

Peter Koroteev

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Research Interests

Algebraic Geometry, Representation Theory, Integrable Systems, Mathematical Physics,
Machine Learning

Employment History

2019-current *Lecturer*, University of California Berkeley, Department of Mathematics
2016-2019 *Krener Assistant Professor*, University of California, Davis, Department of Mathematics
2012-2016 *Postdoctoral Fellow*, Perimeter Institute for Theoretical Physics, Waterloo, ON, Canada.

Appointments held

2017 *Visitor*, IHES, Bures-sue-Yvette, France
2014, 2017 *Visitor*, Kavli Institute for Theoretical Physics, Santa Barbara
2012 *Graduate Fellow*, Kavli Institute for Theoretical Physics, Santa Barbara
2007-2009 *Visiting Researcher*, Albert Einstein Institute, Max Planck Institute, Golm, Germany

Education

2012 PhD: University of Minnesota (adviser Prof. Arkady Vainshtein)
2008 MSc: Moscow Institute of Physics and Technology
2006 BSc: Moscow Institute of Physics and Technology

Grants, honors & awards

2020 AMS-Simons travel grant
2012 KITP Graduate Fellowship (NSF)
2011 Anatoly Larkin Fellowship in Physics at University of Minnesota
2009-2010 GAPSA travel grants by University of Minnesota
2007-2008 N.N. Bogolyubov stipend for master students by INR RAS, Moscow
2007-2008 Dynasty Foundation prize for senior undergraduate students
2006-2007 Research student fellowship by ITEP, Moscow

Workshops Organization

- 2022 Program ‘Geometric and Representation-Theoretic Aspects of Quantum Integrability’ (August 29th - October 21st 2022) [\[link\]](#) with focus workshop ‘Geometric Representation Theory, Integrability, and Supersymmetric Gauge Theories’ [\[link\]](#) at Simons Center of Geometry and Physics at Stony Brook University.
- 2021 Zoom workshop on Elliptic Integrable Systems [\[link\]](#).
- 2021 Zoom workshop on Elliptic Integrable Systems [\[link\]](#).

Publications

Preprints

44. **On the Quantum K-theory of Quiver Varieties at Roots of Unity**
P. Koroteev, and A. Smirnov
arXiv:2412.19383 [math.AG].

Journal articles

43. **Quantum K-Theory and Integrability**
P. Koroteev,
Journal: *Int. J. Mod. Phys. A*
arXiv:2412.19570 [math-ph].
Proceedings of GLSM at 30, in press
42. **Quantum Geometry, Integrability, and Opers**
P. Koroteev,
arXiv:2312.17500 [math.RT].
Proceedings of MSJ-SI 2023, in press
41. **The Zoo of Opers and Dualities**
P. Koroteev and A. M. Zeitlin,
arXiv:2208.08031 [math.AG].
Int. Math. Res. Not. **2024** (2024) 6850
40. **3d Mirror Symmetry for Instanton Moduli Spaces**
P. Koroteev and A. M. Zeitlin,
arXiv:2105.00588 [math.AG].
Commun. Math. Phys. **403**, (2023) 1005–1068
39. **q-Opers, QQ-systems, and Bethe Ansatz II: Generalized Minors**
P. Koroteev and A. M. Zeitlin,
arXiv:2108.04184 [math.AG].
J.Reine Angew. Math. (2023) 271

38. **Branes and DAHA Representations**
S. Gukov, P. Koroteev, S. Nawata, D. Pei, and I. Saberi.
arXiv:2206.03565 [hep-th].
SpringerBriefs in Mathematical Physics. Monograph, **48** (2023)
37. **Toroidal q -Opers,**
P. Koroteev and A. M. Zeitlin,
arXiv:2007.11786 [math.AG].
J. Inst. Math. Jussieu (2021) 1-62
36. **Quantum K-theory of Quiver Varieties and Many-Body Systems**
P. Koroteev, P. P. Pushkar, A. Smirnov and A. M. Zeitlin.
arXiv:1705.10419 [math.AG]
Selecta Math. New Ser. 27, 87 (2021).
35. **q -Opers, QQ-Systems, and Bethe Ansatz,**
E. Frenkel, P. Koroteev, D. S. Sage and A. M. Zeitlin,
arXiv:2002.07344 [math.AG].
J. Europ. Math. Soc. (2023)
34. **$(SL(N), q)$ -opers, the q -Langlands correspondence, and quantum/classical duality**
P. Koroteev, D. S. Sage and A. M. Zeitlin.
arXiv: 1811.09937 [math.RT]
Commun. in Math. Phys. **381** (2021) 641.
33. **A-type Quiver Varieties and ADHM Moduli Spaces**
P. Koroteev.
arXiv:1805.00986 [math.AG]
Comm. in Math. Phys. **381** (2021) 175.
32. **Double Inozemtsev Limits of the Quantum DELL System,**
A. Gorsky, O. Koroteeva, P. Koroteev and S. Shakirov,
arXiv: 2110.02157 [hep-th]
Phys.Lett.B 826 (2022) 136919
31. **On Dimensional Transmutation in 1+1D Quantum Hydrodynamics,**
A. Gorsky, O. Koroteeva, P. Koroteev and A. Vainshtein,
arXiv: 1910.02606 [hep-th]
J.Math.Phys. **61** (2020) 082302
30. **On Quiver W -algebras and Defects from Gauge Origami**
P. Koroteev.
arXiv:1908.04394 [hep-th].
Phys. Lett. B **800**, 135101 (2020)
29. **The Quantum DELL System,**
P. Koroteev and S. Shakirov,

- arXiv: [1906.10354](https://arxiv.org/abs/1906.10354) [hep-th].
Lett.Math.Phys. **110** (2020) 969-999
28. **qKZ/tRS Duality via Quantum K-Theoretic Counts**
P. Koroteev and A. M. Zeitlin.
arXiv:[1802.04463](https://arxiv.org/abs/1802.04463) [math.AG]
Math. Res. Lett. **28** (2021) 435.
27. **On Elliptic Algebras and Large-n Supersymmetric Gauge Theories**
P. Koroteev and A. Sciarappa.
arXiv:[1601.08238](https://arxiv.org/abs/1601.08238) [hep-th]
J. Math. Phys. **57**, no. 11, 112302 (2016)
26. **Quantum Hydrodynamics from Large-n Supersymmetric Gauge Theories**
P. Koroteev and A. Sciarappa.
arXiv:[1510.00972](https://arxiv.org/abs/1510.00972) [hep-th]
Lett. Math. Phys. **108**, no. 1, 45 (2018)
25. **Defects and Quantum Seiberg-Witten Geometry**
M. Bullimore, H. C. Kim and P. Koroteev.
arXiv:[1412.6081](https://arxiv.org/abs/1412.6081) [hep-th]
JHEP **1505**, 095 (2015)
24. **Resurgence and Holomorphy: From Weak to Strong Coupling**
A. Cherman, P. Koroteev and M. Ünsal.
arXiv:[1410.0388](https://arxiv.org/abs/1410.0388) [hep-th]
J. Math. Phys. **56**, no. 5, 053505 (2015)
23. **On Three Dimensional Quiver Gauge Theories and Integrability**
D. Gaiotto and P. Koroteev.
arXiv:[1304.0779](https://arxiv.org/abs/1304.0779) [hep-th]
JHEP **1305**, 126 (2013)
22. **Good IR Duals of Bad Quiver Theories**
A. Dey and P. Koroteev.
arXiv:[1712.06068](https://arxiv.org/abs/1712.06068) [hep-th]
JHEP **1805**, 114 (2018)
21. **On Three-Dimensional Quiver Gauge Theories of Type B**
A. Dey, A. Hanany, P. Koroteev and N. Mekareeya.
arXiv:[1612.00810](https://arxiv.org/abs/1612.00810) [hep-th]
JHEP **1709**, 067 (2017)
20. **Non-Abelian Vortex in Four Dimensions as a Critical String on a Conifold**
P. Koroteev, M. Shifman and A. Yung.
arXiv:[1605.08433](https://arxiv.org/abs/1605.08433) [hep-th]
Phys. Rev. D **94**, no. 6, 065002 (2016)

19. **Studying Critical String Emerging from Non-Abelian Vortex in Four Dimensions**
P. Koroteev, M. Shifman and A. Yung.
arXiv:[1605.01472](#) [hep-th]
Phys. Lett. B **759**, 154 (2016)
18. **Mirror Symmetry in Three Dimensions via Gauged Linear Quivers**
A. Dey, A. Hanany, P. Koroteev and N. Mekareeya.
arXiv:[1402.0016](#) [hep-th]
JHEP **1406**, 059 (2014)
17. **Three Dimensional Mirror Symmetry and Integrability**
P. Koroteev.
DOI:[10.1090/pspum/088/01468](#)
Proc. Symp. Pure Math. **88**, 317 (2014).
16. **On the Integrability of Four Dimensional N=2 Gauge Theories in the Omega Background**
H. Y. Chen, P. S. Hsin and P. Koroteev.
arXiv:[1305.5614](#)
JHEP **1308**, 076 (2013)
15. **Statistical mechanics of Coulomb gases as quantum theory on Riemann surfaces**
T. Gulden, M. Janas, P. Koroteev and A. Kamenev.
arXiv:[1303.6386](#) [cond-mat.stat-mech]
J. Exp. Theor. Phys. **117**, 517 (2013)
14. **BPS States in Omega Background and Integrability**
K. Bulycheva, H. Y. Chen, A. Gorsky and P. Koroteev.
arXiv:[1207.0460](#) [hep-th]
JHEP **1210**, 116 (2012)
13. **On Extended Supersymmetry in Two and Four Dimensions**
P. A. Koroteev.
[PhD Thesis](#)
12. **Causality and Lifshitz holography**
P. Koroteev.
Nucl. Phys. Proc. Suppl. **216**, 245 (2011).
11. **Quantum Dynamics of Low-Energy Theory on Semilocal Non-Abelian Strings**
P. Koroteev, M. Shifman, W. Vinci and A. Yung.
arXiv:[1107.3779](#) [hep-th]
Phys. Rev. D **84**, 065018 (2011)
10. **Large-N Solution of the Heterotic Weighted Non-Linear Sigma-Model**
P. Koroteev, A. Monin and W. Vinci.

- arXiv:[1009.6207](#) [hep-th]
Phys. Rev. D **82**, 125023 (2010)
9. **On the Null Energy Condition and Causality in Lifshitz Holography**
 C. Hoyos and P. Koroteev.
 arXiv:[1007.1428](#) [hep-th]
Phys. Rev. D **82**, 084002 (2010), *Erratum: [Phys. Rev. D* **82**, 109905 (2010)]
 8. **Large-N Solution of the Heterotic $N=(0,1)$ Two-Dimensional $O(N)$ Sigma Model**
 P. Koroteev and A. Monin.
 arXiv:[1003.2645](#) [hep-th]
Phys. Rev. D **81**, 105001 (2010)
 7. **Wilson Loops in Gravity Duals of Lifshitz-like Theories**
 P. Koroteev and A. V. Zayakin.
 arXiv:[0909.2551](#) [hep-th]
 ITEP-TH-40-09, FTPI-MINN-09-33, UMN-TH-2813-09
 6. **Comments on Holography with Broken Lorentz Invariance**
 I. Gordeli and P. Koroteev.
 arXiv:[0904.0509](#) [hep-th]
Phys. Rev. D **80**, 126001 (2009)
 5. **Spectra of Field Fluctuations in Braneworld Models with Broken Bulk Lorentz Invariance**
 P. Koroteev and M. Libanov.
 arXiv:[0901.4347](#) [hep-th]
Phys. Rev. D **79**, 045023 (2009)
 4. **Integrable systems and quantum deformations**
 P. Koroteev.
[AIP Conf. Proc.](#) **1182**, 513 (2009).
 3. **Quantum Deformations of the One-Dimensional Hubbard Model**
 N. Beisert and P. Koroteev.
 arXiv:[0802.0777](#) [hep-th]
J. Phys. A **41**, 255204 (2008)
 2. **On Existence of Self-Tuning Solutions in Static Braneworlds without Singularities**
 P. Koroteev and M. Libanov.
 arXiv:[0712.1136](#) [hep-th]
JHEP **0802**, 104 (2008)
 1. **Morse theory in field theory**
 P. Koroteev and A. V. Zayakin.
[hep-th/0508153](#)
Softex, Sofia, Bulgaria, (2007) 207-220.

Invited talks

- 2024 Lectures at the study group on affine quantum groups and categories O , MIT, Cambridge, MA [\[link\]](#)
Seminar at Kavli IPMU, Tokyo, Japan
Seminar at OIST Okinawa, Japan
String seminar at KIAS, Seoul, Korea
Spring AMS Sectional Meeting, Milwaukee, WI
Spring AMS Sectional Meeting, San Francisco, CA
Geometry, Symmetry and Physics Seminar, Yale University, New Haven, CT
- 2023 Workshop Elliptic Integrable Systems, Representation Theory, and Hypergeometric Functions, Tokyo, Japan
Workshop Dualities and Symmetries in Integrable Systems, Sabhal Mor Ostaig, Isle of Skye, Scotland, UK
Workshop Gauge Linear Sigma Models at 30, Simons Center for Geometry and Physics, Stony Brook, NY
Workshop 50 Years of Supersymmetry, University of Minnesota, MN
- 2022 Australia Mathematical Physics Colloquium (over zoom)
Math Physics Seminar, University of Queensland, Australia
Mathematics Colloquium, Australian National University, Canberra, Australia
Math Physics Seminar, University of Melbourne, Australia
M-Seminar, Kansas State University (over zoom)
2022 Aspen Conference on Geometrization of $D < 7$ Theories
- 2021 Mathematical Physics seminar, Purdue University, Department of Mathematics, West Lafayette, IN
String Theory Seminar, Trinity College, Dublin, Ireland
Mathematical Physics Seminar, CRM, Montreal, QC, Canada
Online Geometry and Physics Seminar, Institute for Advanced Study in Mathematics, Zhejiang University, Zhejiang, China [\[link\]](#)
- 2020 Perimeter Institute for Theoretical Physics, Waterloo, ON, Canada
Mathematical Physics Seminar, University of North Carolina, Chapel Hill, NC
Joint AMS Meeting, Denver, CO
Algebra and Geometry seminar, California Institute of Technology, Pasadena, CA
- 2019 Workshop “Geometric Representation Theory and Quantum Field Theories”, Tsinghua Sanya International Mathematics Forum, Sanya, China
Geometry, Physics, and Representation Theory Seminar, Northeastern University, Boston, MA
Workshop “BPS/CFT Correspondence”, Centre International de Rencontres Mathématiques, Marseille, France [\[link\]](#)
Conference “Verlinde Algebra and Grassmannian”, Sun Yatsen University, Guangzhou, China. [\[link\]](#)[\[slides\]](#)
Conference ‘Non-Local Aspects of Holomorphic and Topological Field Theory’, IHES, France. [\[link\]](#)
Workshop ‘Representation theory, gauge theory and integrable systems’, Kavli IPMU, University of Tokyo, Japan. [\[link\]](#)

- 2018 Conference on Quantum K-theory and related topics. Korean Institute for Advanced Study, Seoul, Korea [\[link\]](#)
 Workshop ‘Exactly Solvable Models of Quantum Field Theory and Statistical Mechanics’. Simons Center for Geometry and Physics, Stony Brook, NY
 High Energy Physics seminar. Arizona State University, Department of Physics, Phoenix, AZ
 Algebraic Geometry seminar. Arizona State University, Department of Mathematics, Phoenix, AZ
 Mirror Symmetry group seminar. Kansas State University, Manhattan, KS
 Workshop “SCFTs in 6 and lower dimensions”. The Yau Mathematical Sciences Center at Tsinghua University [\[slides\]](#)
- 2017 The Yau Mathematical Sciences Center at Tsinghua University, Beijing, China
 Informal Mathematical Physics Seminar. Columbia University, Department of Mathematics [\[link\]](#)
 High Energy Physics seminar. Arizona State University, Department of Physics, Phoenix, AZ
 XXVth International Conference on Integrable Systems and Quantum symmetries. Prague, Czech Republic
 Theory group lunch seminar. University of Amsterdam, Amsterdam, Netherlands
 High energy theory seminar. Uppsala University, Uppsala, Sweden
- 2016 School and Workshop on Geometric Correspondences of Gauge Theories, ICTP, Trieste, Italy [\[slides\]](#)[\[video\]](#)
 Colloquium at University of Virginia, Department of Mathematics, Charlottesville, VA
 Geometry and Physics Seminar, University of Texas, Austin, TX
 High Energy Physics Seminar, University of Toronto, Toronto, ON, Canada
 Korean Institute for Advanced Study, String seminar, Seoul, Korea
 9th Taiwan String Workshop, Taipei, Taiwan
 International Seminar ‘Quarks-2016’, Pushkin, Russia
 String Theory Seminar, University of California at Davis, CA
 Continuous Advances in QCD 2016, Minneapolis, MN [\[slides\]](#)
- 2015 Korean Institute for Advanced Study, String seminar, Seoul, Korea
 Kavli Institute of Physics and Mathematics of the Universe, String seminar, Kashiwa, Japan
 California Institute of Technology, High energy physics seminar, Pasadena, CA
 CERN, High energy physics seminar, Geneva, Switzerland
 Workshop on Classical and Quantum Integrable Systems, Protvino, Russia
 String/high energy seminar at Imperial College, UK
 Workshop on Geometric Correspondences of Gauge Theories 5, SISSA, Trieste, Italy [\[site\]](#)
 High energy physics group seminar, University of Toronto, Toronto, ON
- 2014 Fine Theoretical Physics Institute Seminar, University of Minnesota
 High Energy seminar, CERN, Switzerland
 Workshop on Geometric Correspondences of Gauge Theories 4, SISSA, Trieste, Italy
 Seminar at Simons Center for Geometry and Physics, Stony Brook, NY [\[video\]](#)
 String seminar, University of California, Berkeley

- Talk at New Methods in Nonperturbative Quantum Field Theory, Kavli Institute for Theoretical Physics, Santa Barbara [\[video\]](#)
- High energy physics group seminar, University of South California
- Theory group seminar, University of Texas, Austin
- High energy physics group seminar, California Institute of Technology
- String Theory seminar, University of California, Berkeley
- High energy physics group seminar, University of Minnesota, Duluth
- 2013 Quiver Varieties Program seminar, SCGP, Stony Brook University [\[video\]](#)
- String theory seminar at Oxford University, UK
- String theory seminar at DAMTP, Cambridge University, UK
- High energy seminar at Queen Mary College, UK
- String/high energy seminar at Imperial College, UK
- Great Lakes Strings conference, University of Kentucky [\[video\]](#)
- Continuous Advances in QCD, University of Minnesota [\[slides\]](#)
- 2012 Workshop on Integrability in Modern Theoretical and Mathematical Physics, SCGP, Stony Brook University [\[video\]](#)
- High energy physics group seminar, University of Toronto
- High energy physics group seminar, California Institute of Technology
- Workshop on N=2 Jeometry And ApplicationZ, McGill University, Montreal [\[slides\]](#)
- Theory group seminar. McGill University, Montreal [\[abstract\]](#)
- 2011 Continuous Advances in QCD, University of Minnesota [\[slides\]](#)
- Theory group seminar. University of Victoria
- 2010 High Energy group seminar. University of British Columbia, Vancouver
- 2008 Elementary particle physics group seminar, Niels Bohr Institute, Copenhagen
- String theory group seminar, Utrecht University
- String seminar, Imperial College, London

Teaching

University of California

Berkeley

Math-1A *Calculus*. 2023

Math-55 *Discrete Mathematics*. 2022

Math-54 *Linear Algebra*. 2021, 2023

Math-53 *Multivariable Calculus*. 2020

Math-142 *Elementary Algebraic Topology*. 2019

Math-H185 *Honors Introduction to Complex Analysis*. 2019

Math-185 *Introduction to Complex Analysis*. 2019

Davis

MAT-125A *Real Analysis*. Spring quarter 2016

MAT-108 *Introduction to Abstract Math*. Winter quarter 2016

MAT-016A *Short Calculus*. Spring quarter 2017

MAT-25 *Advanced Calculus*. Winter quarter 2018

MAT-16B *Calculus*. Spring quarter 2018

MAT-21B *Calculus*. Fall quarter 2018

Miscellaneous

- since 2023 Board Member and Chief Financial Officer of United Math Circles.
- since 2019 Instructor at Berkeley Math Circle and Stanford Math Circle both in elementary (grades 1–4) and upper (grades 5–12) circles. Grader of Bay Area Math Olympiad.
- since 2022 Instructor at Stanford University Mathematics Camp (SUMaC), where I teach courses in Abstract Algebra, Number Theory, and Algebraic Topology to advanced high school students from around the world.
- since 2021 Mentor at the online program Pioneer Education. The format includes group lectures followed by individual sessions with each student.

Lecture courses

- 2014 Duluth Winter School 2014 on Supersymmetry and String Theory [\[link\]](#). Week long lecture course on Supersymmetry and String Theory [\[notes\]](#).

References

1. **Andrei Okounkov**
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2. **Hiraku Nakajima**
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