Debanjana Kundu

PhD Candidate, University of Toronto

PERSONAL DETAILS

Birth	January 6, 1993
Address	Department of Mathematics, University of Toronto
Phone	(+1) 437-344-2592
Mail	dkundu@math.toronto.edu

EDUCATION

Class X — 2008

CBSE (India)

98.6% (Mathematics 99, Science 99, English 93)

Class XII — 2010

CBSE (India)

93.2% (Mathematics 98, Chemistry 95, Physics 91, English 94)

(Top 1% in both class X and class XII.)

BS-MS Dual Degree — 2010-2015

Indian Institute of Science Education and Research, Mohali, India

CGPA 9.7

MA PhD — 2015-present

University of Toronto, Toronto, Canada

CGPA NA

RESEARCH EXPERIENCE

Summer Internship — May 2011 - July 2011

Indian Institute of Technology Kanpur, India

Linear Algebra and Probablity with Prof. Debasis Kundu.

Summer Internship (JNCASR Fellowship) — May 2012 - July 2012

Indian Institute of Science Education and Research, Pune, India

A project in Evolutionary Biology with Dr. Sutirth Dey.

Summer Internship (DAAD WISE Fellowship) — May 2013 - July 2013

University of Muenster, Muenster, Germany

Algebraic Geometry and Toric Geometry with Prof. Lutz Hille.

Summer Internship (MITACS Globalink Fellowship) — May 2014 - July 2014

University of British Columbia, Vancouver, Canada

Galois Cohomology and algebraic K-theory with Prof. Sujatha Ramdorai.

Masters Thesis — August 2014 - May 2015

IISER Mohali, India

My thesis is entitled 'Dimension Subgroups and Prime Power Groups'. I pursued the study of Lower Central and Dimension Series of Groups by Mikhailov and Passi, LNM Vol. 1952,

Springer 2009 under the guidance of Prof. I B S Passi at my parent institute. I wanted to understand combinatorial, homological and homotopical methods of investigation of problem in the theory of group rings. The main aim of my thesis was to review the major developments in the area of integral and modular dimension subgroups and study some of their applications.

Summer Internship (VSRP Fellowship)

June 2015 - July 2015

Tata Institute of Fundamental Research, Mumbai, India

Modular Forms and Eisenstein Series with Prof. CS Rajan.

Summer Reading Project

May 2016- August 2016

University of Toronto, Canada

For my summer reading project (2016) I worked under the guidance of Prof. James Arthur to understand more about representation theory and analytic methods in general. I read Tate's thesis, which is obviously a classic paper in this area and here he replaces the classic notion of zeta function as a sum over integral ideals of a certain type of ideal character by the corresponding notion of ideles. I then went on to read what looks like an obvious generalization of the work done by Tate; this was a paper by Herves Jacques titled "Principal L-functions of the Linear Group". I have continued taking courses and working with Prof. Arthur in order to understand the Langland's Program and to enhance my background on automorphic representations and the Arthur-Selberg trace formula.

Primary Research Focus

Aug 2016 - present

My research focus is on the study of Diophantine equations. I am interested in understanding both the (algebro-)geometric as well as the number theoretic aspects of questions in arithmetic geometry. My principal focus is on the Iwasawa theory of elliptic curves, in particular the Selmer group and the fine Selmer group. The study was initiated by Mazur (1972) and more recently has been carried forth by Coates-Sujatha (2005). There are lots of unanswered questions about the structure of the fine Selmer group and for my thesis, I am focusing on some of the conjectures of Coates-Sujatha. Since fine Selmer groups have stronger finiteness properties than Selmer groups, we believe there is much scope to understand the Iwasawa theory of elliptic curves by studying these (less understood) objects.

My main interest is in understanding growth properties of fine Selmer groups in infinite towers of number fields. Much of my research is focussed on understanding the μ-invariant of fine Selmer groups and relating them to the classical Iwasawa μ-invariant. I have also obtained results on the (less studied) λ-invariant. In an ongoing project I am trying to understand the maximal finite Λ-submodules of fine Selmer groups and using this it might be possible to fully resolve isogeny invariance of Coates-Sujatha Conjecture A. I have recently started looking at questions in non-commutative Iwasawa theory. In a project with R. Sujatha, we provide new evidence for the Coates-Sujatha pseudo-nullity conjecture.

Secondary Research Focus

Mar 2018 - present

Courses with Prof. Arthur got me interested in Beyond Endoscopy via Trace Formula. Very little can be said explicitly in this area and much of it is still conjectural. A seminal paper of Ali Altug (2015), initiates the study of the elliptic part of the trace formula. However, he works in the simplest setting of $\mathrm{GL}(2, \mathbb{Q})$. We are interested in looking at $\mathrm{GL}(2, F)$ where F is an arbitrary number fields. This is work in progress with M. Emory, M. Espinosa-Lara, T.A. Wong.

PUBLICATIONS/ PREPRINTS

1. Perfect Powers that are Sums of Squares of an Arithmetic Progression (with V. Patel) *pre-print available on arXiv, submitted*
2. Growth of Fine Selmer Groups in Infinite Towers *pre-print available*
3. Growth of p-Fine Selmer Groups and p-Fine Shafarevich-Tate Group in $\mathbb{Z}/p$-Extensions *pre-print available*
4. On the Relation between Classical Iwasawa $\mu = 0$ Conjecture and Coates-Sujatha Conjecture A *pre-print available*
5. On an Analogue of Kida's Formula for Fine Selmer Groups *pre-print available*
6. Providing Evidence for Coates-Sujatha Pseudo-Nullity Conjecture (with R. Sujatha) *in progress*
7. Beyond Endoscopy via Trace Formula (with M. Emory, M. Espinosa-Lara, T.A. Wong) *in progress*

FELLOWSHIPS

INSPIRE Fellowship 2010-2015
Department of Science and Technology, Government of India

JNCASR Summer Fellowship 2012
JNCASR, India

DAAD WISE Scholarship 2013
Germany

IAS Summer Fellowship (not availed) 2013
Indian Academy of Sciences, India

MITACS Globalink Research Internship 2014
Canada

Rhodes Scholarship finalist (top 18) class of 2015
Oxford University, UK

TIFR VSRP Fellowship 2015
TIFR, India

BIGS Scholarship for Graduate Studies (not availed) 2015-2018
Hausdorff Center for Mathematics, Bonn, Germany

MITACS Graduate Fellowship 2015 - 2018
Canada

Vivekananda Graduate Award for International Students 2018 - 2019
University of Toronto

General Motors Women in Mathematics and Science Award 2019 - 2020
University of Toronto

SEMINARS/ PRESENTATIONS

Introduction to Game Theory Aug 2012
Mathematics Club, IISER Mohali
27 Lines on a Cubic Nov 2013
Department Colloquium, IISER Mohali
Proofs of Quadratic Reciprocity April 2014
Department Colloquium, IISER Mohali
Linear Groups- Malcev's Theorem and Selberg's Lemma April 2014
IISER Mohali
Principal L-Functions of the Linear Group August 2016
Department of Math, University of Toronto
Understanding the Rank Distribution Conjecture Nov 2016
Graduate Seminar, Department of Math, University of Toronto
What is an Elliptic Curve? April 2017
Graduate Seminar, Department of Math, University of Toronto
Summer Learning Seminar on Modular Forms Summer 2017
Graduate Seminar, Department of Math, University of Toronto
Summer Learning Seminar on Galois Cohomology Summer 2017
Graduate Seminar, Department of Math, University of Toronto
Introduction to Automorphic Forms and Langlands Program Sep 2017
Graduate Seminar, Department of Math, University of Toronto
Learning Seminar on Classical Iwasawa Theory Sep-Dec 2017
Graduate Seminar, Department of Math, University of Toronto
Learning Seminar on Beyond Endoscopy 2017-18
Graduate Seminar, Department of Math, University of Toronto
Learning Seminar on Etale Cohomology Winter 2018
Graduate Seminar, Department of Math, University of Toronto
Learning Seminar on Complex Multiplication Fall 2018
Graduate Seminar, Department of Math, University of Toronto

CONFERENCES, WORKSHOPS AND SUMMER SCHOOLS

GANITA Conference, The Fields Institute June 13-16, 2016
participant

Summer Graduate School, MSRI July 11-22, 2016
Summer school on Introduction to Character Theory and the McKay Conjecture.

PIMS Summer School, UBC Vancouver July 27-30 2016
Summer School on Representation Theory of Finite Groups

Fields Medal Symposium, The Fields Institute November 1-4, 2016
participant

Montreal-Toronto Number Theory Workshop, CRM Montreal December 8-9 2016

Workshop on Mock Modular Forms
5 Day Workshops at BIRS, Banff July 2-7 2017
Workshop on Diophantine Approximation and Algebraic Curves
Summer Graduate School, MSRI Jul 24-Aug 4, 2017
Summer school on Automorphic Forms and Langlands Program
AIM Workshop, San Jose December 4-8 2017
Workshop on Functoriality and the Trace Formula
Montreal-Toronto Number Theory Workshop, CRM Montreal January 13-14 2018
Workshop on Unitary Shimura Varieties
Arizona Winter School, Tucson March 3-7 2018
Winter school on Iwasawa Theory
PIMS Focus Period, UBC Vancouver March 25-29 2018
Focus Period on Representations in Arithmetic
Upstate Number Theory Conference, SUNY Buffalo April 28-29 2018
Young Researchers Conference
Strength in Numbers, Queen's University May 11-12 2018
Graduate Student Conference, Contributed talk
CTNT Summer School, University of Connecticut May 28- June 3 2018
Summer School and Conference
CNTA XV Conference, Universite Laval July 9-13 2018
Contributed talk
Montreal-Toronto Number Theory Workshop, CRM Montreal March 22-24 2019
Workshop on p-adic Hodge Theory
John H. Barrett Memorial Lectures, University of Tennessee May 28-30 2019
participant
Analytic & Combinatorial Number Theory, UIUC June 6-9 2019
Contributed talk
SOGMSC, University of Guelph June 17 2019
Contributed talk
Boston University-Keio University Workshop June 24-28 2019
Contributed talk

TEACHING ASSISTANCE EXPERIENCE

IISER M
BIO 606 (Bio-statistics Graduate level course) Fall 2014
Instructor: Dr. N. G. Prasad

University of Toronto

MAT223 (Linear Algebra) — Fall/Winter 2015 – 16

Instructor: Mr. Sean Uppal

MAT246 (Concepts in Abstract Math) — multiple terms

Instructor: Dr. J Korman, Dr. H Soheil, Prof. F Murnaghan, Dr. D. Burbulla

MAT235 (Multivariable Calculus) — Fall/Winter 2018 – 19

Instructor: Dr. Nara Jung

MAT237 (Multivariable Calculus) — multiple terms

Instructor: Dr. Tyler Holden, Prof. Robert Gerrard

MAT240 (Linear Algebra for Math Specialists) — multiple terms

Instructor: Prof. Eckhard Meinrenken

MAT247 (Linear Algebra II for Math Specialists) — Winter 2018

Instructor: Prof. Stephen Kudla

MAT336 (Elements of Analysis) — Winter 2017

Instructor: Dr. H Soheil

MAT401 (Polynomial Equations and Fields) — Summer 2017

Instructor: Dr. Jonathan Korman

TEACHING EXPERIENCE

University of Toronto

MAT188 (Linear Algebra) — Fall 2018

Course Coordinator: Dr. Dietrich Burbulla

MAT136 (Calculus II) — Winter 2019

Course Coordinator: Dr. Sarah Mayes-Tang

EXTRA-CURRICULAR ACTIVITIES

Outreach Committee, IISER Mohali — 2013 - 2015

Student Volunteer/ Organizer

Math Outreach, UofT — Winter 2018/ Winter 2019

2018: Anna Krokhine (Graph Theory and Combinatorics)
2019: Maya Bozzo-Rey (Benford's Law)

SKILLS

Languages	Bengali (mother tongue)
	English (fluent)
	Hindi (fluent)
Software	LaTeX

REFERENCES

Available upon request