Ritwik Chakraborty

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EDUCATION

Tata Institute of Fundamental Research, Mumbai

- Research Scholar, Integrated Ph.D. Program, School of Mathematics — Aug 2021-
- Advisor: Prof. Subhajit Goswami

Indian Institute of Technology Kanpur, Uttar Pradesh, India

- B.S., Double Major, in Physics and Mathematics — Jul 2020

RESEARCH INTERESTS

- Hyperbolic Geometry
- Dynamics
- Probability theory

CONFERENCES / WORKSHOPS

Geometry in Groups, ICTS Bangalore — Aug 2024

Thematic Program on Randomness and Geometry
The Fields Institute for Research in Mathematical Sciences, Toronto — Mar 2024-May 2024

International Colloquium on Randomness, Geometry, and Dynamics, IISER Pune — Jan 2024

Probabilistic Methods in Negative Curvature 2023, ICTS Bangalore — Mar 2023

CIMPA School on Geometric Structures on Surfaces, Moduli Spaces, and Dynamics
Banaras Hindu University, Varanasi — Dec 2022

Ergodic Theory and Dynamical Systems, ICTS Bangalore — Dec 2022

Probabilistic Methods in Negative Curvature 2021, ICTS Bangalore — Mar 2021

Advanced Instructional School on Riemannian Geometry, **NCM** — Jul 2019

PRE-PRINTS

Contact domination, with Balarka Sen and Sekh Kiran Ajij, arXiv:2502.13927

MASTER'S THESIS

Random Walks on Hyperbolic Groups
Supervised by Prof. Mahan Mj, TIFR — Thesis

The thesis was centered on understanding random walks on non-elementary hyperbolic groups, the Green metric and its hyperbolicity, Hausdorff dimension of the hitting measure, Kaimanovich's entropy criterion, Gouëzel's method of pivots and the Poisson boundary identification problem for random walks on hyperbolic groups with finite entropy without assuming any moment condition.

PROJECTS AND SELECTED READING COURSES

Topics in Statistical Physics on general graphs — Jan 2023–Apr 2023
Under Prof. Subhajit Goswami, TIFR

- Following Friedl-Velenik's *Statistical mechanics on lattice systems*, read about infinite-volume Gibbs measures on Euclidean lattices with absolutely summable interaction potentials, basic theory of phase transitions for discrete and continuous spin Ising models and Pigorov-Sinai theory.

Homogeneous dynamics — Sep 2022–Nov 2022
Under Prof. Anish Ghosh, TIFR

- Read basic homogeneous dynamics following Einsidler-Ward's *Ergodic theory with a view towards number theory* and *Homogeneous dynamics and applications* including topics such as Mautner's phenomenon, ergodicity of geodesic flow on hyperbolic surfaces, Howe-Moore theorem.
- Read Manfred Einsiedler. Ratner's theorem on SL(2,R)-invariant measures. Jahresber. Deutsch. Math.-Verein., 108(3):143–164, 2006.

Riemannian Geometry/Gibbs measures on hyperbolic lattice — Sep 2022–Nov 2022
Under Prof. Mahan Mj., TIFR

- Read doCarmo's *Riemannian geometry* and worked out all problems.
- Read C. M. Series and Ya. G. Sinai. Ising models on the Lobachevsky plane. Comm. Math. Phys., 128(1):63–76, 1990.

Percolation — Dec 2020–Mar 2021
Under Prof. Riddhipratim Basu, ICTS

- Read about Bernoulli percolation and group-invariant percolation on transitive graphs from Lyons-Peres' *Probability on Trees and Networks*.

Hyperbolic geometry and cube complexes — Aug 2020-Nov 2020

Under Prof. Mahan Mj, TIFR — Talk

- Audited a course on hyperbolic geometry taken by Prof. Mahan Mj at TIFR. The key topics in the course were:
- Sections H and Γ from Bridson-Haefliger's book, *Metric Spaces of Non-positive Curvature*.
- Introduction to Cannon-Thurston maps and non-positively curved cube complexes.
- Also gave a talk on Coxeter groups, presenting a proof that they are linear.

Ergodic Theory — May 2020–Jul 2020
Under Prof. Mahan Mj., TIFR — Report

- Was a part of the Visiting Students' Research Program at TIFR
- Read the first 7 chapters from Viana-Oliveira's *Foundations of Ergodic Theory*, key topics being - von Neumann, Birkhoff and Kingman's ergodic theorems, unique ergodicity, ergodic decomposition and entropy.

Translation Surfaces — Dec 2019
Under Prof. Bidyut Sanki, IIT Kanpur

- Learnt about translation surfaces, polygonal billiards and SL(2,$\mathbb{R}$) action on strata of abelian differentials.

Kähler Geometry — Aug 2019–Oct 2019
Under Prof. Ajay Singh Thakur, IIT Kanpur — Report

- Learnt basics of sheaf cohomology and sheaf-theoretic methods in (complex) differential geometry following the book "*Complex Geometry*" by Daniel Huybrechts.

Geometry of Teichmüller Spaces — May 2019–Jun 2019
Under Prof. Abhijit Pal, IIT Kanpur

- Learnt several equivalent ways of studying the Teichmüller space of closed oriented surfaces and studied how it is parametrized by Fenchel-Nielsen coordinates following the books by Farb-Margalit and Imayoshi-Taniguchi.

SELECTED TALKS

An Introduction to Patterson-Sullivan measures for Kleinian groups — Apr 2024
Random Geometry Student Seminar, TIFR

Unimodularity and the Geometry of Random Graphs — Apr 2021
ISI Students' Seminar — Video

ACADEMIC ACHIEVEMENTS

- **KVPY National Fellowship, DST, Government of India** — 2015
- **National Standard Examination in Astronomy, IAPT** — 2014

TEACHING EXPERIENCE

Tutor, Analysis-I, TIFR — Aug 2024-Dec 2024
Course Instructor: Prof. Subhajit Goswami

- Graded assignments for First-year Graduate-level course on Measure theory and Functional Analysis at TIFR

Volunteer Tutor, Vigyan Vidushi Program, TIFR — Jul 2024

- Volunteered as an Analysis tutor for the Vigyan Vidushi Program at TIFR, a two-week Summer school for Indian women students.

Teaching Assistant, Introduction to Japanese Language and Culture, NPTEL Jul 2019–Nov 2019

- Served as a teaching assistant for the online course "Introduction to Japanese Language and Culture", a part of the NPTEL, a project funded by the MHRD, Govt. of India.
- Made questions for assignments, wrote down solutions and answered questions on a forum/youtube session.

Academic Mentor, Counselling Service, IITK — Jul 2016–Apr 2017

- Selected as an Academic Mentor for Classical Electrodynamics.
- Taught institute level, hall level remedial classes and provided one-on-one mentoring.

Volunteer Teacher, Prayas, IITK — Dec 2015–Aug 2016

- Volunteered with Prayas, a non-profit organization aimed at providing education to economically weaker sections of the society.
- Taught and designed curriculum for various subjects for intermediate and higher secondary school children at Prayas.

EXTRA CURRICULAR AND OTHER INTERESTS

Music

- I play the **piano** and have completed the 3rd Grade of the examinations taken by the **Associated Board of the Royal School of Music (ABRSM)** for piano.

Japanese

- Completed **Japanese Level-I** and **Japanese Level-II**, offered by the **Foreign Language Program** at IITK, receiving a grade of **A+** in both.
- I appeared for level **N5** of the **JLPT** in July, 2019 and **scored 180/180** in the same. I appeared for level **N4** of the **JLPT** in December, 2019 **scored 133/180**.
- Co-founded and chosen as the **leader** of the **Anime Society**, IITK, a club that comes under the Media and Culture Council at IIT Kanpur, that aims to provide a common social platform to anime, manga and other cultural enthusiasts with the vision to foster better understanding of the culture and connect people.

MISCELLANEOUS PROJECTS

Deleuze's Rhizome

Course project for Posthumanism and Anthropocene, taken by Prof. T. Ravichandran, IIT Kanpur Report

- Read about assemblages and rhizome in Deleuze and Guattari's "*A Thousand Plateaus: Capitalism and Schizophrenia*", wrote an expository article. Briefly talked about assemblages and categories, observing how attempts of trying to describe multiplicities beginning with Riemann, travel down parallel paths - through Bergson into Deleuze, and through Klein into MacLane.

Ontology of Possible Worlds

Course project for Philosophical Logic, taken by A.V. Ravishankar Sarma, IIT Kanpur Report

- Read the paper *"Possible worlds"* by R.C. Stalnaker.
- Wrote a critique in which I argue that all three sets of theses corresponding to the three positions encountered in "Possible Worlds" are descriptively insufficient.

Classifying Spaces and Classifying Topoi Apr 2018

Course project for Sheaves and Topos Theory, taken by Prof. Amit Kuber, IIT Kanpur Report

- Read the basic theory of classifying spaces, G-torsors and classifying topoi, wrote a report and presented it.

TECHNICAL SKILLS

- Languages: Mathematica, Matlab, C/C++, Python
- Utilities: LaTeX