

Research Interests

Random Matrices and Graphs, Large Deviations, Mathematical Physics.

Employment

- 01/2024–present **Associate Professor**, *International Centre for Theoretical Sciences*, Tata Institute of Fundamental Research, Bengaluru, India.
- 08/2018–12/2023 **Reader**, *International Centre for Theoretical Sciences*, Tata Institute of Fundamental Research, Bengaluru, India.
- 08/2016–07/2018 **Postdoctoral fellow**, *Department of Mathematics*, Weizmann Institute of Science, Rehovot, Israel.
Host: Prof. Ofer Zeitouni
- 08/2014–07/2016 **Visiting assistant professor**, *Department of Mathematics*, Duke University, Durham, NC, USA.

Education

- 09/2009–06/2014 **Ph.D. (Statistics)**, *Stanford University*, Stanford, CA, USA.
○ Thesis title: Probability models on large random graphs and matrices.
○ Thesis advisor: Prof. Amir Dembo
- 07/2007–05/2009 **Master of Statistics (with distinction)**, *Indian Statistical Institute*, Kolkata, India.
○ Specialization: Mathematical Statistics and Probability
○ Dissertation title: Large dimensional random matrices
○ Advisor: Prof. Arup Bose
- 07/2004–05/2007 **Bachelor of Statistics (Honors with distinction)**, *Indian Statistical Institute*, Kolkata, India.

Awards, Fellowships, and Grants

- INSA Medal for Young Scientists, 2021.
- Young Scientist Platinum Jubilee Award, the National Academy of Sciences, India, 2020.
- Endowment from Infosys Foundation for a virtual center on Random Geometry, 2020.
(with ten other faculties from ICTS–TIFR and TIFR, Mumbai)
- Science and Engineering Research Board (SERB), Govt. of India, Mathematical Research Impact-Centric Support (grant no. MTR/2019/001105), 2020–2023.
- SERB Start-up Research Grant (grant no. SRG/2019/001376), 2019–2021.
- Feinberg Graduate School prize for outstanding achievements in postdoctoral research, Weizmann Institute of Science, 2019.
- Honorable mention, Bernoulli Society New Researcher Award, 2019–2020.
- Infosys–ICTS Excellence Grant, 08/2018–07/2023.
- AMS–Simons Travel Grant, 07/2015–06/2017.
- Melvin and Joan Lane endowed Stanford Graduate Fellowship, Stanford University, 09/2009–08/2012.
- ISIAA Mrs. M. R. Iyer Gold Medal award for outstanding performance in Master of Statistics, Indian Statistical Institute, Kolkata, March 2010.
- M.A./M.Sc. Scholarship, National Board of Higher Mathematics, 06/2007–05/2009.

- J. M. Sengupta Gold Medal award for outstanding performance in Bachelor of Statistics, Indian Statistical Institute, Kolkata, February 2008.

Papers and preprints

- Basak, A., Dembo, A., and Sly, A., “Potts and random cluster measures on locally regular-tree-like graphs”. Submitted.
- Augeri, F., and Basak, A., “Large deviations of the largest eigenvalue of supercritical sparse Wigner matrices”. Submitted.
- Basak, A., “Upper tail of the spectral radius of sparse Erdős-Rényi graphs”. *Probability Theory and Related Fields*, 187(3-4), 885–947, 2023.
- Basak, A., Vogel, M., and Zeitouni, O., “Localization of eigenvectors of non-Hermitian banded noisy Toeplitz matrices”. *Probability and Mathematical Physics*, 4(3), 477–607, 2023.
- Basak, A., and Basu, R., “Upper tail large deviations of regular subgraph counts in Erdős-Rényi graphs in the full localized regime”. *Communications on Pure and Applied Mathematics*, 76(1), 3–72, 2023.
- Basak, A., and Rudelson, M., “Sharp transition of the invertibility of the adjacency matrices of sparse random graphs”. *Probability Theory and Related Fields*, 180, 233–308, 2021.
- Basak, A., and Zeitouni, O., “Outliers of random perturbation of Toeplitz matrices with finite symbols”. *Probability Theory and Related Fields*, 178(3), 771–826, 2020.
- Basak, A., Paquette, E., and Zeitouni, O., “Spectrum of random perturbations of Toeplitz matrices with finite symbols”. *Transactions of the American Mathematical Society*, 373(7), 4999–5023, 2020.
- Basak, A., and Rudelson, M., “The circular law for sparse non-Hermitian matrices”. *The Annals of Probability*, 47(4), 2359–2416, 2019.
- Basak, A., Paquette, E., and Zeitouni, O., “Regularization of non-normal matrices by Gaussian noise - the banded Toeplitz and twisted Toeplitz cases”. *Forum of Mathematics, Sigma*, 7, E3, 2019.
- Basak, A., Durrett, R., and Foxall, E., “Diffusion limit for the partner model at the critical value”. *Electronic Journal of Probability*, 23, paper no. 102, 42 pp, 2018.
- Basak, A., Cook, N., and Zeitouni, O., “Circular law for the sum of random permutation matrices”. *Electronic Journal of Probability*, 23, paper no. 33, 51 pp, 2018.
- Basak, A., and Rudelson, M., “Invertibility of sparse non-Hermitian matrices”. *Advances in Mathematics*, 310, 426–483, 2017.
- Basak, A., and Mukherjee, S., “Universality of mean-field for the Potts model”. *Probability Theory and Related Fields*, 168(3), 557–600, 2017.
- Basak, A. and Dembo, A., “Ferromagnetic Ising measures on large locally tree-like graphs”. *The Annals of Probability*, 45(2), 780–823, 2017.
- Basak, A., Bhamidi, S., Chakraborty, S., and Nobel, A., “Large subgraphs in pseudo-random graphs”. Preprint.
- Basak, A., Durrett, R., and Zhang, Y., “The evolving voter model on thick graphs”. Preprint.
- Basak, A., Bose, A., and Mukherjee, S. S., “Limiting spectral distribution of a class of Hankel type random matrices”. *Random Matrices: Theory and Applications*, 4(3), 1550010, 2015.
- Basak, A., Bose, A., and Sen, S., “Limiting spectral distribution of sample autocovariance matrices”. *Bernoulli Journal*, 20, 3, 1234–1259, 2014.
- Basak, A., and Dembo, A., “Limiting spectral distribution of sum of unitary and orthogonal matrices”. *Electronic Communications in Probability*, article 69, 2013.
- Basak, A. and Bose, A., “Limiting spectral distribution of some band matrices”. *Periodica Mathematica Hungarica*, 63, 1, 113–150, 2011.
- Basak, A. and Bose, A., “Balanced random Toeplitz and Hankel matrices”. *Electronic Communications in Probability*, 15, 134–148, 2010.

Talks

- Recent Advances in Probability and Statistics, Indian Institute of Technology, Mumbai, December 2024.
- World Congress in Probability and Statistics, Bochum, Germany, August 2024.
- Random Matrices and Related Topics in Jeju, Jeju Island, South Korea, May 2024.
- Efficient Algorithms and Complexity Theory Seminar, Department of Computer Science, TU Dortmund

- University, February 2024.
- International Colloquium, Tata Institute of Fundamental Research, January 2024.
 - Eigenfunctions Seminar, Indian Institute of Science, October 2023.
 - CRM-ISM Montreal Probability Seminar, McGill University, August 2023.
 - Random Matrices and Applications, Research Institute for Mathematical Sciences, Kyoto University, June 2023.
 - Probability Seminar, Dept. of Statistics, Stanford University, February 2023; March 2017; May 2016; June, 2012.
 - Probability Seminar, Dept. of Statistics, University of California, Berkeley, February 2023; September 2013.
 - International Indian Statistical Association (IISA) Conference, IISc, December 2022.
 - Bangalore Probability Seminar, September 2022; November 2018.
 - Combinatorics and Graph Theory Seminar, National University of Singapore, September 2022.
 - The Statistical Physics of Continuum Particle Systems with Strong Interactions, National University of Singapore, September 2022.
 - Workshop on random structures and related topics, Vietnam Institute of Mathematics, July 2022.
 - ICTS Statistical Physics Journal Club, June 2022.
 - Singapore-Abu Dhabi-Shanghai-India Probability Theory and Related Areas (SASI), NYU Abu Dhabi, May 2022.
 - Random Matrix EurAsia, National University of Singapore, May 2022.
 - ICTS In-House Colloquium, April 2022.
 - Infosys Chandrasekharan Random Geometry Colloquium, February 2022.
 - Young Researchers Meeting, World Congress in Probability and Statistics, July 2021.
 - Geometric Functional Analysis and Probability Seminar, Dept. of Mathematics, Weizmann Institute of Science, February 2020; April 2018; November 2016.
 - Spectra, Algorithms and Random Walks on Random Networks, CIRM, Marseille, January 2020.
 - Advances in Applied Probability, ICTS–TIFR, August 2019.
 - Two Random Days in Probability and Statistics, ISI Kolkata, April 2019.
 - Random Matrices and Random Graphs, CIRM, Marseille, April 2019.
 - Random matrices, Stochastic geometry and related topics, National University of Singapore, March 2019.
 - Mathematics Colloquium, IIT Kanpur, February 2019.
 - Universality in random structures: Interfaces, Matrices, Sandpiles, ICTS–TIFR, January 2019.
 - Analysis/Probability Seminar, Dept. of Mathematics, University of Michigan, November 2018.
 - Penn/Temple joint Probability Seminar, October 2018.
 - Probability and Mathematical Physics Seminar, Dept. of Mathematics, New York University, October 2018; September 2012.
 - Probability Seminar, International Centre for Theoretical Sciences, Tata Institute of Fundamental Research, August 2018.
 - Horowitz Seminar on Probability, Ergodic Theory and Dynamical Systems, Tel Aviv University, November 2017.
 - Mathematics Seminar, International Centre for Theoretical Sciences, October 2017.
 - Colloquium Talk, International Centre for Theoretical Sciences, October 2017.
 - Seminar, Dept. of Mathematics, Indian Institute of Science, October 2017.
 - Colloquium Talk, TIFR Centre for Applicable Mathematics, October 2017.
 - International Conference of The Indian Mathematics Consortium, Banaras Hindu University, December 2016.
 - AMS Special Session on Discrete Probability, North Dakota State University, April 2016.
 - Probability Seminar, Dept. of Mathematics, University of Virginia, September 2015.
 - Theoretical Statistics and Mathematics Unit Seminar, Indian Statistical Institute (ISI), Kolkata, December 2014; August 2012.
 - Probability Seminar, Dept. of Mathematics, UCLA, October 2014; October 2013.
 - Probability Seminar (joint), Duke University and UNC Chapel Hill, August 2014; September 2012.
 - IISA conference, UC Irvine, July 2014.
 - Probability and Statistics Seminar, Dept. of Mathematics, USC, December 2013.
 - 36th Conference on Stochastic Processes and their Applications, University of Colorado Boulder, July 2013.
 - Probability Seminar, Dept. of Mathematics, MIT, September 2012.
 - Young Researchers Meet, Stanford University, May 2012.
 - Theoretical Statistics and Mathematics Unit Seminar, ISI Delhi, August 2009.
 - PCM International Symposium on Statistics, ISI Kolkata, July 2009.

Short term academic visits

- Stanford University, February 2023 (four weeks).
- Hausdorff Research Institute for Mathematics, March - April 2021 (*visit cancelled due to COVID-19*).

- Simons Institute for the Theory of Computing, Fall 2020 (*program moved online due to COVID-19*).
- Weizmann Institute of Science, February 2020 (four weeks).
- University of Michigan, November 2018 (one week).
- New York University, October 2018 (four weeks).
- Stanford University, March 2017 (two weeks).
- University of Michigan, October 2015 (one week).

Mentoring and Teaching

- **Postdoctoral fellow supervision:**
 - Akshay Goel, Fall 2021 - Summer 2023.
 - Debapratim Banerjee, Fall 2020 - Summer 2021 (joint with R. Basu).
- **Summer research supervision:**
 - Pranay Agarwal, Summer 2023, at ICTS–TIFR (joint with R. Basu).
Project title: Large deviations for random graphs.
 - Ishaan Bhadoo, Summer 2023, at ICTS–TIFR (joint with R. Basu).
Project title: Percolation on hyperbolic graphs.
 - Saraswata Sensarma, Summer 2023, at ICTS–TIFR (joint with R. Basu).
Project title: Branching random walks and Gaussian free fields.
 - Sanchayan Bhowal, Summer 2022, at ICTS–TIFR (joint with R. Basu).
Project title: Cutoff phenomenon in Markov chains.
 - Tejas Oke, Summer 2022, at ICTS–TIFR (joint with R. Basu).
Project title: A study of planar critical percolation as a conformally invariant process and convergence of exploration paths to SLE_6 .
 - Aaradhya Pandey, Summer 2019, at ICTS–TIFR.
Project title: Spectral properties of random graphs.
 - Trung Can, Summer 2016, at Duke University.
Project title: Largest eigenvalue of random Hankel matrices.
- **Instructor (at ICTS–TIFR/IISc):** Probability Theory (core course for CAM–ICTS Math Ph.D. program). Graduate level topics courses in probability theory: Large Deviations and Related Topics, Probability in High Dimensions, Introduction to Random Matrices.
- **External Teaching Activities:** Mini course on “Universality in Random Matrices” at the Infosys–Chandrasekharan Random Geometry Centre.
- **Instructor (at Duke University):** Math 230 (undergraduate probability course), Math 340 (advanced introduction to probability), Math 541 (master’s level probability course), Math 641 (graduate level probability course), Math 690-40 (topics course on random matrices).

Professional activities

- Outreach activities
 - ICTS Newsletter article titled “Non-normal operators: spectral instability, pseudospectrum, and random perturbation”.
 - Eigenfunctions Seminar at Dept. of Mathematics, IISc, October 2023.
(Popular talk aimed at undergraduate / beginning graduate students)
- Organizational activities
 - Co-organizer of the invited session “Large deviations in random graphs and networks” at the world congress of probability and statistics, August 2024.
 - Co-organizer for the program “High Dimensional Probability”, January 2023.
(Originally scheduled for January 2021. Moved to January 2023 due to COVID-19.)
 - Organizer of Duke probability seminar, Spring 2015.

Reviewer for journals & conference proceedings American Journal of Mathematics, Annals of Applied Probability, Annals of Probability, Annales Henri Poincaré, Annales de l'Institut Henri Poincaré (B) Probabilités et Statistiques, Bulletin of the American Mathematical Society, Duke Mathematical Journal, Electronic Communications in Probability, Electronic Journal of Probability, Israel Journal of Mathematics, Journal of the European Mathematical Society, Journal of Functional Analysis, Journal of Statistical Planning and Inference, Journal of Theoretical Probability, Probability Theory and Related Fields, COLT, Random Matrices: Theory and Applications, Random Structures & Algorithms, RANDOM, Sankhya A, SIAM Journal on Applied Mathematics, SIAM Journal on Discrete Mathematics, SODA, Transactions of the American Mathematical Society, Vietnam Journal of Mathematics.