



Affiliation	Institut of Mathematics, Freie Universität Berlin Arnimallee 2, 14195 Berlin Institut of Mathematics, Goethe-Universität Frankfurt Robert-Mayer-Str. 10, 60325 Frankfurt	
Phone	+49 (0)69 798 23 411	
Email / WWW	sanyal@math.uni-frankfurt.de / http://www.math.uni-frankfurt.de/~sanyal	
Scientific Education	10/2005–07/2008	PhD in Mathematics (summa cum laude) TU Berlin (with Günter M. Ziegler) Title: <i>Constructions and obstructions for extremal polytopes</i>
	10/1999–09/2005	Diploma in Computer Science (with distinction) TU Berlin (with Günter M. Ziegler) Title: <i>On the combinatorics of projected deformed products</i>
Scientific/ Professional Vita	09/2022–08/2023	Professor, Freie Universität Berlin
	08/2017–12/2017	Research Professor, MSRI, Berkeley
	09/2016–	Professor (W2), Goethe-Universität Frankfurt
	07/2011–08/2016	Junior Professor (W1), Freie Universität Berlin
	01/2009–07/2011	Miller Research Fellow, UC Berkeley (with D. Eisenbud, B. Sturmfels)
	10/2008–12/2008	Postdoc, Konrad-Zuse-Zentrum Berlin (ZIB) (with M. Grötschel)
	2006–2008	Phase II Student, Berlin Mathematical School (DFG Graduate School)
	1998–2003	Freelance Software Engineer
Awards	2017	Research Professorship, MSRI-Program <i>Geometric and Topological Combinatorics</i>
	2016	Professorship (W3), University of Konstanz (declined)
	2010	Runner-Up for Richard-Rado-Prize (honorable mention)
	2009	Tiburtius Prize (Berlin dissertation prize)
	2008	Miller Research Fellowship
	2008	Certificate of Excellence of the Berlin Mathematical School
Research Activities	2020	Program member 'Algebraic and enumerative combinatorics', Institute Mittag-Leffler, Sweden
	2019	Program member 'Geometry of polynomials', Simons Institute, Berkeley, USA
	2018	Program member 'Tropical geometry, amoebas and polytopes', Institute Mittag-Leffler, Sweden
	2017	MSRI-Program 'Geometric and Topological Combinatorics', Berkeley, USA
	2012–2016	coPI, DFG Transregio Collaborative Research Unit (TR109) 'Discretization in Geometry and Dynamics' (DGD)
	2012–2016	Junior Faculty Member, DFG Research Training Group (GRK 1408) 'Methods for Discrete Structures' (MDS)
	2011–2016	Faculty Member, Berlin Mathematical School (BMS)

	2006–2012	Associate Member, DFG Research Unit 565 ‘Polyhedral Surfaces’
	2006–2008	Member, RTG ‘Methods for Discrete Structures’ (GRK 1408)
Organiz. Activities	2022	Main Math Challenge (Math competition for high school students)
	2022	Geometry meets Combinatorics in Bielefeld
	2022	Workshop ‘ Combinatorial Coworkspace ’, Kleinwalsertal, Austria
	2021	Session ‘Algebraic and Geometric Combinatorics’, First joint IMU-DMV meeting, Jerusalem (postponed due to Corona)
	2020	Workshop ‘ Combinatorial Coworkspace ’, Kleinwalsertal, Austria
	2020	Program Committee ‘Formal Power Series and Algebraic Combinatorics’ (FPSAC)
	2017	MSRI Summer School ‘Positivity questions in geometric combinatorics’
	2015	Summer school ‘Convex Geometry – discrete and computational’, Berlin
	2015	Workshop ‘Discrete Models in Geometry and Topology’, Berlin
	2013	Workshop ‘Delaunay Geometry: Polytopes, Triangulations and Spheres’, Berlin
	2013	Birthday conference for Günter M. Ziegler, Berlin
	2011	Workshop ‘High-Complexity Discrete Geometry’, Berlin
	2011	Minisymposium ‘Algebraic Geometry in Convex Optimization’, SIAM Conference on Applied Algebraic Geometry, Raleigh, NC, USA
	2009–2011	Member of steering committee, ‘Bay Area Discrete Math Day’
	2010	Main organizer, 21st Bay Area Discrete Math Day, MSRI, Berkeley, USA
	2009–2010	Organizer ‘Discrete Math Seminar’, UC Berkeley, USA
Editorships	2011	Guest Editor, Special Issue of <i>Annals of Combinatorics</i> for the 10th Anniversary of the Bay Area Discrete Math Day
Review duties (Selection)		American Mathematical Monthly, Advances in Geometry, Compositio Mathematica, Discrete & Computational Geometry, European Journal of Combinatorics, Geometriae Dedicata, Israel Journal of Mathematics, Journal of Algebraic Combinatorics, Journal of Combinatorial Theory Series A, Mathematische Zeitschrift, Michigan Mathematical Journal, SIAM Journal on Optimization, Proceedings of the AMS, Transactions of the AMS; Symposium on Computational Geometry (SoCG), Symposium on Discrete Algorithms (SODA); International Conference on Formal Power Series and Algebraic Combinatorics (FPSAC)
Invited Lectures (Selection)	2022	Geometry, Combinatorics and Optimization, Sorbonne Université, Paris, France
	2021	Tropical geometry and the geometry of linear programming (virtual), Hausdorff Institute, Bonn, Germany
	2021	(Polytop)ics: Recent advances on polytopes (virtual), MPI Leipzig, Germany
	2021	Optimization Under Symmetry (virtual), Simons Institute, Berkeley, USA
	2019	Discrete geometry with a view on symplectic and tropical geometry, Cologne, Germany
	2019	Convex, Discrete and Integral Geometry, Jena, Germany
	2019	Convexity day, MPI Leipzig, Germany
	2019	Oberwolfach Workshop ‘Geometric, algebraic, and topological combinatorics’
	2019	Summer School on Geometric and Algebraic Combinatorics, Paris, France
	2019	Colloquium talk, University of Fribourg, Switzerland
	2019	Minicourse, Simons Institute, Berkeley, USA
	2019	Algebra & Discrete Mathematics Seminar, UC Davis, USA
	2019	Combinatorics Seminar, UC Berkeley, USA University, USA

2019 Seminar 'Algebra, Combinatorics, Geometry', San Francisco State University, USA
 2018 Colloquium talk, University Bielefeld, Germany
 2018 Discrete Optimization Seminar, EPFL, Lausanne, Switzerland
 2018 BMS Friday Lecture, Berlin Mathematical School, Berlin, Germany
 2018 Combinatorial Geometries: Matroids, Oriented Matroids and Applications, CIRM, France
 2018 26th National School on Algebra, Constanta, Romania
 2018 Colloquium talk, University Heidelberg, Germany
 2018 Colloquium talk, University Osnabrück, Germany
 2018 Combinatorics Seminar, Université Aix-Marseille, France
 2018 Workshop on Combinatorics, Polytopes, and Complexity, Mittag-Leffler Institute, Sweden
 2018 Combinatorics Seminar, KTH Stockholm, Sweden
 2017 Combinatorics Seminar, U Washington, Seattle
 2017 Mini-Workshop: Lattice Polytopes, Oberwolfach, Germany
 2017 79-te Seminaire Lotharingien de Combinatoire, Bertinoro, Italy
 2017 MSRI-Workshop: Geometric and Topological Combinatorics
 2017 Colloquium talk, University Cologne, Germany
 2017 Workshop on Perspectives and Emerging Topics in Algebra and Konvexity (PEAK), Austria
 2016 Einstein Workshop on Lattice Polytopes, FU Berlin, Germany
 2016 Fall School, 'Discrete Geometry and Topology', TU Graz, Austria
 2016 Combinatorics Seminar, UC Berkeley, Berkeley, USA
 2015 SIAM Conference 'Applied Algebraic Geometry', Korea
 2015 RISC Summer School 'Algorithmic and Enumerative Combinatorics', Linz, Austria
 2015 Workshop on NonLinear Algebra, Berlin
 2015 ERC Workshop 'Discrete Models in Geometry and Topology', Berlin
 2015 Oberwolfach Workshop 'Discrete Differential Geometry'
 2015 Dagstuhl Seminar 'Limitations of convex programming'
 2015 Oberwolfach Workshop 'Algebraic and topological combinatorics'
 2014 Algebra & Geometry Seminar, Aalto University, Finland
 2014 Oberseminar Geometrie, Universität zu Köln
 2014 Oberwolfach Workshop 'Real Algebraic Geometry'
 2014 Oberseminar Diskrete Mathematik, Goethe Universität Frankfurt
 2014 BMS Days, Berlin Mathematical School, Berlin
 2014 Kolloquium der Mathematik, Universität Osnabrück
 2013 INdA Conference 'Combinatorial Methods in Algebra and Topology', Cortona, Italy
 2013 SIAM Conference 'Applied Algebraic Geometry', Fort Collins, Colorado, USA
 2013 Spring School 'Geometric Combinatorics', Hanoi, Vietnam
 2013 Mathematisches Kolloquium, Universität Rostock
 2012 Berlin-Poznań Seminar on Discrete Mathematics, ZIB, Berlin
 2012 Seminar 'Algebra, Combinatorics, Geometry', San Francisco State University, USA
 2012 National School 'Invariants in Comm. Algebra and in Algebraic Geometry', Mangalia, Romania
 2012 21st International Symposium on Mathematical Programming, Berlin
 2012 12th International Workshop on High Performance Optimization, Delft, Netherlands
 2012 Monday lecture, RTG 'Methods for Discrete Structures', Berlin
 2011 Minisymposium 'Diskrete Geometrie und Diskrete Topologie', DMV Annual Meeting, Cologne
 2010 Workshop 'Convex Optimization and Algebraic Geometry', IPAM, Los Angeles, USA
 2010 Symposium 'Diskrete Mathematik', Vienna, Austria
 2010 AMS Section Meeting 'Special Session on Geometric Combinatorics', Albuquerque, USA
 2009 Oberwolfach Seminar 'New Trends in Algorithms for Real Algebraic Geometry'

2009 19th Bay Area Discrete Math Day, California State University, East Bay, USA
 2007 Oberwolfach Workshop ‘Geometric and Topological Combinatorics’
 2007 MSRI Workshop ‘Topological Methods in Combinatorics, Computational Geometry, and the Study of Algorithms’, Berkeley, USA
 2006 Discrete and Computational Geometry – Twenty Years Later, Snowbird, USA

Advising	Postdocs	Arnau Padrol (1/2013–9/2015, Project A3, DGD) Spencer Backman (5/2017–12/2017, Project A3, DGD)
	PhD	Katharina Jochemko (10/2011–12/2014, Hilda Geiringer Scholarship, BMS) Francesco Grande (10/2012–10/2015, PhD scholarship, MDS) Tobias Friedl (10/2013–05/2017) Sebastian Manecke (04/2017–) Aenne Benjes (11/2020–)
	Master	15 completed, 1 current
	Bachelor	10 completed, 2 current
	Mentoring	7 BMS Phase-II students (PhD), 1 BMS Phase-I student 2 undergraduate students (Deutschlandstipendium, TANDEM) Mentor for <i>Schülerstudenten</i> (currently 10) at Goethe University

Publications Books

- [1] M. Beck and R. Sanyal, *Combinatorial Reciprocity Theorems*, vol. 195 of Graduate Studies in Mathematics, American Mathematical Society, Providence, RI, 2018.

Refereed publications

- [2] K. Adiprasito and R. Sanyal, *An Alexander-type duality for valuations*, Proc. Amer. Math. Soc., 143 (2015), pp. 833–843. [doi:10.1090/S0002-9939-2014-12366-5](https://doi.org/10.1090/S0002-9939-2014-12366-5).
- [3] ———, *Relative Stanley–Reisner theory and Upper Bound Theorems for Minkowski sums*, Publ. Math. Inst. Hautes Études Sci., 124 (2016), pp. 99–163. [doi:10.1007/s10240-016-0083-7](https://doi.org/10.1007/s10240-016-0083-7).
- [4] K. A. Adiprasito, P. Brinkmann, A. Padrol, P. Paták, Z. Patáková, and R. Sanyal, *Colorful simplicial depth, minkowski sums, and generalized gale transforms*, International Mathematics Research Notices, 6 (2019), pp. 1894–1919. [doi:10.1093/imrn/rnx184](https://doi.org/10.1093/imrn/rnx184).
- [5] S. Artstein-Avidan, S. Sadovsky, and R. Sanyal, *Geometric inequalities for anti-blocking bodies*, Communications in Contemporary Mathematics, 0 (0), p. 2150113. [doi:10.1142/S0219199721501133](https://doi.org/10.1142/S0219199721501133).
- [6] A. Bhardwaj, P. Rostalski, and R. Sanyal, *Deciding polyhedrality of spectrahedra*, SIAM J. Optim., 25 (2015), pp. 1873–1884. [doi:10.1137/120904172](https://doi.org/10.1137/120904172).
- [7] G. Blekherman, M. Kummer, R. Sanyal, K. Shu, and S. Sun, *Linear principal minor polynomials: Hyperbolic determinantal inequalities and spectral containment*. Preprint, December 2021, 21 pages, [arXiv:2112.13321](https://arxiv.org/abs/2112.13321). accepted to *Int. Math. Res. Not. (IMRN)*.
- [8] F. Breuer and R. Sanyal, *Ehrhart theory, modular flow reciprocity, and the Tutte polynomial*, Math. Z., 270 (2012), pp. 1–18. [doi:10.1007/s00209-010-0782-6](https://doi.org/10.1007/s00209-010-0782-6).
- [9] T. Chappell, T. Friedl, and R. Sanyal, *Two double poset polytopes*, SIAM J. Discrete Math., 31 (2017), pp. 2378–2413. [doi:10.1137/16M1091800](https://doi.org/10.1137/16M1091800).
- [10] G. Codenotti, L. Katthän, and R. Sanyal, *On f - and h -vectors of relative simplicial complexes*, Algebraic Combinatorics, 2 (2019), pp. 343–353. [e-journal](https://arxiv.org/abs/1905.08001).
- [11] A. Dochtermann, M. Joswig, and R. Sanyal, *Tropical types and associated cellular resolutions*, J. Algebra, 356 (2012), pp. 304–324. [doi:10.1016/j.jalgebra.2011.12.028](https://doi.org/10.1016/j.jalgebra.2011.12.028).
- [12] A. Dochtermann and R. Sanyal, *Laplacian ideals, arrangements, and resolutions*, J. Algebraic Combin., 40 (2014), pp. 805–822. [doi:10.1007/s10801-014-0508-7](https://doi.org/10.1007/s10801-014-0508-7).
- [13] A. Engström, R. Sanyal, and C. Stump, *Standard complexes of matroids and lattice paths*, Vietnam Journal of Mathematics, 50 (2022), pp. 763–779. Sturmfels birthday issue, [doi:10.1007/s10013-021-00546-z](https://doi.org/10.1007/s10013-021-00546-z).

- [14] F. Frick and R. Sanyal, *Minkowski complexes and convex threshold dimension*, J. Combin. Theory Ser. A, 151 (2017), pp. 202–206. doi:10.1016/j.jcta.2017.04.010.
- [15] T. Friedl, C. Riener, and R. Sanyal, *Reflection groups, reflection arrangements, and invariant real varieties*, Proc. Amer. Math. Soc., 146 (2018), pp. 1031–1045. doi:10.1090/proc/13821.
- [16] K. Fritsch, J. Heuer, R. Sanyal, and N. Schulz, *The martin gardner polytopes*, The American Mathematical Monthly, 127 (2020), pp. 594–601. doi:10.1080/00029890.2020.1751547.
- [17] L. Gellert and R. Sanyal, *On degree sequences of undirected, directed, and bidirected graphs*, European J. Combin., 64 (2017), pp. 113–124. doi:10.1016/j.ejc.2017.04.002.
- [18] F. Grande, A. Padrol, and R. Sanyal, *Extension complexity and realization spaces of hypersimplices*, Discrete Comput. Geom., 59 (2018), pp. 621–642. doi:10.1007/s00454-017-9925-4.
- [19] F. Grande and R. Sanyal, *Theta rank, levelness, and matroid minors*, J. Combin. Theory Ser. B, 123 (2017), pp. 1–31. doi:10.1016/j.jctb.2016.11.002.
- [20] C. Haase, M. Juhnke-Kubitzke, R. Sanyal, and T. Theobald, *Mixed Ehrhart polynomials*, Electron. J. Combin., 24 (2017), pp. Paper 1.10, 14. e-journal.
- [21] B. Hanke, R. Sanyal, C. Schultz, and G. M. Ziegler, *Combinatorial Stokes formulas via minimal resolutions*, J. Combin. Theory Ser. A, 116 (2009), pp. 404–420. doi:10.1016/j.jcta.2008.06.009.
- [22] K. Jochemko and R. Sanyal, *Arithmetic of marked order polytopes, monotone triangle reciprocity, and partial colorings*, SIAM J. Discrete Math., 28 (2014), pp. 1540–1558. doi:10.1137/130944849.
- [23] —, *Combinatorial mixed valuations*, Adv. Math., 319 (2017), pp. 630–652. doi:10.1016/j.aim.2017.08.032.
- [24] —, *Combinatorial positivity of translation-invariant valuations and a discrete Hadwiger theorem*, J. Eur. Math. Soc. (JEMS), 20 (2018), pp. 2181–2208. doi:10.4171/JEMS/809.
- [25] F. Kohl, M. Olsen, and R. Sanyal, *Unconditional reflexive polytopes*, Discrete Comput. Geom., 64 (2020), pp. 427–452. Branko Grünbaum Memorial Issue, doi:10.1007/s00454-020-00199-8.
- [26] S. Manecke and R. Sanyal, *Coprime Ehrhart Theory and Counting Free Segments*, International Mathematics Research Notices, (2022). doi:10.1093/imrn/rnab059.
- [27] S. Manecke, R. Sanyal, and J. So, *S-hypersimplices, pulling triangulations, and monotone paths*, Electron. J. Combin., 27 (2020), pp. Paper No. 3.16, 14. doi:10.37236/8457.
- [28] T. Netzer and R. Sanyal, *Smooth hyperbolicity cones are spectrahedral shadows*, Math. Program. Ser. B, 153 (2015), pp. 213–221. doi:10.1007/s10107-014-0744-6.
- [29] C. Pegel and R. Sanyal, *On piecewise-linear homeomorphisms between distributive and anti-blocking polyhedra*, in Combinatorial structures in algebra and geometry, vol. 331 of Springer Proc. Math. Stat., Springer, Cham, [2020] ©2020, pp. 95–114. arXiv:1911.12090.
- [30] T. Rörig and R. Sanyal, *Non-projectability of polytope skeleta*, Adv. Math., 229 (2012), pp. 79–101. doi:10.1016/j.aim.2011.09.004.
- [31] R. Sanyal, *Topological obstructions for vertex numbers of Minkowski sums*, J. Combin. Theory Ser. A, 116 (2009), pp. 168–179. doi:10.1016/j.jcta.2008.05.009.
- [32] —, *On the derivative cones of polyhedral cones*, Adv. Geom., 13 (2013), pp. 315–321. doi:10.1515/advgeom-2011-051.
- [33] R. Sanyal and G. Loho, *Tropical carathéodory with matroids*. Preprint, December 2019, 15 pages, arXiv:1912.11262. Disc. Comput Math, accepted for publication.
- [34] R. Sanyal, F. Sottile, and B. Sturmfels, *Orbitopes*, Mathematika, 57 (2011), pp. 275–314. doi:10.1112/S002557931100132X.
- [35] R. Sanyal and C. Stump, *Lipschitz polytopes of posets and permutation statistics*, J. Combin. Theory Ser. A, 158 (2018), pp. 605–620. doi:10.1016/j.jcta.2018.04.006.
- [36] R. Sanyal, B. Sturmfels, and C. Vinzant, *The entropic discriminant*, Adv. Math., 244 (2013), pp. 678–707. doi:10.1016/j.aim.2013.05.019.
- [37] R. Sanyal, A. Werner, and G. M. Ziegler, *On Kalai’s conjectures concerning centrally symmetric polytopes*, Discrete Comput. Geom., 41 (2009), pp. 183–198. doi:10.1007/s00454-008-9104-8.
- [38] R. Sanyal and G. M. Ziegler, *Construction and analysis of projected deformed products*, Discrete Comput. Geom., 43 (2010), pp. 412–435. doi:10.1007/s00454-009-9146-6.

Preprints

- [39] K. Adiprasito and R. Sanyal, *Whitney numbers of arrangements via measure concentration of intrinsic*

- volumes. Preprint, June 2016, 9 pages, [arXiv:1606.09412](https://arxiv.org/abs/1606.09412).
- [40] S. Backman, S. Manecke, and R. Sanyal, *Cone valuations, Gram's relation, and flag-angles*. Preprint, September 2018, 17 pages, [arXiv:1809.00956](https://arxiv.org/abs/1809.00956).
- [41] ———, *Fan valuations and spherical intrinsic volumes*. Preprint, June 2021, 13 pages, [arXiv:2106.06407](https://arxiv.org/abs/2106.06407).
- [42] A. E. Black, J. A. D. Loera, N. Lütjeharms, and R. Sanyal, *The polyhedral geometry of pivot rules and monotone paths*. Preprint, January 2022, 27 pages, [arXiv:2201.05134](https://arxiv.org/abs/2201.05134).
- [43] A. E. Black and R. Sanyal, *Flag polymatroids*. Preprint, July 2022, 27 pages, [arXiv:2207.12221](https://arxiv.org/abs/2207.12221).
- [44] S. Manecke and R. Sanyal, *Inscribable fans I: Inscribed cones, virtual polytopes, and routed particle trajectories*. Preprint, December 2020, 40 pages, [arXiv:2012.07724](https://arxiv.org/abs/2012.07724).
- [45] ———, *Inscribable fans II: Inscribed zonotopes, simplicial arrangements, and reflection groups*. Preprint, March 2022, 39 pages, [arXiv:2203.11062](https://arxiv.org/abs/2203.11062).
- [46] J. Saunderson and R. Sanyal, *Spectral polyhedra*. Preprint, Janua 2020, 13 pages, [arXiv:2001.04361](https://arxiv.org/abs/2001.04361).