Ingmar A. Saberi

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Personal information

Date and place of birth:	7 May 1990 Pullman, Washington, U.S.A.
Citizenship:	U.S.A. (German permanent resident)

Professional appointments

Ludwig-Maximilians-Universität München Munich, Germany	Senior Researcher in Mathematical Physics *supervisor: Ilka Brunner*	from October 2020
Universität Heidelberg Heidelberg, Germany	Postdoc in Mathematics *supervisor: Johannes Walcher*	October 2016–September 2020

Education

California Institute of Technology Pasadena, Calif.	Ph.D., Physics *advisor: Sergei Gukov*	June 2017
—〃—	M.S., Physics	June 2015
Princeton University Princeton, N.J.	A.B., Mathematics *advisor: Gang Tian*	May 2011
Washington State University Pullman, Wash.	M.S., Physics *advisor: Fred Gittes*	May 2007

Publications

Refereed publications:

1. S. Raghavendran, I. Saberi, and B. R. Williams, "Twisted eleven-dimensional supergravity." Communications in Mathematical Physics **402**, no. 2, 1103–1166 (2023). `arXiv:math-ph/2111.03049` .
2. C. Elliott, F. Hahner, and I. Saberi, "The derived pure spinor formalism as an equivalence of categories." SIGMA **19** (2023), 022. `arXiv:math-ph/2205.14133` .
3. I. Saberi and B. R. Williams, "Twisting pure spinor superfields, with applications to supergravity." In press (Pure and Applied Mathematics Quarterly **19**, 2023). `arXiv:math-ph/2106.15639` .
4. I. Saberi and B. R. Williams, "Constraints in the BV formalism: six-dimensional supersymmetry and its twists." Advances in Mathematics **412**, 108806 (2023). `arXiv:math-ph/2009.07116` .
5. S. Gukov, P. Koroteev, S. Nawata, D. Pei, and I. Saberi, *Branes and DAHA representations*. In the book series "SpringerBriefs in Mathematical Physics" (2023). `arXiv:hep-th/2206.03565` .
6. I. Saberi and B. R. Williams, "Superconformal algebras and holomorphic field theories." Annales Henri Poincaré **24**, no. 2, pp. 541–604 (2022). `arXiv:math-ph/1910.04120` .

7. R. Eager, F. Hahner, I. Saberi and B. R. Williams, "Perspectives on the pure spinor superfield formalism." Journal of Geometry and Physics **180**, 104626 (2022). arXiv:hep-th/2111.01162 .
8. I. Saberi and B. R. Williams, "Twisted characters and holomorphic symmetries." Letters in Mathematical Physics **110**, no. 10, pp. 2779–2853 (2020). arXiv:math-ph/1906.04221 .
9. M. Heydeman, M. Marcolli, S. Parikh, and I. Saberi, "Nonarchimedean holographic entropy from networks of perfect tensors." Advances in Theoretical and Mathematical Physics **25**, no. 3 (2022). arXiv:hep-th/1812.04057 .
10. R. Eager, I. Saberi, and J. Walcher, "Nilpotence varieties." Annales Henri Poincaré **22**, pp. 1319–1376 (2021). arXiv:hep-th/1807.03766 .
11. R. Eager and I. Saberi, "Holomorphic field theories and Calabi–Yau algebras." International Journal of Modern Physics A **34**, no. 16, p. 1950071 (2019). arXiv:hep-th/1805.02084 .
12. I. Saberi, "An introduction to spin systems for mathematicians." In *Topology and quantum theory in interaction* (D. Ayala, D. S. Freed, and R. E. Grady, eds.), AMS Contemporary Mathematics 718 (2018). arXiv:math-ph/1801.07270 .
13. I. Saberi, "Holography and local fields." p-adic Numbers, Ultrametric Analysis, and Applications **10**, no. 3, pp. 151–165 (2018). arXiv:hep-th/1801.04942 .
14. S. S. Gubser, M. Heydeman, C. Jepsen, S. Parikh, I. Saberi, B. Stoica, and B. Trundy, "Signs of the time: melonic theories over diverse number systems." Physical Review D **98**, 126007 (2018). arXiv:hep-th/1707.01087 .
15. S. S. Gubser, M. Heydeman, C. Jepsen, M. Marcolli, S. Parikh, I. Saberi, B. Stoica, and B. Trundy, "Edge length dynamics on graphs with applications to p-adic AdS/CFT." Journal of High Energy Physics 1706 (2017) 157. arXiv:hep-th/1612.09580 .
16. M. Heydeman, M. Marcolli, I. Saberi, and B. Stoica, "Tensor networks, algebraic curves, and p-adic local fields: arithmetic generalizations of the AdS_3/CFT_2 correspondence." Advances in Theoretical and Mathematical Physics **22**, no. 1 (2018). arXiv:hep-th/1605.07639 .
17. S. Gukov, S. Nawata, I. Saberi, M. Stošić, and P. Sułkowski, "Sequencing BPS spectra." Journal of High Energy Physics 1603 (2016) 004. arXiv:hep-th/1512.07883 .
18. H. Kim and I. Saberi, "Real homotopy theory and supersymmetric quantum mechanics." Journal of Mathematical Physics **59**, no. 7 (2018). arXiv:hep-th/1511.00978 .
19. S. Gukov and I. Saberi, "Lectures on knot homologies and quantum curves." In *Topology and Field Theories* (S. Stolz, ed.), AMS Contemporary Mathematics Series 613, 2014. Also in *New Ideas in Low Dimensional Topology* (L. Kauffman and V. Manturov, eds.), Series on Knots and Everything 56, World Scientific, 2015. arXiv:hep-th/1211.6075 .
20. I. Saberi and F. Gittes, "Nonconservative forcing and diffusion in refractive optical traps." Journal of the Optical Society of America B **28**, 2369–2373 (2011). arXiv:cond-mat.stat-mech/1102.3343
21. X. Wang, H. F. Grip, A. Saberi, A. A. Stoorvogel, and I. Saberi, "Remarks on the relationship between L_p stability and internal stability of nonlinear systems." International Journal of Robust and Nonlinear Control **23** (16), 1822–1827 (2013). Also in *Proc. American Control Conference*, San Francisco, Calif., 2011.

Preprints:

22. F. Hahner and I. Saberi, "Eleven-dimensional supergravity as a Calabi–Yau twofold." Preprint available at arXiv:math-ph/2304.12371 (2023).
23. M. Cederwall, S. Jonsson, J. Palmkvist, and I. Saberi, "Canonical supermultiplets and their Koszul duals." Submitted. Preprint available at arXiv:hep-th/2304.01258 (2023).
24. F. Hahner, S. Noja, I. Saberi, and J. Walcher, "Six-dimensional supermultiplets from bundles on projective spaces." Submitted. Preprint available at arXiv:math-ph/2206.08388 (2022).

25. I. Brunner, I. Lavdas, and I. Saberi, "Holomorphic boundary conditions for topological field theories via branes in twisted supergravity."
Preprint available at `arXiv:hep-th/2110.15257` (2021).

Expository publications:

26. I. Saberi, "Felder und Räume: Symmetrie und Lokalität in Mathematik und theoretischer Wissenschaft." *Snapshots of Modern Mathematics from Oberwolfach* (2023).

Research funding

2023 Selected as a Junior Researcher in Residence at the LMU Center for Advanced Studies (winter semester 2023/24). The program provides funding to cover teaching duties and to invite long-term research visitors, as well as office space at the CAS.

2023 Three-year DFG project "Homological algebra of supersymmetry: locality, unitarity, duality," with S. Noja and J. Walcher. One full Ph.D position was funded (TV-L 13 75%), together with travel funding. (Total funding ~ 172 000 Euro).

2019 Exploratory project "From nilpotence varieties to twisted supergravity: Towards holomorphic holography," within the excellence cluster "Structures" at Heidelberg University. One six-month postdoctoral position was funded (35 000 Euro), together with an associated workshop in fall 2021, postponed from summer 2020 due to COVID-19 (30 000 Euro).

Invited talks

Minicourses and lecture series:

- *Approaches to holography: twists, tensors, entropy* (6 hours). Korea Institute for Advanced Study, planned for August 2024.
- *New tools in M-theory via twisted eleven-dimensional supergravity* (4 hours). Center for Quantum Mathematics, Odense, Denmark, planned for November 2023.
- *p-adic models in quantum physics* (5 hours). CIMPA-CINVESTAV research school on "p-adic numbers, ultrametric analysis, and applications," Guanajuato, Mexico, May 2022 (online).
- *The physics and number theory of the A-polynomial* (3 hours). International Conference in Number Theory and Physics, IMPA, June 2015.

At conferences:

- *Twisting and untwisting in supergravity, conformal field theory, and holography.* Plenary talk, DESY Theory Workshop, Deutsches Elektronen-Synchrotron, Hamburg, September 2023.
- *Six- and eleven-dimensional theories via superspace torsion and Poisson brackets.* Research talk, Strings 2023, Perimeter Institute for Theoretical Physics, July 2023.
- *Eleven-dimensional supergravity as a Calabi–Yau twofold.* Special session on "Invariants of manifolds from quantum field and string theories," 29th Nordic Congress of Mathematicians, Aalborg, July 2023.
- *Pure spinor techniques in twisted supergravity and twisted holography.* Workshop on "Exact results and holographic correspondences," Mainz Institute for Theoretical Physics, July 2023.
- *Algebraic structures in the pure spinor superfield formalism.* Workshop on "Higher structures, gravity, and fields," Mainz Institute for Theoretical Physics, January 2023.
- *Twisted eleven-dimensional supergravity and exceptional Lie superalgebras.* Workshop on "enumerative invariants, quantum fields, and string theory correspondences," Institut Mittag-Leffler, Stockholm, July 2022.
- *Networks of perfect tensors via symplectic geometry over finite fields.* Conference on "p-adic mathematical physics and its applications," May 2021 (online).

- *A presymplectic BV formalism for the abelian* $(2,0)$ *tensor multiplet.* Conference on "Homotopy algebra of quantum field theory and its applications," YITP, Kyoto, March 2021 (online).
- *Superconformal algebras, holomorphic theories, and higher symmetries.* Conference on "Holomorphic quantum field theories," IPMU, Tokyo, May 2020. *Conference postponed due to COVID-19.*
- *Superconformal algebras, holomorphic theories, and higher symmetries.* Workshop on "Higher structures in geometry and physics," Fields Institute, Toronto, November 2019.
- *Branes, moduli spaces, and quantization.* Workshop on "Geometry and physics of Higgs bundles," Mathematisches Forschungsinstitut Oberwolfach, May 2019.
- *Supersymmetric field theories, invariants of manifolds, and nilpotence varieties.* Workshop on "Categorification in quantum topology and beyond," Erwin Schrödinger International Institute for Mathematics and Physics, January 16, 2018.
- *Nilpotence varieties.* Nielsen retreat, Centre for Quantum Geometry of Moduli Spaces, October 25, 2018.
- *Quasilocal fields on affine spaces over local fields.* International workshop on arithmetic geometry and quantum field theory, Korea Institute for Advanced Study, August 17, 2018.
- *Spectral sequences in and around physics.* Winter conference on quantum knot homology and supersymmetric gauge theories, Aspen Center for Physics, March 9, 2018
- *p-adic approaches to discretizing holography.* Sixth international conference on p-adic mathematical physics and its applications, CINVESTAV, Mexico City, October 26, 2017.
- *Holographic lattice field theories.* DESY theory workshop, Hamburg, September 28, 2017.
- *Holography on discrete bulk spaces: arithmetic generalizations of* AdS_3/CFT_2. SoCal Grad Strings, May 17, 2016.

Seminars and colloquia:

- *Twisted eleven-dimensional supergravity and exceptional Lie superalgebras.* Research seminar, Center for Quantum Mathematics, Syddansk Universitet, November 28, 2022.
- *Twisted eleven-dimensional supergravity and exceptional Lie superalgebras.* Joint mathematical physics seminar, University of Vienna/TU Vienna, June 21, 2022.
- *Twisted eleven-dimensional supergravity and exceptional Lie superalgebras.* GRIFT (geometry and representation theory in field theory) seminar, University of Edinburgh, March 11, 2022.
- *Twisted eleven-dimensional supergravity and exceptional Lie superalgebras.* Online. Physics seminar series, Uppsala University, January 24, 2022.
- *Pure spinors and Koszul duality: supermultiplets from algebraic geometry.* Online. Mathematical physics seminar, Charles University of Prague, December 2, 2021.
- *Twisted eleven-dimensional supergravity and exceptional Lie superalgebras.* Online. Mathematical physics seminar, Perimeter Institute, November 5, 2021.
- *Networks of perfect tensors via symplectic geometry over finite fields.* Online. String theory seminar, Técnico Lisboa, July 5, 2021.
- *Twists of supergravity theories via algebraic geometry.* Online. TQFT seminar, Técnico Lisboa, June 4, 2021.
- *Networks of perfect tensors via symplectic geometry over finite fields.* Online. Eighth international conference on p-adic mathematical physics and its applications, May 18, 2021.
- *Spin representations, symmetric spaces, and supersymmetric physics.* Online. Mathematics colloquium, University of Idaho, February 11, 2021.
- *Twisting the abelian* $(2,0)$ *multiplet: constraints, BV, and pure spinors.* Online seminar series, Vrije Universiteit Brussel, December 2, 2020.
- *Holomorphic field theories and higher symmetries.* Online Seminar in Derived Geometry, Representation Theory, and Physics (organized by Chris Elliott, University of Massachusetts at Amherst), June 10, 2020.

- *Holomorphic field theories and higher symmetries.* Heidelberg–Munich–Vienna Joint Online Seminar in Mathematical Physics, June 8, 2020.
- *Holomorphic field theories and higher symmetry algebras.* QGM seminar, Centre for Quantum Geometry of Moduli Spaces, Aarhus, May 2, 2019.
- *An introduction to the Batalin–Vilkovisky formalism and its applications.* QGM introductory seminar series, Centre for Quantum Geometry of Moduli Spaces, Aarhus, April 29, 2019.
- *Nilpotence varieties.* Operator algebras seminar, NTNU Trondheim, November 8, 2018.
- *Nilpotence varieties.* Mathematical physics seminar, University of Bristol, October 19, 2018.
- *Rudiments of quantization.* Heidelberg »kennenlernen« seminar, December 13, 2017.
- *Lattice field theories, hierarchy, and holography.* QMAP seminar, University of California at Davis, November 3, 2017.
- *Brane quantization and the double affine Hecke algebra.* Seminar in theoretical physics, Uppsala Universitet, October 11, 2017.
- *Brane quantization and the double affine Hecke algebra.* QGM seminar, Centre for Quantum Geometry of Moduli Spaces, Aarhus, October 4, 2017.
- *An introduction to the quantization problem.* QGM introductory seminar series, Centre for Quantum Geometry of Moduli Spaces, Aarhus, October 3, 2017.
- *Scale invariance, lattice models, and holography.* STRUCTURES Arbeitstagung der Universität Heidelberg, July 14, 2017.
- *Holographic lattice field theories.* Heidelberg theoretical physics institute (seminar of Prof. M. Salmhofer), June 28, 2017.
- *Holographic lattice field theories.* Caltech high-energy theory seminar, April 21, 2017.
- *Holographic lattice field theories.* Harvard CMSA mathematical physics seminar, April 17, 2017.
- *Holographic lattice field theories.* Heidelberg, Oberseminar der physikalischen Mathematik, April 10, 2017.
- *A rough-and-ready introduction to some mathematical applications of quantum field theory.* Physics department colloquium, Washington State University, August 30, 2016.
- *Holography on discrete bulk spaces: arithmetic generalizations of AdS_3/CFT_2.* Caltech Institute for Quantum Information & Matter journal club, June 6, 2016.
- *Supersymmetric quantum mechanics revisited.* String seminar, Berkeley Center for Theoretical Physics, April 19, 2016.

Advising

Alex Strunk (Munich, master's thesis, expected March 2024)
Dayuan Wang (Munich, master's thesis, expected December 2023)
Fabian Hahner (Heidelberg, Ph.D. coadvisor, expected January 2024)
Arnau Mas (Munich, master's thesis, July 2023)
Gabriele Castellari (Munich, master's thesis, April 2023)
Leon Rehse (Munich, bachelor's thesis, winter 2021/2022)
Ngoc Quang Bui (Munich, bachelor's thesis, winter 2021/2022)
Robert Windesheim (Munich, bachelor's thesis, winter 2021/2022)
Alex Strunk (Munich, bachelor's thesis, summer 2021)
Martin Uttendorfer (Munich, bachelor's thesis, summer 2021)
Fabian Hahner (Heidelberg, master's thesis, December 2020)
Joan Aitor Austrich Olivares (Heidelberg, master's thesis, October 2019)
Menelaos Zikidis (Heidelberg, bachelor's thesis, December 2017)

Teaching

2022/23 Lecture course: "Supersymmetry (an introduction)."
LMU, summer term 2023.

Obertutor (plenary recitation) for the lecture course "Statistische Mechanik."
LMU, winter term 2022.

2021/22 Lecture course: "Supersymmetry (an introduction)."
LMU, summer term 2022 (developed independently).

Obertutor (plenary recitation) for the master's lecture course "Quantenmechanik II" (Prof. Ivo Sachs).
LMU, winter term 2021.

2020/21 Lecture course: "Mathematical methods and selected topics in supersymmetry."
LMU, summer term 2021 (developed independently).

Obertutor (plenary recitation) for the lecture course "Statistische Mechanik."
LMU, winter term 2020.

2019/20 Obertutor (plenary recitation) for the lecture course "Höhere Mathematik für Physiker, II."
Undergraduate course at the sophomore level (in German); summer term 2020.

Master's seminar: "Mirror symmetry."
With J. Walcher and L. Hahn; winter term 2019–2020.

2018/19 Lecture course: "Topics in supersymmetry: from pure spinors to BPS states."
Course website at `https://www.mathi.uni-heidelberg.de/~saberi/ws1819.html`.
Winter term 2018–2019 (developed independently).

2017/18 Master's seminar on "Holography and large N dualities."
With R. Eager and J. Walcher; summer term 2018.

2016/17 Master's seminar on "Physical applications of topological quantum field theory."
With R. Eager and J. Walcher; summer term 2017.

2015/16 Ph 2abc (waves, quantum mechanics, statistical physics).

2014/15 Ph 12a (waves); Ph 250b, grader (string theory); Ph 12c (statistical physics).

2013/14 Ph 2ab (waves, quantum mechanics, statistical physics).

2012/13 Ph 2ab (waves, quantum mechanics, statistical physics); Ph 1c, analytic (electromagnetism).

2011/12 Ph 1abc, practical (mechanics and electromagnetism).

Organization

- Organizer, Strings and Fields seminar series, LMU Munich (August 2021–August 2023)
- Co-organizer (with T. Creutzig, T. Gannon, S. Noja, and J. Walcher) of the Heidelberg Workshop on Pure Spinors, Superalgebras, and Holomorphic Twists (October 4–8, 2021)
- Member, International Advisory Committee, Seventh International Conference on p-adic Mathematical Physics and its Applications (fall 2019, Covilha, Portugal)
- Co-organizer (with R. Eager and J. Walcher) of the 2017 Heidelberg Workshop on Flat Connections in Physics and Geometry (July 20–22, 2017)
- Co-organizer of the Heidelberg seminar series "Physical Mathematics" (2016–2020)

Professional service and outreach

- Reviewer for *Mathematical Reviews* (since 2016)
- Referee service for:
  - — Journal of High Energy Physics (2017),
  - — Communications in Number Theory and Physics (2017),
  - — Letters in Mathematical Physics (2018),

— p-adic Numbers, Ultrametric Analysis, and Applications (2018),
— Journal of Physics A (2020, 2020),
— SIGMA (2018, 2020),
— Symmetry (2021),
— Physica Scripta (2021),
— Selecta Mathematica (2021),
— Nuclear Physics B (2021),
— Communications in Mathematical Physics (2022, 2023), and
— Nature Communications (2023).

- Alumni interviewer for Princeton undergraduate admissions (2012–2016; currently on hiatus)

Conference participation

2023 DESY Theory Workshop, Hamburg
Strings 2023, Perimeter Institute
29th Nordic Congress of Mathematicians, Aalborg
Workshop on exact results and holographic correspondences, MITP Mainz
Program on higher structures, gravity, and fields, MITP Mainz

2022 Enumerative invariants, quantum fields, and string theory correspondences, Institut Mittag-Leffler
School on p-adic numbers, ultrametric analysis, and applications, Guanajuato, Mexico (online)

2021 Workshop on pure spinors, superalgebras, and holomorphic twists, Heidelberg
Eighth international conference on p-adic mathematical physics (online)
Homotopy algebra of quantum field theory and its applications, Yukawa Institute, Kyoto (online)

2020 Program on knots, strings, symplectic geometry, and dualities, Institut Mittag-Leffler (online)
Holomorphic quantum field theories, IPMU, Tokyo *(postponed indefinitely due to Covid-19)*

2019 Workshop on higher structures in geometry and physics, Fields Institute, Toronto
Topological string theory and related topics, CERN, Geneva
Geometry and physics of Higgs bundles, Mathematisches Forschungsinstitut Oberwolfach
Categorification in quantum topology and beyond, Erwin Schrödinger Institute, Vienna

2018 Program on knot homology and supersymmetric gauge theories, Kavli Institute for Theoretical Physics
Nielsen retreat, Centre for Quantum Geometry of Moduli Spaces, Sandbjerg Estate, Denmark
Workshop on arithmetic geometry and quantum field theory, Korea Institute for Advanced Study
Perspectives on the Riemann hypothesis, Heilbronn Institute for Mathematical Research, Bristol
Quantum knot homology and supersymmetric gauge theories, Aspen Center for Physics

2017 Sixth international conference on p-adic mathematical physics, CINVESTAV, Mexico City
DESY Theory Workshop, DESY, Hamburg, September 2017
Topological and geometric methods in QFT, Montana State University, Bozeman
Arbeitstagung 2017 on physical mathematics (in honor of Yuri Manin), MPI für Mathematik, Bonn
Workshop on quantum fields, knots, and integrable systems, ICMS Edinburgh
New connections between link homologies and physics, SQuaRE at AIM (continuation)

2016 Workshop on the geometry and physics of Higgs bundles I, U.I.C.
Gone Fishing meeting 2016, U.C. Boulder
Higgs bundles in geometry and physics, Heidelberg

2015 New connections between link homologies and physics, SQuaRE at AIM
International conference in number theory and physics, IMPA, Rio de Janeiro
Program on knot homologies, BPS states, and SUSY gauge theories, Simons Center

2014 Mathematical aspects of six-dimensional quantum field theories, Berkeley
Homological methods in quantum field theory, Simons Center
West Coast algebraic topology summer school, PIMS, University of British Columbia
Strings 2014, Princeton University
School on prospects in theoretical physics, Institute for Advanced Study

String math summer school, PIMS, University of British Columbia
Workshop on the geometry and physics of moduli spaces, ICMAT Madrid

2013 Physics and mathematics of link homology (SMS 2013), University of Montreal

2012 Summer school on topology and field theories, University of Notre Dame

Languages

English	native
German	near-native
French	tolerable, but rusty

Honors and awards

Junior Researcher in Residence, LMU Center for Advanced Studies, 2023–24
Book Prize recipient for Philosophy, Princeton University Dept. of German, 2010
Sam B. Treiman Fellowship, Princeton University Dept. of Physics, 2008
Member, United States Physics Team, 2006 (and 2007, declined)

References

- Ilka Brunner — LMU München — *ilka.brunner@physik.uni-muenchen.de*
- Johannes Walcher — Universität Heidelberg — *walcher@uni-heidelberg.de*
- Sergei Gukov — California Institute of Technology — *gukov@theory.caltech.edu*
- Matilde Marcolli — California Institute of Technology — *matilde@caltech.edu*
- Robert Helling (teaching) — LMU München — *helling@lmu.de*

Additional references available upon request.

Other involvement

Einjähriger Lehrgang — Krameterhof — 2021–2022

Yearlong training and certification program in permaculture and sustainable agriculture with Josef A. Holzer.

Bass — Universitätschor München — from 2021

Bass — Camerata Carolina — 2016–2020

Chamber choir of the Internationales Studienzentrum der Universität Heidelberg. Performances in Germany, France, Italy, Austria, Switzerland, and Canada.

Guest D.J. — WPRB-FM, Princeton — intermittent, 2009–2011

Two-Sided Plays — Princeton Atelier — spring 2009

Performance workshop with Laurie Anderson, focusing on multimedia performances taking the form of dialogues and incorporating audiovisual and generative elements.

Bass — Princeton University Chapel Choir — 2008–2011