–Tate groups for elliptic curves in  $\mathbb{Z}/p\mathbb{Z}$ -extensions (with L. Beneish and A. Ray) *pre-print available on arXiv, submitted*
5. Growth of  $p$ -parts of ideal class groups and fine Selmer groups in  $\mathbb{Z}_q$ -extensions with  $p \neq q$  (with A. Lei) *preprint available upon request, submitted*
6. Cotorsion of anti-cyclotomic Selmer groups on average (with F. Sprung) *submitted*
7.  $\lambda$ -invariant stability in Families of Modular Galois Representations (with J. Hatley) *preprint available on arXiv, submitted*
8. Studying Hilbert's 10<sup>th</sup> problem via explicit elliptic curves (with A. Lei and F. Sprung) *preprint available on arXiv, submitted*
9. Heuristics for anti-cyclotomic  $\mathbb{Z}_p$ -extensions (with L. Washington) *preprint available on arXiv, submitted*

## AWARDS/ DISTINCTIONS/ PRIZES

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<b>Academic Excellence Award (three times)</b> <i>IISER Mohali (for SGPA 10 in three semesters)</i>	2010–2015
<b>Vivekananda Graduate Award for International Students</b> <i>University of Toronto</i>	2018–2019
<b>General Motors Women in Mathematics and Science Award</b> <i>University of Toronto</i>	2019–2020
<b>Malcolm Slingsby Robertson Prize in Mathematics</b> <i>University of Toronto (best thesis award)</i>	2020

## FELLOWSHIPS

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<b>INSPIRE Fellowship</b> <i>Department of Science and Technology, Government of India</i>	2010–2015
<b>JNCASR Summer Fellowship</b> <i>JNCASR, India</i>	2012

<b>DAAD WISE Scholarship</b> <i>Germany</i>	2013
<b>IAS Summer Fellowship (not availed)</b> <i>Indian Academy of Sciences, India</i>	2013
<b>MITACS Globalink Research Internship</b> <i>Canada</i>	2014
<b>Rhodes Scholarship finalist (top 18)</b> <i>Oxford University, UK</i>	Class of 2015
<b>TIFR VSRP Fellowship</b> <i>TIFR, India</i>	2015
<b>BIGS Scholarship for Graduate Studies (not availed)</b> <i>Hausdorff Center for Mathematics, Bonn, Germany</i>	2015–2018
<b>MITACS Graduate Fellowship</b> <i>Canada</i>	2015–2018
<b>CRM-ISM Postdoctoral Fellowship</b> <i>Université de Montréal</i>	Fall 2020
<b>PIMS Postdoctoral Fellowship</b> <i>University of British Columbia, Vancouver</i>	January 2021– December 2022
<b>IAS Summer Research Fellowship</b> <i>Institute for Advanced Study, Princeton</i>	Summer 2022

## SEMINARS

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<b>Introduction to Game Theory</b> <i>Mathematics Club, IISER Mohali</i>	Aug 2012
<b>27 Lines on a Cubic</b> <i>Department Colloquium, IISER Mohali</i>	Nov 2013
<b>Proofs of Quadratic Reciprocity</b> <i>Department Colloquium, IISER Mohali</i>	April 2014
<b>Linear Groups- Malcev's Theorem and Selberg's Lemma</b> <i>IISER Mohali</i>	April 2014
<b>Principal <math>L</math>-Functions of the Linear Group</b> <i>Department of Math, University of Toronto</i>	August 2016
<b>Understanding the Rank Distribution Conjecture</b> <i>Graduate Seminar, Department of Math, University of Toronto</i>	Nov 2016
<b>What is an Elliptic Curve?</b> <i>Graduate Seminar, Department of Math, University of Toronto</i>	April 2017
<b>Fun with Tilings</b> <i>Graduate Seminar, Department of Math, University of Toronto</i>	Fall 2018
<b>Möbius Functions and Number Theory</b> <i>Math Camp, Department of Math, University of Toronto</i>	Summer 2019
<b>Pigeonhole Principle and its Applications</b> <i>Graduate Seminar, Department of Math, University of Toronto</i>	January 2020
<b>Iwasawa Theory and Pseudo-nullity Conjectures</b> <i>Invited talk, Algebra &amp; Number Theory Seminar, Université Laval</i>	January 2020
<b>Iwasawa Theory of Fine Selmer Groups</b> <i>Invited talk, QVNTS, Montreal</i>	January 2020
<b>Overview of Iwasawa Theory</b> <i>Invited talk, Junior Number Theory Seminar, University of Toronto</i>	October 2020

<b>Iwasawa Theory of Fine Selmer Groups</b> <i>Invited talk, Fields Institute Number Theory Seminar <a href="#">video</a></i>	November 2020
<b>Iwasawa Theory of Fine Selmer Groups</b> <i>Invited talk, PIMS Online Colloquium</i>	February 2021
<b>Iwasawa Theory of Fine Selmer Groups</b> <i>Invited talk, Number Theory Seminar, University of Toronto</i>	March 2021
<b>Iwasawa Theory</b> <i>Invited lecture series (3 lectures), Seoul National University</i>	Summer 2021
<b>Iwasawa Theory and Arithmetic Statistics</b> <i>Invited talk, University of Göttingen</i>	June 2021
<b>Iwasawa Theory and Arithmetic Statistics</b> <i>Invited talk, Ohio State University</i>	October 2021
<b>Iwasawa Theory and Arithmetic Statistics</b> <i>Invited talk, Möbius ANT, CRM Montreal</i>	November 2021
<b>Iwasawa Theory and Arithmetic Statistics</b> <i>Invited talk, IISER Mohali Online Colloquium <a href="#">video</a></i>	November 2021
<b>Iwasawa Theory and Arithmetic Statistics</b> <i>Invited talk, Fields Institute Number Theory Seminar <a href="#">video</a></i>	January 2022
<b>Fine Selmer Groups, Modular Forms, and Duality</b> <i>Invited talk, Iwasawa Theory Virtual Seminar <a href="#">video</a> (use passcode: upUiJL8%)</i>	February 2022
<b>Studying Hilbert's 10th Problem via Explicit Elliptic Curves</b> <i>Invited talk, IMSc Chennai, India</i>	August 2022
<b>Studying Hilbert's 10th Problem via Explicit Elliptic Curves</b> <i>Invited talk, HRI Allahabad, India</i>	September 2022
<b>Studying Hilbert's 10th Problem via Explicit Elliptic Curves</b> <i>Invited talk, University of Lethbridge</i>	October 2022
<b>Iwasawa Theory and Arithmetic Statistics</b> <i>Invited colloquium talk, HRI Allahabad, India</i>	October 2022
<b>Studying Hilbert's 10th Problem via Explicit Elliptic Curves</b> <i>Invited talk, University of Washington, Seattle</i>	October 2022
<b>Studying Hilbert's 10th Problem via Explicit Elliptic Curves</b> <i>Invited talk, IIT Bombay, India</i>	October 2022
<b>Heuristics for Iwasawa invariants in anti-cyclotomic <math>\mathbb{Z}_p</math>-extensions</b> <i>Invited talk, Philadelphia Area Number Theory Seminar, Bryn Mawr</i>	November 2022
<b>Iwasawa Theory and Arithmetic Statistics</b> <i>Invited colloquium talk, Fordham University</i>	November 2022
<b>Heuristics for Iwasawa invariants in anti-cyclotomic <math>\mathbb{Z}_p</math>-extensions</b> <i>Invited talk, Arizona State University, Tempe</i>	November 2022
<b>TBA</b> <i>Invited talk, Waterloo</i>	January 2023
<b>TBA</b> <i>Invited talk, IIT Gandhinagar</i>	January 2023
<b>TBA</b> <i>Invited talk, University of California, Berkeley</i>	Spring 2023

## CONFERENCES, WORKSHOPS AND SUMMER SCHOOLS

<b>Summer Graduate School, MSRI</b> <i>Summer school on Introduction to Character Theory and the McKay Conjecture.</i>	July 2016
<b>PIMS Summer School, UBC Vancouver</b> <i>Summer School on Representation Theory of Finite Groups</i>	July 2016
<b>Montreal-Toronto Workshop in Number Theory, CRM</b> <i>Workshop on Mock Modular Forms</i>	Dec 2016
<b>5 Day Workshops at BIRS, Banff</b> <i>Workshop on Diophantine Approximation and Algebraic Curves</i>	July 2017
<b>Summer Graduate School, MSRI</b> <i>Summer school on Automorphic Forms and Langlands Program</i>	July 2017

<b>AIM Workshop, San Jose</b> <i>Workshop on Functoriality and the Trace Formula</i>	Dec 2017
<b>Montreal-Toronto Workshop in Number Theory, CRM</b> <i>Workshop on Unitary Shimura Varieties</i>	January 2018
<b>Arizona Winter School, Tucson</b> <i>Winter school on Iwasawa Theory</i>	March 2018
<b>PIMS Focus Period, UBC Vancouver</b> <i>Focus Period on Representations in Arithmetic</i>	March 2018
<b>Upstate Number Theory Conference, SUNY Buffalo</b> <i>Young Researchers Conference</i>	April 2018
<b>Strength in Numbers, Queen's University</b> <i>Graduate Student Conference, Contributed talk</i>	May 2018
<b>CTNT Summer School, University of Connecticut</b> <i>Summer School and Conference</i>	May 2018
<b>CNTA Conference, Universite Laval</b> <i>Contributed talk</i>	July 2018
<b>Montreal-Toronto Workshop in Number Theory, CRM</b> <i>Workshop on p-adic Hodge Theory</i>	March 2019
<b>Analytic &amp; Combinatorial Number Theory, UIUC</b> <i>Contributed talk</i>	June 2019
<b>SOGMSC, University of Guelph</b> <i>Contributed talk</i>	June 2019
<b>Boston University-Keio University Workshop</b> <i>Contributed talk</i>	June 2019
<b>Palmetto Number Theory Seminar (PANTS) XXXII</b> <i>Invited talk</i>	Sep 2019
<b>Maine-Quebec Number Theory Conference</b> <i>Contributed talk</i>	October 2019
<b>MAAIM, Emory University</b> <i>Contributed talk</i>	Nov 2019
<b>CTNT Conference, University of Connecticut</b> <i>Contributed talk</i> <a href="#">slides</a>	June 2020
<b>Maine-Quebec Number Theory Conference</b> <i>Contributed talk</i> <a href="#">slides</a> <a href="#">video</a>	Fall 2020
<b>John's Hopkins Junior Number Theory Days</b> <i>Invited Talk</i> <a href="#">notes</a> <a href="#">video</a>	Dec 2020
<b>AIM Workshop, Online</b> <i>Workshop on Arithmetic Intersection Theory on Shimura Varieties</i>	Jan 2021
<b>CMS Summer Meeting</b> <i>Invited talk, Session: Algebraic Number Theory</i>	June 2021
<b>Workshop on Arithmetic Statistics Problems</b> <i>Invitation-only Conference</i>	July 2021
<b>Maine-Quebec Number Theory Conference</b> <i>Contributed talk</i>	October 2021
<b>Women in Maths: Progress and Challenges, IIT Jodhpur</b> <i>Invited talk</i>	May 2022
<b>Pair of Automorphic Workshops</b> <i>part of Castella-Liu research group</i>	August 2022
<b>CMS Winter Meeting</b> <i>Invited talk, Session: Diophantine Arithmetic Geometry and Number Theory</i>	December 2022
<b>PRIMA Congress</b> <i>Invited talk, Session: Arithmetic geometry: theory and computation</i>	December 2022
<b>5 Day Workshops at BIRS, Banff</b> <i>Workshop on Arithmetic Aspects of Deformation Theory</i>	January 2023
<b>Special values of L-functions, Paderborn University (Germany)</b> <i>Invited talk</i>	March 2023

## ORGANIZATION: SEMINARS AND MINI-COURSES

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<b>Summer Learning Seminar on Modular Forms</b> <i>Graduate Seminar, Department of Math, University of Toronto</i>	Summer 2017
<b>Summer Learning Seminar on Galois Cohomology</b> <i>Graduate Seminar, Department of Math, University of Toronto</i>	Summer 2017
<b>Introduction to Automorphic Forms and Langlands Program</b> <i>Graduate Seminar, Department of Math, University of Toronto</i>	Fall 2017
<b>Learning Seminar on Classical Iwasawa Theory</b> <i>Graduate Seminar, Department of Math, University of Toronto</i>	Fall 2017
<b>Learning Seminar on Beyond Endoscopy</b> <i>Graduate Seminar, Department of Math, University of Toronto</i>	2017–18
<b>Learning Seminar on Etale Cohomology</b> <i>Graduate Seminar, Department of Math, University of Toronto</i>	Winter 2018
<b>Learning Seminar on Complex Multiplication</b> <i>Graduate Seminar, Department of Math, University of Toronto</i>	Fall 2018
<b>Learning Seminar on <math>p</math>-adic Lie Groups</b> <i>Graduate Seminar, Department of Math, University of Toronto</i>	Summer 2019
<b>Learning Seminar on Tate Conjectures</b> <i>Graduate Seminar, Department of Math, University of Toronto</i>	Fall 2019
<b>CMS Mini-Course on Iwasawa Theory</b> <i>Co-organizer with R. Sujatha</i>	Dec 2019
<b>Learning Seminar on Abelian <math>\ell</math>-Adic Representations</b> <i>Graduate Seminar, Department of Math, University of Toronto</i>	Summer 2020
<b>Learning Seminar on Euler system and Eisenstein congruences</b> <i>Iwasawa Seminar, Department of Math, UBC Vancouver</i>	Fall 2020
<b>CRM Women's Seminar</b> <i>Part of the thematic program at CRM</i>	Fall 2020
<b>Learning Seminar on Coleman Families of Modular Forms</b> <i>Part of the thematic program at CRM</i>	Fall 2020
<b>Learning Seminar on Eigenvarieties</b> <i>Iwasawa Seminar, Department of Math, UBC Vancouver <a href="#">notes</a></i>	Winter 2021
<b>Learning Seminar on Quadratic Twists</b> <i>Iwasawa Seminar, online</i>	Winter 2021
<b>UBC Number Theory Seminar</b> <i>Department of Mathematics, UBC Vancouver</i>	2021–present

## TEACHING ASSISTANCE EXPERIENCE (UNIVERSITY OF TORONTO)

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<b>MAT223 (Linear Algebra)</b> <i>Instructor: S. Uppal</i>	multiple times
<b>MAT235 (Multivariable Calculus)</b> <i>Instructor: Dr. N. Jung</i>	multiple times
<b>MAT237 (Multivariable Calculus)</b> <i>Instructor: Dr. T. Holden, Prof. R. Gerrard</i>	multiple times
<b>MAT240 (Linear Algebra for Math Specialists)</b> <i>Instructor: Prof. E. Meinrenken</i>	multiple times
<b>MAT246 (Concepts in Abstract Math)</b> <i>Instructor: Dr. J. Korman, Dr. H. Soheil, Prof. F. Murnaghan, Dr. D. Burbulla</i>	multiple times
<b>MAT247 (Linear Algebra II for Math Specialists)</b> <i>Instructor: Prof. S. Kudla</i>	Winter 2018
<b>MAT315 (Elementary Number Theory)</b> <i>Instructor: Prof. H. Kim</i>	Winter 2020
<b>MAT336 (Elements of Analysis)</b> <i>Instructor: Dr. H. Soheil</i>	Winter 2017

**MAT401 (Polynomial Equations and Fields)**  
*Instructor: Dr. J. Korman*

Summer 2017

## TEACHING EXPERIENCE

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**University of Toronto:**

**MAT188 (Linear Algebra)**

Fall 2018

*Course Coordinator: Dr. D. Burbulla*

**MAT136 (Calculus II)**

Winter 2019

*Course Coordinator: Dr. S. Mayes-Tang*

**MAT136 (Calculus II)**

Summer 2019

*Course Coordinator with Dr. D. Le and A. Oswal*

**MAT237 (Multivariable Calculus)**

Summer 2020

*Course Coordinator with Dr. T. Ens, A. Pannu, and Dr. R. Zhu*

**University of British Columbia (Vancouver):**

**MAT105 (Integral Calculus for Social Sciences and Commerce)**

Winter 2021

*Course Coordinator: Prof. K. Liu*

**MAT152 (Linear Systems)**

Winter 2022

*Course Coordinator: Prof. K. Karu*

## ACADEMIC SERVICES

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*Refereed for*

Annales Mathématiques du Québec, Canadian Math Bulletin,  
Czechoslovak Mathematical Journal, Forum Mathematicum,  
Mathematika, The Ramanujan Journal, Documenta Math

*Reviewer for*

Mathematics Reviews

## MENTORSHIP

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**Math Outreach, UofT**

2018–2020

*I was a mentor for the high school mentor-ship program. I mentored Anna Krokhine for her research project on graph theory and combinatorics in 2018. In 2019, I mentored Maya Bozzo-Rey on her project on Benford's Law. In 2020, my student, Jennifer Wang explored questions from number theory.*

**Undergraduate Mentorship**

2021–present

*Aug 2021 – present: I am supervising Adithya Chakravarty (student at University of Toronto) for his Bachelor's (research) thesis on Iwasawa theory.*

*Jan–May 2022: I supervised Vitthal Yelambase (student at BITS Goa, India) for his Bachelor's project.*

## OTHER SERVICES

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**Women in Math, Toronto Chapter**

2019–2020

*Female graduate students from schools in and around the Greater Toronto Area came together for WiM, Toronto Chapter in 2019. I was a part of the core team and a mentor for incoming graduate students.*

**Outreach, UBC**

2021

*I was an adjudicator for MURC 2021. This is an undergraduate level multi-disciplinary research conference organized at UBC every year.*

**Panelist at MathPath**

July 2021

*I was a panelist at the MathPath Summer Camp for middle school students talking about hardships faced as a female mathematician.*

**EDI Committee, UBC**

2021–2022

*I was a member of the UBC Math Department Equity, Diversity and Inclusion Committee.*

## REFERENCES

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**Kumar Murty** ([murty@math.toronto.edu](mailto:murty@math.toronto.edu))

*Professor (University of Toronto) & Director (Fields Institute)*

**R. Sujatha** ([sujatha@math.ubc.ca](mailto:sujatha@math.ubc.ca))

*Professor (UBC Vancouver)*

**Henri Darmon** ([henri.darmon@mcgill.ca](mailto:henri.darmon@mcgill.ca))

*Professor (McGill University)*

**Otmar Venjakob** ([venjakob@mathi.uni-heidelberg.de](mailto:venjakob@mathi.uni-heidelberg.de))

*Professor (University of Heidelberg)*

**Lawrence Washington** ([lcw@umd.edu](mailto:lcw@umd.edu))

*Professor (University of Maryland)*

**Antonio Lei** ([antonio.lei@uottawa.ca](mailto:antonio.lei@uottawa.ca))

*Associate Professor (University of Ottawa)*

**Fok-Shuen Leung** ([fsl@math.ubc.ca](mailto:fsl@math.ubc.ca))

*Undergraduate Chair (Department of Mathematics, UBC Vancouver) – for teaching*