SLAVA KRUSHKAL
Curriculum Vitae
February 2022

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Academic positions:

2001 – present	Department of Mathematics, **University of Virginia**:
2009 – present	Professor
2003 – 2009	Associate Professor
2001 – 2003	Assistant Professor
1999 – 2001	Gibbs Instructor, **Yale University**
1998/99	Member, **Institute for Advanced Study**, Princeton
1997/98	Member, **Max Planck Institute**, Bonn, Germany
1996/97	Visiting Research Instructor, **Michigan State University**

Visiting positions:

Spring 2020	Department of Mathematics, **UC Berkeley**
Spring 2008	**The Kavli Institute for Theoretical Physics**, UCSB
Spring 2004	**Microsoft Research**, Theory Group, Redmond
Spring 1995	**I.H.E.S.**, Bures-sur-Yvette, France

Short-term visiting positions:

July 2022	I.H.E.S., France
July 2019	University of Geneva and EPFL, Lausanne
July 2018	Oxford University, UK
June-July 2015	I.H.E.S., France
April 2014	Harvard University
January 2014	Microsoft Station Q, Santa Barbara, CA
May-June 2013	Max Planck Institute, Bonn, Germany
June-July 2011	ETH and University of Zurich, Switzerland

Degrees:

1996	Ph.D. in Mathematics, University of California, San Diego
1988-1991	undergraduate study: Novosibirsk State University, Russia

Research Interests:

- Low-dimensional geometry and topology, in particular topology of 4-manifolds
- Quantum topology and categorification
- Topological methods in statistical mechanics

Awards, grants and fellowships:

2021 – 2024	P.I. for NSF grant "Topology of 4-Manifolds, Embeddings, and Stable Homotopy Invariants of Links", DMS-2105467
2020	Miller Visiting Professorship, UC Berkeley
2020	Simons Fellowship
2016 – 2021	P.I. for NSF grant "Topology of 4-manifolds, links and Engel groups"
2014	Simons Fellowship
2013 – 2016	P.I. for NSF grant "Geometric and quantum topology in low dimensions"
2010 – 2013	P.I. for NSF grant "Low-dimensional topology and topological methods in condensed matter physics"
2006 – 2010	P.I. for NSF grant "Surfaces and 4-manifolds"
2007 – 2008	P.I. for NSF grant "Topological structures in condensed matter physics"
2004/05	University of Virginia Teaching fellowship
2004	P.I. for NSF grant "Conference on low-dimensional topology"
2003 – 2006	P.I. for NSF grant "Classification theory of 4-manifolds"
2000 – 2003	P.I. for NSF grant "Topology of 4-manifolds"
1994/95	Sloan Doctoral Dissertation Fellowship
1993/94	Hepps Graduate Fellowship

Ph.D students and Postdocs supervised:

Matthew Hogancamp, Ph.D. August 2013.
Thesis: *A polynomial action on colored $sl(2)$ link homology.*
Michael Willis, Ph.D., June 2017.
Thesis: *Stable Limits of the Khovanov Homology and L-S-K Spectra for Infinite Braids*
Gabriel Islambouli, Ph.D., May 2019.
Thesis: *Parallels between Heegaard splittings and trisections of 4-manifolds*
Ross Akhmechet, Andrew Will, Louisa Liles, Yangxiao Luo: Current Ph.D. students
Benjamin Cooper, Whyburn instructor, 2009-2012

Supervision of undergraduate research:
2010: David Renardy, 2013: Sittipong Thamrongpairoj, 2013-14: Calvin McPhail-Snyder, 2016: Bradley Zykoski, 2018: Ethan Zell, 2019: Sebastian Haney

Outreach:

2017 - present: Organizer and instructor of the UVa Math Circle, a weekly Fall semester program for elementary and middle school students of Charlottesville area schools.

Conferences organized:

April 2022	Workshop "Categorical methods in representation theory and quantum topology", UVa
May 2021	Workshop "Perspectives on knot homology", Banff
2016–18	Virginia Topology Conference, UVa
October 2015	Workshop on Geometric Group theory, UVa
April 2015	Mid-Atlantic Topology conference, UVa
June 2011	Conference "Low-dimensional manifolds and high-dimensional categories", UC Berkeley
January 2009	Special session on Topology, Combinatorics and Physics National AMS Meeting, Washington DC.
December 2004	Conference on Low-dimensional Topology, UVa
April 2003	Special session on Low-Dimensional Topology AMS Meeting, New York

Publications:

[1] M. Freedman, V. Krushkal and P. Teichner, *Van Kampen's embedding obstruction is incomplete for* 2*-complexes in* $\mathbb{R}^4$, Math. Res. Lett. 1 (1994), 167-176.

[2] M. Freedman and V. Krushkal, *Notes on ends of hyperbolic* 3*-manifolds*, Proceedings of the 13th Annual Workshop in Geometric Topology, Colorado College (1996), 1-15.

[3] V. Krushkal and P. Teichner, *Alexander duality, gropes and link homotopy*, Geom. Topol. 1 (1997), 51-69.

[4] V. Krushkal, *Additivity properties of Milnor's* $\bar{\mu}$*-invariants*, J. Knot Theory Ramifications 7 (1998), 625-637.

[5] V. Krushkal, *On the Relative Slice Problem and* 4*-Dimensional Topological Surgery*, Math. Ann. 315 (1999), 363-396.

[6] V. Krushkal, *Embedding obstructions and* 4*-dimensional thickenings of* 2*-complexes*, Proc. Amer. Math. Soc. 128 (2000), 3683-3691.

[7] V. Krushkal, *Exponential separation in* 4*-manifolds*, Geom. Topol. 4 (2000), 397-405.

[8] V. Krushkal and F. Quinn, *Subexponential groups in* 4*-manifold topology*, Geom. Topol. 4 (2000), 407-430.

[9] V. Krushkal and R. Lee, *Surgery on closed* 4*-manifolds with free fundamental group*, Math. Proc. Cambridge Philos. Soc. 133 (2002), 305-310.

[10] V. Krushkal, *Dwyer's filtration and topology of* 4*-manifolds*, Math. Res. Lett. 10 (2003), 247-251.

[11] V. Krushkal, *Surgery and involutions on 4-manifolds*, Algebr. Geom. Topol. 5 (2005), 1719-1732.

[12] V. Krushkal, *Surfaces in 4-manifolds and the surgery conjecture*, Geometry and topology of manifolds, 137–146, Fields Inst. Commun. 47, Amer. Math. Soc. 2005.

[13] M. Freedman and V. Krushkal, *On the asymptotics of quantum $SU(2)$ representations of mapping class groups*, Forum Math. 18 (2006), 293–304.

[14] V. Krushkal, *Link groups and the A-B slice problem*, Proceedings of the International conference on Topology and Physics, World Sci. Publ. 2008, 203-218.

[15] V. Krushkal, *A counterexample to the strong version of Freedman's conjecture*, Ann. of Math. 168 (2008), 675–693.

[16] P. Fendley and V. Krushkal, *Tutte chromatic relations from the Temperley-Lieb algebra*, Geom. Topol. 13 (2009), 709–741.

[17] P. Fendley and V. Krushkal, *Link invariants, the chromatic polynomial and the Potts model*, Adv. Theor. Math. Phys. 14 (2010), 507-540.

[18] V. Krushkal, *Robust 4-manifolds and robust embeddings*, Pacific J. Math. 248 (2010), 191-202.

[19] V. Krushkal, *Graphs, links, and duality on surfaces*, Combin. Probab. Comput. 20 (2011), 267-287.

[20] B. Cooper, M. Hogancamp and V. Krushkal, *$SO(3)$ homology of graphs and links*, Algebr. Geom. Topol. 11 (2011), 2137-2166.

[21] M. Freedman and V. Krushkal, *Topological arbiters*, J. Topol. 5 (2012), 226-247.

[22] B. Cooper and V. Krushkal, *Categorification of the Jones-Wenzl projectors*, Quantum Topol. 3 (2012), 139-180.

[23] V. Krushkal, *Link groups of 4-manifolds*, Proceedings of the Freedman Fest, Geometry and Topology Monographs 18 (2012), 199-234.

[24] B. Cooper and V. Krushkal, *Handle slides and localizations of categories*, Int. Math. Res. Not. IMRN 2013, no. 10, 2179-2202.

[25] Editor (with R. Kirby and Z. Wang) of the Proceedings of the Freedman Fest, Geometry & Topology Monographs 18 (2013).

[26] V. Krushkal and D. Renardy, *A polynomial invariant and duality for triangulations*, Electron. J. Combin. 21 (2014), no. 3, Paper 3.42.

[27] M. Freedman and V. Krushkal, *Geometric complexity of embeddings in $\mathbb{R}^d$*, Geom. Funct. Anal. (GAFA) 24 (2014), 1406-1430.

[28] V. Krushkal, *Slicing the Hopf link*, Geom. Topol. 19 (2015), 1657-1683.

[29] M. Freedman and V. Krushkal, *Engel relations in 4-manifold topology*, Forum of Mathematics, Sigma 4 (2016), e22, 57 pp.

[30] I. Agol and V. Krushkal, *Tutte relations, TQFT, and planarity of cubic graphs*, Illinois Journal of Mathematics 60 (2016), 273-288 (Volume in honor of W. Haken).

[31] M. Freedman and V. Krushkal, *A homotopy$^+$ solution to the A-B slice problem*, J. Knot Theory Ramifications 26 (2017), no. 2, 1740018, 18 pp. (Volume in memory of T. Cochran)

[32] V. Krushkal, *Sticky Cantor sets in* $\mathbb{R}^d$, Journal of Topol. Anal. 10 (2018), 477-482.

[33] I. Agol and V. Krushkal, "*Structure of the flow and Yamada polynomials of cubic graphs*, Breadth in contemporary topology, 1-20, Proc. Sympos. Pure Math., 102, Amer. Math. Soc., Providence, RI, 2019.

[34] M. Freedman and V. Krushkal, "*Universal surgery problems with trivial Lagrangian*, Math. Res. Lett. 26 (2019), 1587-1601.

[35] M. Freedman and V. Krushkal, *"Engel groups and universal surgery models"*, J. Topol. 13 (2020), 1302-1316.

[36] R. Akhmechet, V. Krushkal, and M. Willis "*Stable homotopy refinement of quantum annular homology"*, Compositio Math. 157 (2021), 710-769.

[37] P. Fendley and V. Krushkal, "*Topological quantum field theory and polynomial identities for graphs on the torus*, to appear in Ann. Inst. Henri Poincaré D.

[38] M. Freedman and V. Krushkal, "*Filling links and spines in* 3*-manifolds*, with an appendix by C. Leininger and A. Reid, To appear in Comm. Anal. Geom.

[39] V. Krushkal, and P. Wedrich, "$\mathfrak{gl}_2$ *foams and the Khovanov homotopy type"*, To appear in Indiana Univ. Math. J.

[40] R. Akhmechet, V. Krushkal, and M. Willis "*Towards an* $\mathfrak{sl}_2$ *action on the annular Khovanov spectrum"*, arXiv:2011.11234, submitted.

[41] G. Arone and V. Krushkal, "*Embedding obstructions in* $\mathbb{R}^d$ *from the Goodwillie-Weiss calculus and Whitney disks"*, arXiv:2101.10995, submitted.

[42] R. Akhmechet, P. Johnson, and V. Krushkal, "*Lattice cohomology and q-series invariants of* 3*-manifolds"*, arXiv:2109.14139, submitted.

Selected seminar and conference talks (since 2002):

Mar 2022	AMS Spring Central Sectional meeting (online), AMS special session on Geometric topology in the middle dimensions: *Obstructions to relative slicing.*
Apr. 2022	JMM (online), AMS Special Session on Skein Theory and Quantum Algebra: *q-series invariants and lattice cohomology of* 3*-manifolds.*
Apr. 2022	UC Davis, Algebra and Discrete Mathematics seminar.
Mar. 2021	MIT, Topology seminar (online), *"Filling links in* 3*-manifolds"*
Feb. 2021	Online seminar on surfaces and 4-manifolds (hosted at the Max Planck Institute) *"Milnor and Arf invariants for 2-complexes in* $\mathbb{R}^4$*"*
Jan. 2021	Online seminar on Invariants of embedding spaces (hosted at Paris 13), *"Embedding obstructions in 4-space from the Goodwillie-Weiss calculus and Whitney disks"*
Jan. 2021	Rice University, Topology seminar (online), *"Filling links in* 3*-manifolds"*
Nov. 2020	University of Iowa, Topology seminar (online), *TQFT and graph polynomials*
Aug. 2020	Online seminar on Trisections of 4-manifolds, *"Embedding obstructions in 4-space from intersections of Whitney disks and from Goodwillie calculus"*
March 2020	Topology seminar, UC Berkeley, *"Applications of TQFT to polynomial identities for graphs on surfaces"*
Nov. 2019	Mathematics Colloquium, Caltech, "*Quantum topology and combinatorics of graphs on surfaces*"
May 2019	Moab Topology Conference 2019, Moab, UT. Two lectures: "*Using quantum topology to count colorings and flows in planar graphs*", "*Applications of TQFT to classical and quantum graph polynomials*"
May 2019	Algebra and Geometry Quantized and Quantified, Vanderbilt University, "*Applications of TQFT to classical and quantum graph polynomials*"
Apr. 2019	CUNY, Geometry seminar, "*Combinatorics of planar triangulations and quantum topology*"
Jan. 2019	Knots in Washington, Washington, DC, "*Universal surgery problems with trivial Lagrangian*"
Dec. 2018	UCLA, Topology Seminar, "*Embeddings of* 2*-complexes in* $\mathbb{R}^4$"

Mar. 2018 Dartmouth College, Topology Seminar, "*Engel relations in 4-manifold topology*"

Mar. 2018 Dartmouth College, Mathematics Colloquium,
"*The combinatorics of planar triangulations and quantum topology*"

Dec. 2017 Knots in Washington, "*Applications of TQFT to the structure of the Yamada and flow polynomials*"

Oct. 2017 Triangle (Duke-UNC-NCSU) Topology Seminar,
"*Flow and Yamada polynomials, planar triangulations, and TQFT*"

July 2017 Mathematical Congress of the Americas, Montreal. Special session on Quantitative Topology, "*Geometric complexity of embeddings*"

Apr. 2017 UCLA, Mathematics Colloquium, "*Quantum topology and the combinatorics of planar triangulations*"

Apr. 2017 UCLA, Topology Seminar, "*Engel relations in 4-manifold topology*"

Nov. 2016 Workshop on Topology and Geometry in a Discrete Setting, ICERM Brown University: *Tutte chromatic relations, extensions and applications*

Feb. 2016 Workshop on Topological and smooth 4-manifolds, Banff Canada. Two lectures: *1/2-null surgery kernels are universal*, *A homotopy+ solution to the AB-slice problem*

March 2016 Advances in Quantum and Low-dimensional Topology, University of Iowa *Tutte chromatic relations and TQFT*

December 2015 Conference ''Knots in Washington", Washington, DC *Geometric complexity of embeddings*

August 2015 The 11th Hamilton Geometry and Topology Workshop, Dublin, Ireland, *Engel relations in 4-manifold topology*

April 2014 Brandeis University, Topology seminar: *Slicing the Hopf link*

March 2014 Spring Topology and Dynamics conference, Richmond, VA, Special session on Geometric Topology: *Geometric complexity of embeddings.*

October 2013 AMS meeting in St. Louis, MO, Special session on Geometric aspects of 3-manifold invariants: *Distortion and thickness in Euclidean space.*

June 2013 Lecture series (6 lectures) on Topology of 4-manifolds, Max Planck Institute, Bonn, Germany

March 2012	Graduate Center, City University of New York, Geometry/Topology seminar: *Slicing the Hopf link*
March 2012	Columbia University, seminar on Categorical actions of braid groups: *Tutte identities from the Temperley-Lieb algebra*
Jan. 2012	Joint mathematics meeting, Boston, AMS special session on Knot theory: *Categorification of the Jones-Wenzl projectors and applications*
Nov. 2011	University of California - San Diego, Topology seminar: *TQFTs, categorification, and localization*
Nov. 2011	CalTech, Topology seminar: *TQFTs, categorification, and localization*
July 2011	University of Zurich: Mini-course (six lectures) on Topology of 4-manifolds
July 2011	Conference on applied algebraic topology, ETH Zurich: *Topological arbiters*
June 2011	University of Zurich, seminar on quantum topology: *Categorification of the Jones-Wenzl projectors*
June 2011	Conference on Low-dimensional manifolds and high-dimensional categories, UC Berkeley: *The A-B slice problem*
June 2010	Universite Pierre et Marie Curie, Paris 6, Topology seminar: *Tutte chromatic identities from the Temperley-Lieb algebra*
March 2010	Paul Erdös memorial conference and lecture series, Memphis: *The Tutte and chromatic polynomial relations for planar and surface graphs*
Dec. 2009	Special session on Knot theory and related topics, Joint AMS - Korean Math Society meeting, Seoul, South Korea
Nov. 2009	Special session on Knotting around dimension 3, in memory of X.-S. Lin AMS meeting, Riverside: *The Jacobi identity and the A-B slice problem.*
August 2008	Workshop on Low-dimensional Topology, MSRI, Berkeley: *4-manifolds and the A-B slice problem.*
May 2008	University of California, Santa Barbara, Topology Seminar: *The A-B slice problem.*

April 2008	Microsoft Research, Santa Barbara, Q-seminar: *Tutte chromatic identities and the Temperley-Lieb algebra.*
Dec. 2007	Workshop Knots in Washington: *Chromatic algebra and applications.*
Nov. 2007	Harvard University, Basic Notions/Faculty Colloquium *The chromatic polynomial, the golden ratio, and quantum topology.*
October 2007	Yale University, Topology seminar: *The chromatic polynomial and quantum topology.*
October 2007	MIT, Combinatorics seminar: *Tutte chromatic identities and the Temperley-Lieb algebra.*
October 2007	Boston College, Mathematics Colloquium: *An approach to chromatic polynomial via quantum topology*
October 2007	Harvard University, Gauge theory seminar: *Algebraic and geometric duality in dimension 4.*
October 2007	Brandeis University, Topology seminar: *The chromatic polynomial and quantum topology*
Sep. 2007	Brown University, Geometry seminar: *The chromatic polynomial, the golden ratio, and quantum topology.*
April 2007	Conference Knots in Washington, George Washington University: *Links, Milnor's invariants, and robust manifolds*
March 2007	Conference on Surfaces in Low-dimensional manifolds, Eilat, Israel: *Topological arbiters*
Nov. 2006	Topology conference (in honor of Frank Quinn's 60th birthday), Binghamton, NY: *Algebraic and geometric duality in dimension* 4
August 2006	Workshop on 4−manifolds, Oberwolfach, Germany: *A counterexample to the strong version of Freedman's conjecture*
July 2006	IAS/Park City summer school on low-dimensional topology: 4−*manifolds, links and Alexander duality*
August 2005	University of California – Berkeley, Topology seminar: *Link groups of* 4−*manifolds*
Nov. 2005	Holon Institute of Technology, Israel, Mathematics Colloquium:

On the asymptotics of quantum representations of mapping class groups

Feb. 2005 — Yale University, Dynamics and Geometry seminar:
Quantum representations of mapping class groups and the Fourier transform

Feb. 2005 — CUNY Graduate Center, Differential geometry and Lie groups seminar:
Quantum representations of mapping class groups and the Fourier transform

Feb. 2005 — California State University, Long Beach, Colloquium:
Fourier transform, Kazhdan groups and quantum topology.

Sep. 2004 — University of Pennsylvania, Geometry-Topology seminar:
On the asymptotics of quantum representations of mapping class groups

Sep. 2004 — Columbia University, Topology seminar:
Rigidity of mapping class groups and quantum topology

May 2004 — Conference on Geometry and Topology of Manifolds,
McMaster University, Canada: *Link groups of* 4*-manifolds*

May 2004 — Workshop on Knot theory, Banff, Canada:
Rigidity and quantum representations of mapping class groups

May 2004 — Workshop on Knot theory, Banff, Canada:
Survey of 4*-dimensional surgery*

Jan. 2004 — Courant Institute (NYU), Diferential Topology seminar:
Topology of 4-manifolds and link homotopy

Jan. 2004 — Rutgers University, New Brunswick, Geometry/Topology Seminar:
4-manifolds, Dwyer's filtration and link homotopy

May 2003 — Conference Knots is Washington, University of Maryland:
4-dimensional surgery and the A,B-slice problem

Feb. 2003 — University of Maryland, Geometry-Topology seminar:
Dwyer's filtration and topology of 4-manifolds

Jan. 2003 — Japan-US workshop on Knot theory, Johns Hopkins University:
4*-manifolds, slice links, and Dwyer's filtration.*

July 2002 — Workshop on Geometry and Topology, Warwick, England:
4*-manifolds, trees, and amenable groups*

June 2002 — Workshop on Topology of manifolds, Münster, Germany:
4*-dimensional surgery and amenable groups*

May 2002 Georgia Topology Conference, Athens, GA:
A new class of slice links

Feb. 2002 George Washington University, Colloquium:
On classification of 4*-dimensional manifolds*

Jan. 2002 AMS Meeting, San Diego, special session on low-dimensional topology:
Surgery and involutions on 4*-manifolds*