NATHAN C. GEER

October 28, 2021

RESEARCH INTERESTS

- Low-dimensional topology
- Representation theory of Lie (super)algebras and quantum groups
- Mathematical Physics and topological quantum field theory

EDUCATION

2004 **University of Oregon, Eugene**
Ph.D. Mathematics
Thesis: Link invariants, quantized superalgebras and the Kontsevich integral
Advisor: Arkady Vaintrob

1998 **Colorado State University, Fort Collins**
B.S in Mathematics, *Summa Cum Laude*

EMPLOYMENT

August 2018 – present **Utah State University**, Logan, UT.
Professor

August 2015 – July 2018 **Utah State University**, Logan, UT.
Associate Professor

August 2009 – July 2015 **Utah State University**, Logan, UT.
Assistant Professor

August 2008 – July 2009 **Max-Planck Institute for Mathematics**, Bonn, Germany,
Member

August 2004 – July 2008 **Georgia Institute of Technology**, Atlanta, GA,
VIGRE Postdoctoral Fellow

HONORS AND AWARDS

2015 NSF CAREER Award

2015 CNRS Directeur de Recherches, Paris

2015 Japan Society for the Promotion of Science (JSPS) Research Fellowship, Tokyo

2013 College of Science Researcher of the Year, Utah State University

INVITED RESEARCH POSITIONS (1 MONTH OR LONGER STAYS*)

August – September 2015	**Max-Planck Institute for Mathematics**, Bonn, Germany Member
May 2014	**Paris VII, Jussieu**, Paris, France Professor Invite
March 2014	**Erwin-Schrödinger Institute**, Vienna, Austria, Member
June 2012	**Pisa University**, Pisa, Italy (*2 weeks) Visitor
April 2012	**Paris VII, Jussieu**, Paris, France Maitre de Conference Invite
June - July 2011	**Center for Topology and Quantization of Moduli Spaces**, Aarhus, Denmark, Member
July 2008 and June 2009	**Geneva University**, Geneva, Switzerland, Visitor
May - June 2007	**Institut de Recherche Mathmatique Avance**, Strasbourg, France Maitre de Conference Invite
July 2007 and May 2011	**Universit de Bretagne Sud**, Vannes, France Maitre de Conference Invite

FUNDING

Career-total awarded: US $2,130,691

6. **National Science Foundation** DMS-2104497: *Quantum Topology beyond Semi-Simplicity.*, PI: Nathan Geer, Award Amount: $325,617, Dates: 07/01/2021-06/30/2024

5. **National Science Foundation Focused Research Grant** DMS-1664387: *FRG: Collaborative Research: Homotopy Renormalization of Topological Field Theories* , Lead PI: Nathan Geer, Co-PI's: Tudor Dimofte, Nicolai Reshetikhin, Vladimir Turaev, Total budget $897,767 (Geer portion: $149,209), Dates: 07/01/17-06/30/21

4. **National Science Foundation CAREER Award** DMS-1452093: *CAREER: The geometry and physics of non-semi-simple quantum topology*, PI: Nathan Geer, Award Amount: $450,193, Dates: 10/01/2015-9/30/2020

3. **National Science Foundation** DMS-1308196: *Quantum topology, via re-normalized invariants*, PI: Nathan Geer, Award Amount: $148,404, Dates: 06/01/2013 - 05/30/2016

2. **National Science Foundation** DMS-1007197: *Vanishing Quantum Dimensions in Low-Dimensional Topology*, PI: Nathan Geer, Award Amount: $135,510, Dates: 07/01/2010 - 07/30/2013

1. **National Science Foundation** DMS-0706725: *Low-Dimensional Topology from a 'Super' View Point*, PI: Nathan Geer, Award Amount: $120,800, Dates: 07/01/2007 - 07/30/2010

Other Grants

4. **Japan Society for the Promotion of Science (JSPS)** Research Fellowship: PI: Nathan Geer, Sponsor: Jun Murakami, Award Amount: $9400, Dates: 01/01/2016-01/31/2016

3. **Centre national de la recherche scientifique (CNRS)** Directeur de Recherches: PI: Nathan Geer, Sponsor: Christian Blanchet, Award Amount: $13000, Dates: 10/01/2015-12/31/2015

2. **National Science Foundation Conference grant** DMS-1202922 : *Moab Topology Conference 2012*, Co-PI: Nathan Geer, Co-PI: Jessica Purcell, Award Amount: $25000, Dates: May 2012

1. **American Mathematical Society-National Science Foundation Travel Research Grant** PI: Nathan Geer, Award Amount: $5000, Dates: August 2006.

PUBLICATIONS

Graduate students indicated with (∗) and postdocs with (†). The `arXiv` numbers correspond to the corresponding entries on the ArXiv preprint server, accessible at `http://arxiv.org`.

44. **Modified graded Hennings invariants from unrolled quantum groups and modified integral**, with P. Ha† and B. Patureau-Mirand, J. Pure Appl. Algebra 226 (2022), no. 3 `arXiv:2006.12050`.

43. **Some remarks on relative modular categories**, with M. Rupert† and B. Patureau-Mirand, (2021) `arXiv:2110.15518`.

42. **A QFT for non-semisimple TQFT**, with T. Creutzig, T. Dimofte and N. Garner†, arxiv-preprint.

41. **Pseudo-Hermitian Levin-Wen models from non-semisimple TQFTs**, with Nathan Geer, Bertrand Patureau-Mirand, and Joshua Sussan, (2021), `arXiv:2108.10798`.

40. **A Hermitian TQFT from a non-semisimple category of quantum sl(2)-modules**, with Nathan Geer, Bertrand Patureau-Mirand, and Joshua Sussan, (2021), `arXiv:2108.09242`.

39. **Mapping Class Group Representations From Non-Semisimple TQFTs**, with M. De Renzi†, A. Gainutdinov, B. Patureau-Mirand and I. Runkel (2021), `arXiv:2010.14852`.

38. **Relative (pre)-modular categories from special linear Lie superalgebras**, with C. Anghel† and B. Patureau-Mirand, *Journal of Algebra*, Volume 586, 479–525, (2021), `arXiv:2010.13759`.

37. **The ADO Invariants are a q-Holonomic Family,** with J. Brown∗, T. Dimofte, and S. Garoufalidis (2020), `arXiv:2005.08176`.

36. **3-Dimensional TQFTs from Non-Semisimple Modular Categories**, with M. De Renzi†, A. Gainutdinov, B. Patureau-Mirand and I. Runkel, to appear in *Communications in Contemporary Mathematics* `arXiv:1912.02063`.

35. **M-traces in (Non-Unimodular) Pivotal Categories**, with J. Kujawa and B. Patureau-Mirand *Algebras and Representation Theory* (2021), `arXiv:1809.00499`.

34. **Non-Semisimple Quantum Invariants and TQFTs from Small and Unrolled Quantum Groups**, with M. De Renzi∗ and B. Patureau-Mirand, *Algebraic & Geometric Topology* **20** (2020), no. 7.

33. **Kuperberg and Turaev-Viro Invariants in Unimodular Categories,** with F. Costantino, B. Patureau-Mirand and V. Turaev *Pacific J. Math.* **306** (2020), no. 2, 421–450.

32. **Holonomy braidings, biquandles and quantum invariants of links with $SL_2(\mathbb{C})$ flat connections,** with C. Blanchet, B. Patureau-Mirand, and N. Reshetikhin *Selecta Mathematica (N.S.)* **26** (2020), no. 2.

31. **Modified Turaev-Viro Invariants from quantum Lie superalgebra $sl(2|1)$,** with C. Anghel∗ *J. Knot Theory Ramifications* **29** (2020), no. 4.

30. **Logarithmic Hennings invariants for restricted quantum sl_2,** with C. Blanchet and A. Beliakova *Algebr. Geom. Topol.* **18** (2018), no. 7, 4329–4358.

29. **Renormalized Hennings Invariants and 2+1-TQFTs,** with M. De Renzi∗ and B. Patureau-Mirand *Comm. Math. Phys.* 362 (2018), no. 3, 855–907.

28. **Full Dyon Excitation Spectrum in Generalized Levin-Wen Models,** with Y. Hu∗ and Y. Wu *Phys. Rev. B* **97**, 195154 (2018).

27. **The trace on projective representations of quantum groups,** with B. Patureau-Mirand *Letters in Mathematical Physics* **108** (2018), no. 1, 117–140.

26. **Non semi-simple TQFTs, Reidemeister torsion and Kashaev's invariants,** with C. Blanchet, F. Costantino and B. Patureau-Mirand *Advances in Mathematics* **301** (2016), 1–78.

25. **Non semi-simple TQFTs from unrolled quantum** $sl(2)$ with C. Blanchet, F. Costantino and B. Patureau-Mirand *Proceedings of the Gökova Geometry-Topology Conference* 2015, 218–231, Gökova Geometry/Topology Conference (GGT), Gökova, 2016.

24. **Relations between Witten-Reshetikhin-Turaev and non semi-simple** $sl(2)$ **3-manifold invariants,** with F. Costantino and B. Patureau-Mirand *Algebraic & Geometric Topology,* **15** (2015), no. 3, 1363–1386.

23. **Some remarks on the unrolled quantum group of sl(2)** with F. Costantino and B. Patureau-Mirand *Journal of Pure and Applied Algebra,* **219** (2015), no. 8, 3238–3262.

22. **Non semi-simple sl(2) quantum invariants, spin case,** with C. Blanchet, F. Costantino and B. Patureau-Mirand *Acta Math. Vietnam.* **39** (2014), no. 4, 481–495.

21. **Quantum invariants of 3-manifolds via link surgery presentations and non-semi-simple categories,** with F. Costantino and B. Patureau-Mirand *Journal of Topology,* **7** (2014), no. 4, 1005–1053.

20. **The Kontsevich integral and re-normalized link invariants arising from Lie superalgebra,** *Knots in Poland. III.* Part 1, 79–84, Banach Center Publ., 100, Polish Acad. Sci. Inst. Math., Warsaw, 2014.

19. **Topological invariants from non-restricted quantum groups,** with B. Patureau-Mirand *Algebraic and Geometric Topology* **13** (2013), no. 6, 3305–3363.

18. G**-links invariants, Markov traces and the semi-cyclic** $U_q(sl_2)$**-modules,** with B. Patureau-Mirand *Journal of Knot Theory and Its Ramifications* **22** (2013), no. 11.

17. **Ambidextrous objects and trace functions for nonsemisimple categories,** with J. Kujawa and B. Patureau-Mirand *Proceedings of the American Mathematical Society* **141** (2013), no. 9, 2963–2978.

16. **Traces on ideals in pivotal categories,** with B. Patureau-Mirand and A. Virelizier *Quantum Topology* **4** (2013), no. 1, 91–124.

15. **Tetrahedral forms in monoidal categories and 3-manifold invariants,** with R. Kashaev and V. Turaev *J. Reine Angew. Math. (Crelle's Journal)* **673** (2012), 69–123.

14. **Modified** $6j$**-Symbols and** 3**-Manifold Invariants,** with B. Patureau-Mirand and V. Turaev *Advances in Mathematics,* **228** (2011), no. 2, 1163–1202.

13. **Polynomial 6j-Symbols and States Sums,** with B. Patureau-Mirand *Algebraic & Geometric Topology* **11** (2011) 1821–1860.

12. **Generalized trace and modified dimension functions on ribbon categories,** with J. Kujawa and B. Patureau-Mirand *Selecta Math. (N.S.)* **17** (2011), no. 2, 453–504.

11. **Multivariable link invariants arising from Lie superalgebras of type I** with B. Patureau-Mirand *J. Knot Theory Ramifications* **19** (2010), no. 1, 93–115.

10. **On Invariants of Graphs Related to Quantum** $\mathfrak{sl}(2)$ **at Roots of Unity,** with N. Reshetikhin *Letters in Mathematical Physics.* **88** (2009), no. 1-3, 321–331.

9. **Modified quantum dimensions and re-normalized link invariants,** with B. Patureau-Mirand and V. Turaev *Compos. Math.* **145** (2009), no. 1, 196–212.

8. **Compatibility of quantization functors of Lie bialgebras with duality and doubling operations,** with B. Enriquez *Selecta Math. (N.S.)* **15** (2009), no. 1, 1–59.

7. **An invariant supertrace for the category of representations of Lie superalgebras of type I,** with B. Patureau-Mirand *Pacific J. Math.* **238** (2008), no. 2, 331–348.

6. **On the colored HOMFLY-PT, multivariable and Kashaev link invariants,** with B. Patureau-Mirand *Commun. Contemp. Math.* **10** (2008), suppl. 1, 993–1011.

5. **Monodromy of the trigonometric KZ equations** with P. Etingof *Int. Math. Res. Not. IMRN* (2007), no. 24.

4. **Some remarks on quantized Lie superalgebras of classical type,** *J. Algebra* **314** (2007) no. 2, 565–580.

3. **Multivariable link invariants arising from $\mathfrak{sl}(2|1)$ and the Alexander polynomial,** with B. Patureau-Mirand *J. Pure Appl. Algebra,* **210** (2007), no. 1, 283–298.

2. **The Etingof-Kazhdan quantization of Lie superbialgebras,** *Adv. Math.* **207** (2006), no. 1, 1–38.

1. **The Kontsevich integral and quantized Lie superalgebras,** *Algebr. Geom. Topol.* **5** (2005), no. 45. 1111–1139.

CONFERENCE ORGANIZATION

9. Co-Organizer of "Quantum Topology and Geometry"
   Institut Henri Poincaré, Paris, Spring, 2022.

8. Co-Organizer of "Quantum Field Theories and Quantum Topology Beyond Semisimplicity,"
   Banff International Research Station, Fall 2021.

7. Co-Organizer of "New Developments in Quantum Topology,".
   University of California, Berkeley, Summer 2019

6. Co-Organizer of "2019 Moab Topology Conference"
   Moab Utah, Spring 2019.

5. Co-Organizer "Journées TQFT, groupes quantiques et invariants non commutatifs Conference,"
   Université Sorbonne-Paris-Cité 1, Paris, Spring 2016

4. Co-Organizer "2015 Moab Topology Conference"
   Moab Utah, Spring 2015.

3. Co-Organizer "2012 Moab Topology Conference"
   Moab Utah, Spring 2012.

2. Organizer of a research section for MAA conference
   Utah State University, Logan, UT, Spring 2010.

1. Organizer of "Topics in Topology"
   Max-Planck Institute for Mathematics, Bonn, Germany, September 2008 - July 2009.

INVITED LECTURES

Invited Lectures Series

7. *Catégorification en topologie et théorie des représentations*
   Caen, France , February 2019

6. *Meeting on non-semisimple TFT and logarithmic CFT*
   Hamburg, Germany , February 2018

5. *Renormalized Quantum Invariants and Categorification Workshop*
   Engelberg, Switzerland (4 hours), September 2015

4. *Quantum Algebra and Topology Workshop*
   Pisa University, Pisa, Italy (3 hours), June 2012

3. *Workshop on Quantum Invariants from non-semi-simple categories.*
   Institute of Mathaematics de Jussieu, Pairs, France (3 hours, with B. Patureau), April 2012

2. *Volume Conjecture, Invariants and geometry of knots*
   Waseda University, Tokyo, Japan (3 hours), January 2010

1. *Representation of $U_q(\mathfrak{sl}(2))$ and the Alexander invariant*
   Institut Fourier Grenoble, France (3 hours), December 2008

Invited Conference Lectures

Subfactors, Vertex Operator Algebras, and Tensor Categories, BIRS, Sept 24, 2021

Representation Theory, Mathematical Physics and Integrable Systems, CIRM, Luminy, France , June 4, 2018

TQFT and categorification, IESC, Corsica, France , April, 2018

Invariants in low dimensional geometry and topology, Toulouse France, May, 2017

Quantum Topology, Steklov Mathematical Institute, Moscow, June, 2016

Journées TQFT, groupes quantiques et invariants non commutatifs, Université Sorbonne-Paris, May, 2016

Third SwissMAP Geometry & Topology conference, Engelberg, Switzerland, January 2016

Mathematics of Knots VIII, Waseda University, Tokyo, Japan, December, 2015

Quantum Topology, Euler Institute, St. Petersburg, Russia, July, 2015

Categorification in Algebra, Geometry and Physics, Cargese Corsica, France, May, 2015

Modern trends in topological quantum field theory, ESI, Vienna, Austria, March, 2014

Wasatch Topology Conference, Park City, UT, August, 2013

Spring School in Geometry and Quantum Topology, Les Diablerets, Switzerland, March, 2011

FRG-Chern-Simons Workshop, Berkeley, CA, January, 2011

Quantum Geometry and Topology, Luminy, France, July, 2010

AMS Sectional Meeting, St. Paul, MN, April, 2010

MAA Sectional Meeting, Logan, UT, March, 2010

Lie Groups and Moduli Spaces, Geneva, Switzerland, June 2009

Cascade Topology Seminar, Boise, Idaho, October 2007

International Conference on Quantum Topology, Ha-Noi, Vietnam, August 2007

International Congress of Mathematicians, Madrid, Spain, August 2006

Pure Mathematics Symposium, University of Zurich, Switzerland, June 2006

AMS National Meeting, San Antonio, TX, January 2006

Joint Meeting of AMS, DMV, and MG, Mainz, Germany, June 2005

Workshop on Representation Theory and Geometry, UC, Berkeley, May 2005

AMS National Meeting, Atlanta, GA, January 2005

AMS National Meeting, Phoenix, AZ, January 2004

Knots in Poland 2003, Bedlewo, Poland, July 2003

Invited Colloquia and Seminar Lectures

Give regular lectures (about 4 per year) at a variety universities and institutes. For example, past lectures were given at Boise State University, Brigham Young University, Emory University, Indiana University, Jussieu Institute of Mathematics, Kyoto University, MIT, Max-Planck Institute, Microsoft research Station Q, Université de Bretagne Sud, Université de Nantes, Université de Toulouse, University of Bielefeld, University of Calgary, UC Berkeley, UC Davis, UC Riverside, UC Santa Cruz, University of Geneva, University of Georgia, University of Miami, University of Oxford, University of Southern California, University of Utah, University of Wisconsin-Madison and University of Zurich.