

Apoorva Khare

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Curriculum Vitae (abridged)

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Education and Appointments:

- 2020-present Indian Institute of Science: Associate Professor (Mathematics)
- 2017-2020 Indian Institute of Science: Assistant Professor (Mathematics)
- 2017-present Analysis and Probability Research Group: Member
- 2011-2017 Stanford University: Research Associate (Mathematics and Statistics)
- 2009-2011 Yale University: Lecturer (Mathematics)
- 2006-2009 University of California at Riverside: Visiting Assistant Professor (Mathematics)
- 2000-2006 M.S. and Ph.D. (Mathematics), University of Chicago
- 1997-2000 B.Stat. (Hons., First Class with Distinction), Indian Statistical Institute, Kolkata

Short academic visits: Amer. Instt. of Math. (*Jul 2023, Nov 2016, Oct 2014*), Univ. of Delaware (*Aug 2022, Dec 2021, Jan-Feb 2020*), UCLA (*Sep-Oct 2018*), ICMS (Edinburgh, *Aug 2016*), Univ. of Illinois at Chicago (*Sep-Oct 2015*), HRI (Allahabad, *Dec 2014*), Institut Fourier (Grenoble, *Jun 2008*)

Selected grants, awards, and fellowships:

- 2022+ Indian Academy of Sciences, Bangalore: Elected as a Fellow
- 2023 American Institute of Mathematics (USA): Research award to co-organize a workshop (with full funding) on “Theory and applications of total positivity”
- 2022 Department of Science and Technology and Vigyan Prasar (Government of India): One of 75 scientists profiled in the book “75 under 50: Scientists Shaping Today's India”
- 2020-25 Department of Science and Technology (Government of India): SwarnaJayanti Fellowship
- 2018-23 Science and Engineering Research Board (Government of India): Ramanujan Fellowship
- 2018-21 Science and Engineering Research Board (Government of India): MATRICS research grant
- 2017-19 Infosys Foundation (India): Young Investigator Award (research grant)
- 2016 International Centre for Mathematical Sciences (Edinburgh, UK): Research award to participate in the Research-in-Groups (RiG) programme (joint with A. Belton, D. Guillot, M. Putinar)
- 2014 American Institute of Mathematics (USA): Research award to co-organize a workshop (with full funding) on “Positivity, graphical models, and modeling of complex multivariate dependencies”
- 2011-2013 DARPA (USA): Co-investigator, DARPA Research Grant in pure mathematics

Selected invited talks (see website for larger list of 180+ invited talks / links to abstracts)

Recent conference talks (including upcoming talks):

- Jan 2023: AMS Joint Mathematics Meetings, Boston (USA), [ILAS Invited Address \(Plenary\)](#)
- Dec 2022: 88th Annual Conference of the Indian Mathematical Society, BIT Mesra: [Hansraj Gupta Memorial Award Lecture](#)
- Jul 2022: FPSAC (Formal Power Series and Algebraic Combinatorics; *Satellite of ICM-2022*), IISc Bangalore, [Invited \(Plenary\) talk](#)
- Jun 2022: ILAS Meeting (Int. Lin. Alg. Soc.), Galway (Ireland): [Special Session on General Preservers](#)
- Apr 2022: Kerala School of Mathematics: 2nd conference on [Recent advances in Mathematics and related areas](#)
- Mar 2022: Oberwolfach (Germany): Workshop on [The Laguerre–Pólya Class and Combinatorics](#)
- Dec 2021: 4th BRICS Mathematics Conference, IISER Trivandrum, [Invited talk](#)
- Aug 2021: 36th Annual conference of the Ramanujan Math. Society, Amrita University: [Invited talk](#)
- Jul 2021: ICMS Edinburgh (Scotland): Workshop on [Applied Matrix Positivity](#)
- Sep 2019: MAT-TRIAD, Liblice (Czechia): [Special Session on Total Positivity](#)
- Jul 2019: ILAS Meeting (International Linear Algebra Society), Rio de Janeiro (Brazil): [Plenary talk](#)

- Jul 2019: [8th ICMAA](#), University of Nevada at Reno (USA)
- Aug 2018: Algebras, Representations and Applications: [ICM Satellite Conference](#), Cusco (Peru)
- Jul 2017: [Mathematical Congress of the Americas](#), Centre Mont-Royal, Montreal (Canada)
- **AMS–MAA Joint Mathematics Meetings**: 4 Jan 2017 and 6 Jan 2016 and 10, 12, 13 Jan 2015
- Oct 2014: American Institute of Mathematics, Palo Alto (USA): Workshop on Positivity, graphical models, and modeling of complex multivariate dependencies

In honor of: G. Misra (Nov 2022), [K.B. Sinha](#) (Dec 2019), [R.B. Bapat](#) (Dec 2019), [S.H. Kulkarni](#) (Jun 2018), [R. Bhatia](#) (Dec 2017), [D.S. Passman](#) (Oct 2015), [S.E. Rao](#) (Dec 2014), [J. Lepowsky](#) and [R. Wilson](#) (May 2005)

Colloquia, Joint seminars, Annual Day Talks, etc.:

- Jul 2022: Indian Academy of Sciences Mid-Year Meeting, IISc Bangalore: [Inaugural Fellows’ Lecture](#)
- Jan 2022: [2nd K.S.S. Nambooripad Endowment Lecture](#), IMRT, Kerala (India)
- Oct 2021: [Mathematics Discipline Seminar](#), IIT Gandhinagar (India)
- Feb 2021: [Research Scholars’ Day](#), IIT Roorkee (India)
- Feb 2020: Annual Math-Stat Departmental Symposium, IISER Kolkata (India)
- Sep 2019: [20th Professor Wazir Hasan Abdi Memorial Lecture](#), CUSAT, Cochin (India)
- Jul 2018: Joint [New York Group Theory](#) + [New York Combinatorics](#) Seminar, CUNY (New York)
- May 2018: International Mathematics Olympiad Training Camp: Valedictory Lecture, Mumbai (India)
- Apr 2017: San Francisco State Univ., [Joint Algebra–Geometry–Combinatorics + Analysis Seminar](#)
- **Colloquia** at: NISER Bhubaneswar (Oct 2021), IISER Pune (Jan 2021), ICTS Bangalore (Sep 2020), Drexel Univ. (Feb 2020), Delhi Univ. (Oct 2019), CMI Chennai (Apr 2019), IIT Kanpur (Apr 2019), TIFR-CAM (Mar 2019), IMSc Chennai (Nov 2018), IIT Bombay (May 2018), ISI Bang. (May 2018), TIFR Mumbai (CS; Oct 2017), ISI Bangalore (Nov 2013), De Paul University (Oct 2013), University of Toledo (Apr 2013), Iowa State University (Feb 2011), IMSc Chennai (Sep 2009).

Selected seminar talks:

- 2022: **(a)** UniRoma-1 “La Sapienza”; **(b)** UniRoma-2 “Tor Vergata”; **(c)** CUSAT
- 2022 Webinars: **(a)** Univ. Georgia; **(b)** Ruhr Universität Bochum; **(c)** ARCSIN; **(d)** Unofficial IMOTC
- 2021 Webinars: **(a)** Univ. Sao Paulo; **(b)** IMAR “Simion Stoilow”; **(c)** ISI Delhi; **(d)** IISER Mohali
- 2020 Webinars: **(a)** IMSc Chennai; **(b)** Special Functions/Number Theory (India); **(c)** Preserver Webinar
- 2020: **(a)** Univ. of Pennsylvania; **(b)** Temple University; **(c)** CUNY; **(d)** Univ. of Delaware
- 2019: **(a)** Univ. of Maryland at College Park; **(b)** Rutgers University; **(c)** CUNY; **(d)** TIFR, Mumbai
- 2018: **(a)** Massachusetts Inst. of Technology (MIT); **(b)** UCLA; **(c)** Univ. of Sydney; **(d)** TIFR, Mumbai
- 2017: **(a)** UC Berkeley; **(b)** UCLA; **(c)** CalTech; **(d)** Stanford
- 2016: **(a)** Univ. of California at Santa Barbara; **(b)** IISc, Bangalore
- 2015: **(a)** Univ. of Pennsylvania; **(b)** Rutgers Univ.; **(c)** Northeastern Univ.; **(d)** Univ. of Chicago
- 2014: **(a)** UC Berkeley; **(b)** Univ. of Wisconsin, Madison; **(c)** IIT Bombay
- 2013: **(a)** Univ. of Washington at Seattle; **(b)** Univ. of Illinois at Chicago; **(c)** IISc, Bangalore
- 2010–2012: **(a)** TIFR, Mumbai; **(b)** Univ. of Michigan at Ann Arbor; **(c)** ISI Delhi; **(d)** UC Riverside
- 2009: **(a)** CalTech; **(b)** Univ. of Michigan at Ann Arbor; **(c)** Yale; **(d)** Univ. of Southern California
- 2008: **(a)** TIFR, Mumbai; **(b)** Univ. of Chicago; **(c)** Yale; **(d)** Cornell Univ.; **(e)** Rutgers Univ.

Professional service: 1. Editorial

- Editor, [Acta Scientiarum Mathematicarum \(Szeged\)](#) (2022-present)
- Editor, [Indian Journal of Pure and Applied Mathematics](#) (2020-present)
- Editor, [Linear and Multilinear Algebra](#) (2020-present)
- Editor, [TRIM Series](#) (Texts and Readings in Mathematics), Hindustan Book Agency (2018-present)
- Associate Editor, [Sao Paulo Journal of Mathematical Sciences](#) (2018-present)
- Guest Editor, [Journal of Indian Institute of Science](#) (2022 Special volume on “Number Theory and Representation Theory”)

Professional service: 2. Other

- [Board of Directors](#), International Linear Algebra Society (2021-2024)

Professional Service: 3. Refereeing

- Trans. Amer. Math. Soc.
- Int. Math. Res. Not. IMRN
- Israel Journal of Math.
- Math. Zeitschrift
- J. Combin. Theory Series A
- Journal of Algebra
- J. Geom. Analysis
- Bull. London Math. Soc.
- Pacific Journal of Math.
- Kyoto Journal of Math.
- J. Non-Comm. Geometry
- Letters Math. Phys.
- AMS Contemporary Math.
- Linear Algebra and Appl.
- Indian J. Pure Appl. Math.
- Linear Multilinear Algebra
- Comm. Algebra
- Discrete Mathematics
- Algebr. Represent. Theory
- Journal of Algebra and Appl.
- Electronic J. Linear Algebra
- Bull. Iranian Math. Society
- Open Mathematics
- Resonance

Also a referee for *grant proposals for SERB* (Science and Engineering Research Board, India).

Professional service: 4. Teaching and mentoring

- **IISc Mentoring:** 3 PhD students (2 graduated; 1 cleared “Comprehensives”); 4 NPDF/NBHM/CV Raman Postdocs + 1 Inspire Faculty.
- *Indian Institute of Science:* Developed and taught new course “MA341: Matrix analysis and positivity”.
- *Yale University:* Developed+taught new course “Math 107 : Mathematics in the Real World”, in 2011 – the course is taught at Yale every year since then. Also co-authored the Course textbook (2015; below).
- *Stanford University:* Developed and proposed new course “Math 16/Stats 90: Mathematics and Statistics in the Real World”, co-taught with Bala Rajaratnam.
- Co-advised a Math. PhD Student at Stanford (2012-16) with Bala Rajaratnam.
- Mentored a Math. PhD student of V. Futorny of Univ. Sao Paulo (Spring+Summer 2016).
- Taught 50+ courses – undergraduate and graduate – at University of Chicago, University of California at Riverside, Yale University, Stanford University, and Indian Institute of Science.

Professional service: 5. Conference organization (see website for complete list + co-organizers)

- *Dec 2023:* Conference on “Algebraic and Combinatorial Methods in Representation Theory”, ICTS Bangalore: Member of the Scientific Committee.
- *Jun 2022:* Invited Mini-Symposium on “[Distance Matrices of Graphs](#)”, International Linear Algebra Society (ILAS) Meeting, National University of Ireland, Galway.
- *Jul 16-20, 2018:* 30th International Conference on [Formal Power Series and Algebraic Combinatorics](#) (FPSAC), supported by the NSF, Dartmouth College. Also the *Proceedings Editor*.
- *Jul 24-28, 2017:* Invited Mini-symposium on “[Linear Algebra and Positivity with Applications to Data Science](#)”, International Linear Algebra Society (ILAS) Meeting, Iowa State University.
- *Jan 13, 2015:* AMS Special Session on “[Positivity and Matrix Inequalities](#)”, AMS-MAA Joint Mathematics Meetings, San Antonio.
- *Oct 13-17, 2014:* Workshop on “[Positivity, graphical models, and modeling of complex multivariate dependencies](#)” (sponsored by the AIM and NSF), American Institute of Mathematics.
- *Feb 1-2, 2014:* [Lie Theory Workshop on Quantum Groups](#) (supported by the NSF), Stanford University.
- *May 26-27, 2012:* [Young Researchers’ Meet](#) (Math and CS), Stanford University.
- *Feb 4-5, 2012:* [Lie Theory Workshop on Quantum Groups](#) (supported by the NSF), Stanford University.

Selected peer-reviewed publications: (see website for [complete list](#))

I. Papers:

1. (With Alexander Belton, Dominique Guillot, and Mihai Putinar.) *Totally positive kernels, Pólya frequency functions, and their transforms*, [Journal d’Analyse Mathématique](#) (63 pp.), **in press**.
2. (With Alexander Belton, Dominique Guillot, and Mihai Putinar.) *Moment-sequence transforms*, [Journal of the European Mathematical Society](#) 24, pages 3109–3160, **2022**.

I. Papers: (cont.)

3. *Smooth entrywise positivity preservers, a Horn–Loewner master theorem, and symmetric function identities*, [Transactions of the American Mathematical Society](#) 375, pages 2217–2236, **2022**.
4. (With Gurbir Dhillon.) *The weights of simple modules in Category O for Kac–Moody algebras*, [Journal of Algebra](#) 603, pages 164–200, **2022**.
[12-page extended abstract published in [Seminaire Lothar. Combin.](#) 78B, #77, **2017**.]
5. (With Alexander Belton, Dominique Guillot, and Mihai Putinar.) *Hirschman–Widder densities*, [Applied and Computational Harmonic Analysis](#) 60, pages 396–425, **2022**.
6. (With Terence Tao.) *On the sign patterns of entrywise positivity preservers in fixed dimension*, [American Journal of Mathematics](#) 143, pages 1863–1929, **2021**.
[12-page extended abstract published in [Seminaire Lothar. Combin.](#) 80B, #14, **2018**.]
7. (With Projesh Nath Choudhury and M. Rajesh Kannan.) *Sign non-reversal property for totally non-negative and totally positive matrices, and testing total positivity of their interval hull*, [Bulletin of the London Mathematical Society](#) 53, pages 981–990, **2021**.
8. (With Carolina Benedetti, Rafael S. González D’León, Christopher R.H. Hanusa, Pamela E. Harris, Alejandro H. Morales, and Martha Yip.) *A combinatorial model for computing volumes of flow polytopes*, [Transactions of the American Mathematical Society](#) 372, pages 3369–3404, **2019**.
[12-page extended abstract published in [Seminaire Lothar. Combin.](#) 80B, #87, **2018**.]
9. (As D.H.J. Polymath: with Tobias Fritz, Siddhartha Gadgil, Pace Nielsen, Lior Silberman, and Terence Tao.) *Polymath14: Homogeneous length functions on groups*, [Algebra & Number Theory](#) 12, pages 1773–1786, **2018**.
10. *Generalized nil-Coxeter algebras over discrete complex reflection groups*, [Transactions of the American Mathematical Society](#) 370, pages 2971–2999, **2018**.
[12-page extended abstract published in [Seminaire Lothar. Combin.](#) 80B, #29, **2018**.]
11. (With Gurbir Dhillon.) *Faces of highest weight modules and the universal Weyl polyhedron*, [Advances in Mathematics](#) 319, pages 111–152, **2017**.
12. *Standard parabolic subsets of highest weight modules*, [Transactions of the American Mathematical Society](#) 369, pages 2363–2394, **2017**.
13. (With Bala Rajaratnam.) *The Hoffmann–Jørgensen inequality in metric semigroups*, [Annals of Probability](#) 45, pages 4101–4111, **2017**.
14. (With Dominique Guillot and Bala Rajaratnam.) *Preserving positivity for rank-constrained matrices*, [Transactions of the American Mathematical Society](#) 369, pages 6105–6145, **2017**.
15. (With Alexander Belton, Dominique Guillot, and Mihai Putinar.) *Matrix positivity preservers in fixed dimension. I*, [Advances in Mathematics](#) 298, pages 325–368, **2016**.
[12-page abstract published in [DMTCS Proceedings](#) BC, pages 155–166, **2016**.]
16. (With Dominique Guillot and Bala Rajaratnam.) *Preserving positivity for matrices with sparsity constraints*, [Transactions of the American Mathematical Society](#) 368, pages 8929–8953, **2016**.
17. (With Dominique Guillot and Bala Rajaratnam.) *Critical exponents of graphs*, [Journal of Combinatorial Theory Series A](#) 139, pages 30–58, **2016**.
[12-page extended abstract published in [Seminaire Lothar. Combin.](#) 78B, #62, **2017**.]
18. *Faces and maximizer subsets of highest weight modules*, [Journal of Algebra](#) 455, pages 32–76, **2016**.
19. (With Akaki Tikaradze.) *On Category O over triangular generalized Weyl algebras*, [Journal of Algebra](#) 449, pages 687–729, **2016**.
20. (With Peter Diao, Dominique Guillot, and Bala Rajaratnam.) *Differential calculus on graphon space*, [Journal of Combinatorial Theory, Series A](#) 133, pages 183–227, **2015**.

II. Books and survey articles:

21. (**Book.**) *Matrix analysis and entrywise positivity preservers*, **2022**.
Vol. 471 in [London Mathematical Society Lecture Note Series](#), Cambridge University Press (314 pp.);
and Vol. 82 in [Texts and Readings In Mathematics](#) (TRIM Series), Hindustan Book Agency (361 pp.).

22. (Survey article, peer-reviewed, with Alexander Belton, Dominique Guillot, and Mihai Putinar.) *A panorama of positivity*: [arXiv:math.CA/1812.05482](https://arxiv.org/abs/math/1812.05482) (unified version).
- Part I: Dimension free, in: *Analysis of Operators on Function Spaces* (The Serguei Shimorin Memorial Volume; A. Aleman, H. Hedenmalm, D. Khavinson, M. Putinar, Eds.), pp. 117–165, Trends in Mathematics, Birkhauser, **2019**.
 - Part II: Fixed dimension, in: *Complex Analysis and Spectral Theory* (in honor of Thomas Ransford), Proceedings of the CRM Workshop held at Laval University, QC, May 21-25, 2018 (G. Dales, D. Khavinson, J. Mashreghi, Eds.). CRM Proceedings – AMS Contemporary Mathematics, American Mathematical Society 743, pp. 109–150, **2020**.
23. (**Book**, with Anna Lachowska.) *Beautiful, Simple, Exact, Crazy: Mathematics in the Real World*, [Yale University Press](https://www.yale.edu/yupress/), 480 pp., **2015**.
24. (Invited survey article.) *Representations of complex semi-simple Lie groups and Lie algebras*, in [Connected at Infinity II: A Selection of Mathematics by Indians](https://www.ams.org/bookseries/MSR-100) (Rajendra Bhatia, Conjeevaram S. Rajan, and Ajit I. Singh, Eds.), TRIM, Hindustan Book Agency, pp. 85–129, **2013**.

Seminar organization:

- *2021-present*: Current co-organizer of the [ARCSIN Seminar](#) Series, IISc–IIT Kanpur–IMSc
- *2019-present*: Current organizer of the [Eigenfunctions](#) Series, IISc
- *2019-present*: Current co-organizer of the [APRG Seminar](#) Series, IISc
- *2018-present*: Co-organizer of the [Algebra & Combinatorics Seminar](#) Series, IISc