

CURRICULUM VITAE

Oleksandr (Sasha) Tsymbaliuk

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Born: May 21, 1987, Kharkiv, Ukraine
Citizenship: Ukraine, USA

Research Interests

- Representation Theory and its connection to Algebraic Geometry, Combinatorics, and Integrable Systems

Employment

- Associate Professor
Purdue University 2024–present
- Assistant Professor
Purdue University 2020–2024
- Gibbs Assistant Professor
Yale University 2017–2020
- Research Assistant Professor
Simons Center for Geometry and Physics 2014–2017

Education

- PhD in Mathematics, Massachusetts Institute of Technology 2009–2014
Thesis title: *The affine Yangian of \mathfrak{gl}_1 and the infinitesimal Cherednik algebras*
Thesis advisor: Prof. Pavel Etingof
- MS in Mathematics, Independent University of Moscow 2004–2009
Thesis title: *Quantum affine Gelfand-Tsetlin bases and quantum toroidal algebra via K -theory of affine Laumon spaces*
Thesis advisor: Prof. Boris Feigin
- MS in Mathematics, Moscow State University (summa cum laude) 2004–2009
Thesis title: *Heisenberg action in the equivariant K -theory of Hilbert schemes via shuffle algebra*
Thesis advisor: Prof. Ernest Vinberg

Research Visits

- Institut des Hautes Études Scientifiques (IHES) June–July 2025
Bures-sur-Yvette, France
- Università degli Studi di Roma “La Sapienza” June 2024
Rome, Italy
- Centre International de Rencontres Mathématiques (CIRM) August 2023
Luminy, France
- Oberwolfach Research Institute for Mathematics (MFO) July 2023
Oberwolfach, Germany
- Institut des Hautes Études Scientifiques (IHES) May 2023
Bures-sur-Yvette, France
- Institut des Hautes Études Scientifiques (IHES) July 2021
Bures-sur-Yvette, France

- Institut des Hautes Études Scientifiques (IHES) May–July 2020
Bures-sur-Yvette, France *Cancelled due to COVID-19*
- Institut des Hautes Études Scientifiques (IHES) June–July 2019
Bures-sur-Yvette, France
- Institut des Hautes Études Scientifiques (IHES) January 2019
Bures-sur-Yvette, France
- Kavli Institute for the Physics and Mathematics of the Universe August 2018
(IPMU) and Research Institute for Mathematical Sciences (RIMS)
Kashiwa and Kyoto, Japan
- Max Planck Institut für Mathematik (MPIM) July 2018
Bonn, Germany
- Institut des Hautes Études Scientifiques (IHES) June–July 2017
Bures-sur-Yvette, France
- Max Planck Institut für Mathematik (MPIM) June–July 2016
Bonn, Germany
- Max Planck Institut für Mathematik (MPIM) June 2015
Bonn, Germany
- Research Institute for Mathematical Sciences (RIMS) January 2015
Kyoto, Japan
- Hebrew University of Jerusalem Fall 2010
Jerusalem, Israel

Grants, Awards and Fellowships

- Purdue Seed Funding for 2024
high-profile journal review papers, books and monographs
- NSF grant DMS-2302661 2023–2026
- NSF grant DMS-2001247 (changed to DMS-2037602 in 2020) 2020–2024
- Yale Travel Grant 2019–2020
- Yale Travel Grant 2018–2019
- NSF grant DMS-1502497 (changed to DMS-1821185 in 2017) 2015–2019
- SUNY Individual Development Award 2015–2016
- JSPS Fellowship for Foreign Researchers Winter 2015
- Akamai Presidential Fellowship, MIT 2009–2010
- Dobrushin Fellowship, Independent University of Moscow Fall 2008
- Dobrushin Fellowship, Independent University of Moscow Spring 2008
- Dobrushin Fellowship, Independent University of Moscow Spring 2007
- Silver Medal at the 45th International Mathematical Olympiad July 2004

Publication List

- *Affine standard Lyndon words*
joint with C. Elkins
Submitted; arXiv:2505.15432 (47pp, last update on 06/19/2025)

- *Shuffle algebras and their integral forms:
specialization map approach in types C_n and D_n*
joint with Y. Hu
Submitted; arXiv:2503.22535 (55pp, last update on 03/28/2025)
- *Orthogonal bases for two-parameter quantum groups*
joint with I. Martin
Submitted; arXiv:2412.06670 (43pp, last update on 06/12/2025)
- *Orthosymplectic R -matrices*
joint with K. Hong
Submitted; arXiv:2408.16720 (64pp, last update on 12/23/2024)
- *Fusion and specialization for type ADE shuffle algebras*
joint with A. Neguţ
Submitted; arXiv:2408.02411 (28pp, last update on 08/05/2024)
- *Standard Lyndon loop words: weighted orders*
joint with S. Khomych, N. Korniiichuk, K. Molokanov
International Math. Research Notices (2025), 32pp
DOI:10.1093/imrn/rnaf030
- *Two-parameter quantum groups and R -matrices: classical types*
joint with I. Martin
Submitted; arXiv:2407.01450 (46pp, last update on 01/05/2025)
- *Orthosymplectic Yangians*
joint with R. Frassek
Letters in Mathematical Physics 115 (2025), Paper No. 43, 100pp
DOI:10.1007/s11005-025-01926-z
- *Orthosymplectic superoscillator Lax matrices*
joint with R. Frassek
Letters in Mathematical Physics 114 (2024), Paper No. 49, 39pp
- *Affine standard Lyndon words: A -type*
joint with Y. Avdieiev
International Math. Research Notices (2024), no. 21, 13488–13524
- *Shuffle algebras and their integral forms:
specialization map approach in types B_n and G_2*
joint with Y. Hu
International Math. Research Notices (2024), no. 7, 6259–6302
- *Difference operators via GKLO-type homomorphisms:
shuffle approach and application to quantum Q -systems*
Letters in Mathematical Physics 113 (2023), Paper No. 22, 43pp
- *Shuffle approach towards quantum affine and toroidal algebras*
SpringerBriefs in Mathematical Physics (2023), xi+130pp
DOI:10.1007/978-981-99-3150-7, ISBN:978-981-99-3150-7
- *Transfer matrices of rational spin chains via novel BGG-type resolutions*
joint with R. Frassek and I. Karpov
Communications in Mathematical Physics 400 (2023), 1–82
- *Rational Lax matrices from antidominantly shifted
extended Yangians: BCD types*
joint with R. Frassek

- Communications in Mathematical Physics** 392 (2022), 545–619

 - *Surface defects in gauge theory and KZ equation*
joint with N. Nekrasov
Letters in Mathematical Physics 112 (2022), Paper No. 28, 53pp
 - *Quantum loop groups and shuffle algebras via Lyndon words*
joint with A. Neguţ
Advances in Mathematics 439 (2024), Paper No. 109482, 69pp
 - *Lax matrices from antidominantly shifted Yangians and quantum affine algebras: A-type*
joint with R. Frassek and V. Pestun
Advances in Mathematics 401 (2022), Paper No. 108283, 73pp
 - *Shuffle algebra realizations of type A super Yangians and quantum affine superalgebras for all Cartan data*
Letters in Mathematical Physics 110 (2020), 2083–2111
 - *Duality of Lusztig and RTT integral forms of $U_v(L\mathfrak{sl}_n)$*
Journal of Pure and Applied Algebra 225 (2021), no. 1
Paper No. 106469, 14pp
 - *Shifted quantum affine algebras: integral forms in type A*
joint with M. Finkelberg (with appendices joint with A. Weekes)
Arnold Mathematical Journal 5 (2019), 197–283
 - *PBWD bases and shuffle algebra realizations for $U_v(L\mathfrak{sl}_n), U_{v_1, v_2}(L\mathfrak{sl}_n), U_v(L\mathfrak{sl}(m|n))$ and their integral forms*
Selecta Mathematica (New Series) 27 (2021), Paper No. 35, 48pp
 - *On Sevostyanov’s construction of quantum difference Toda lattices*
joint with R. Gonin
International Math. Research Notices (2021), no. 12, 8885–8945
 - *Multiplicative slices, relativistic Toda and shifted quantum affine algebras*
joint with M. Finkelberg
Representations and Nilpotent Orbits of Lie Algebraic Systems
(special volume in honour of the 75th birthday of Anthony Joseph)
Progress in Mathematics 330 (2019), 133–304
 - *Classical limits of quantum toroidal and affine Yangian algebras*
Journal of Pure and Applied Algebra 221 (2017), no. 10, 2633–2646
 - *Several realizations of Fock modules for toroidal $\ddot{U}_{q,d}(\mathfrak{sl}_n)$*
Algebras and Representation Theory 22 (2019), 177–209
 - *Homomorphisms between different quantum toroidal and affine Yangian algebras*
joint with M. Bershtein
Journal of Pure and Applied Algebra 223 (2019), no. 2, 867–899
 - *Bethe subalgebras of $U_q(\widehat{\mathfrak{gl}}_n)$ via shuffle algebras*
joint with B. Feigin
Selecta Mathematica (New Series) 22 (2016), 979–1011
 - *The affine Yangian of \mathfrak{gl}_1 revisited*
Advances in Mathematics 304 (2017), 583–645
 - *Infinitesimal Hecke algebras of \mathfrak{so}_N*
Journal of Pure and Applied Algebra 219 (2015), no. 6, 2046–2061

- *Infinitesimal Cherednik algebras as W-algebras*
joint with I. Losev
Transformation Groups 19 (2014), no. 2, 495–526
- *Representations of infinitesimal Cherednik algebras*
joint with F. Ding
Representation Theory (electronic) 17 (2013), 557–583
- *Equivariant K-theory of Hilbert schemes via shuffle algebra*
joint with B. Feigin
Kyoto Journal of Mathematics 51 (2011), no. 4, 831–854
- *Quantum affine Gelfand–Tsetlin bases and quantum toroidal algebra via K-theory of affine Laumon spaces*
Selecta Mathematica (New Series) 16 (2010), 173–200

Teaching

- Lecturer for *Elements of Complex Analysis* MA42500/52500 (Purdue) Fall 2025
- Lecturer for *Infinite dimensional Lie algebras* MA59500 (Purdue) Spring 2025
- Lecturer for *Linear Algebra* MA26500 (Purdue) Fall 2024
- Lecturer for *Quantum Groups and Applications* MA59500 (Purdue) Spring 2024
- Lecturer for *Linear Algebra* MA26500 (Purdue) Spring 2024
- Lecturer for *Lie Algebras* MA59800 (Purdue) Fall 2023
- Lecturer for *Linear Algebra* MA26500 (Purdue) Fall 2022
- Lecturer for *Linear Algebra* MA26500 (Purdue) Spring 2022
- Lecturer for *Infinite dimensional Lie algebras* MA59800 (Purdue) Spring 2021
- Lecturer for *Linear Algebra* MA26500 (Purdue) Fall 2020
- Lecturer for *Calculus of Functions of Several Variables* (Yale) Fall 2019
- Lecturer for *Shuffle approach towards quantum toroidal algebras* (Crash-course, Tokyo University of Marine Science and Technology) March 2019
- Lecturer for *Infinite dimensional Lie algebras and applications* (Yale) Spring 2019
- Lecturer for *Introduction to Representation Theory* (Yale) Fall 2018
- Lecturer for *Calculus of Functions of Several Variables* (Yale) Fall 2018
- Lecturer for *Topics in Quantum Groups* (Yale) Spring 2018
- Lecturer for *Calculus of Functions of Several Variables* (Yale) Fall 2017
- Head instructor for *Mathematical Thinking* (Stony Brook) Fall 2016
- Lecturer for *Calculus B* (Stony Brook) Fall 2015
- Section leader for *Calculus IV with Applications* (Stony Brook) Fall 2014
- Teaching assistant for *Real Analysis* (MIT) Spring 2014
- Section leader for *Multivariable Calculus* (MIT) Fall 2012
- Grader for the following courses at MIT: 2011–2013
Real and Functional Analysis, Calculus, Commutative Algebra, Introduction to Arithmetic Geometry, Algebraic Groups

Mentoring

- Mentoring undergraduate students at REU program October 2023–present
 C. Elkins, A. Tsymbaliuk,
Affine standard Lyndon words
 Submitted; arXiv:2505.15432 (2025), 47pp
Awards: With our project, C. Elkins won Purdue
 Joel Spira Undergraduate Summer Research Award
- I. Martin, A. Tsymbaliuk,
Orthogonal bases for two-parameter quantum groups
 Submitted; arXiv:2412.06670 (2024), 43pp
- I. Martin, A. Tsymbaliuk,
Two-parameter quantum groups and R-matrices: classical types
 Submitted; arXiv:2407.01450 (2024), 46pp
- Mentoring a team of high school students from Ukraine May 2022–present
Yulia's Dream – initiative under MIT PRIMES program
Research program for exceptional high school students from Ukraine
 S. Khomych, N. Korniihuk, K. Molokanov, A. Tsymbaliuk
Standard Lyndon loop words: weighted orders
 International Math. Research Notices (2025), 32pp
 DOI:10.1093/imrn/rnaf030
- Y. Avdieiev, A. Tsymbaliuk
Affine standard Lyndon words: A-type
 International Math. Research Notices (2024), no. 21, 13488–13524
Awards: With our project, Y. Avdieiev won the Student Research Award
 at ICMU (International Centre for Mathematics in Ukraine)
 and became a recipient of Akhiezer Foundation stipend
- Mentoring three undergraduate students at Purdue since Fall 2021
Emerging Leaders Science Scholar program
for students in STEM fields from historically underrepresented groups
- Mentoring a high school student Summer 2020
 H. Cui, *Correlation functions of quantum toroidal \mathfrak{gl}_n algebra*
 Journal of Mathematics Research 14 (2022), no. 4, 94–105
 H. Cui, *Correlation functions of quantum toroidal \mathfrak{gl}_1 algebra*
 Journal of Mathematics Research 13 (2021), no. 2, 7–20
- Mentoring an MIT undergraduate student Winter 2014
MIT Directed Reading Program
- Mentoring a high school student at MIT PRIMES program 2011–2013
 F. Ding, A. Tsymbaliuk
Representations of infinitesimal Cherednik algebras
 Representation Theory (electronic) 17 (2013), 557–583
Awards: With our project, F. Ding won the 4th Prize at 2012 Intel STS US
 national competition and became 2012 Davidson Fellow Laureate

Talks

- Purdue University, Bridge to Research Seminar November 2024
- BIRS-IASM, Hangzhou, China September 2024
 Workshop “Geometry and Physics of Quantum Toroidal Algebra”
- La Sapienza University, Algebra Seminar June 2024
 Rome, Italy

- UNIMORE, Mini-course on Lie algebras
Modena, Italy June 2024
- Korea Institute for Advanced Study
Combinatorics and Representation Theory Seminar May 2024
- Purdue University, Bridge to Research Seminar April 2024
- University of Virginia
Conference “Quantum Structures in Lie Theory” March 2024
- Michigan State University, Seminar in Cluster Algebras November 2023
- Ohio State University, Representations and Lie theory Seminar October 2023
- Purdue University, Bridge to Research Seminar April 2023
- UIUC, Integrability and Representation Theory Seminar March 2023
- SCGP, Workshop “Geometric Representation Theory,
Integrability, and Supersymmetric Gauge Theories” September 2022
- University of Saskatchewan, Geometry, Algebra and Physics Seminar May 2022
- University of Denver, Spring 2022 Western AMS Sectional Meeting
Special session “Some modern developments in the theory of vertex algebras” May 2022
- Purdue University, Spring 2022 Central AMS Sectional Meeting
Special session “Integrability, Symmetry and Physics” March 2022
- Tufts University, Spring 2022 Eastern AMS Sectional Meeting
Special session “Macdonald theory and beyond” March 2022
- MIT, Infinite-Dimensional Algebra Seminar March 2022
- Perimeter Institute, Mathematical Physics Seminar March 2022
- Purdue University, Mathematical Physics Seminar March 2022
- Purdue University, Bridge to Research Seminar November 2021
- GRT, Online Representation Theory Seminar June 2021
- Paris Algebra Seminar May 2021
- Ohio State University, Representations and Lie algebras Seminar April 2021
- Purdue University, Bridge to Research Seminar April 2021
- Skoltech Center for Advanced Studies, Math-Physics Seminar March 2021
- UMass Amherst, Representation Theory Seminar March 2020
- UC Berkeley, String-Math Seminar September 2019
- ETH, Conference “Representation Theory and Integrable Systems”
Zurich, Switzerland August 2019
- Yale University, Geometry, Symmetry and Physics Seminar March 2019
- Auburn University, Spring 2019 Southeast AMS meeting
Special session “Geometric Methods in Representation Theory” March 2019
- Tokyo University of Marine Science and Technology, 3 talks
Crash-course “Shuffle approach towards quantum toroidal algebras”
Tokyo, Japan March 2019
- Tokyo University, 2 talks at Workshop “Infinite Analysis 2019:
Quantum Symmetries and Integrable Systems”
Tokyo, Japan March 2019
- Purdue University, Colloquium December 2018

- University of Virginia, Colloquium December 2018
- SCGP, Workshop “Vertex Algebras and Gauge Theory” December 2018
- Columbia University, Informal Mathematical Physics Seminar December 2018
- U. Wisconsin-Madison, Algebra and Algebraic Geometry Seminar October 2018
- MIT, Geometric Representation Theory Seminar September 2018
- RIMS, Representation Theory Seminar August 2018
Kyoto, Japan
- IPMU, Mathematics-String Theory Seminar August 2018
Kashiwa, Japan
- CIME School “Geometric Representation Theory and Gauge Theory” June 2018
Cetraro, Italy
- Fields Institute, Geometric Representation Theory Seminar April 2018
Toronto, Canada
- UC Riverside, Colloquium February 2018
- Yale University, Geometry, Symmetry and Physics Seminar November 2017
- Ohio State University, Representations and Lie algebras Seminar August 2017
- QGM, QGM weekly seminar June 2017
Aarhus, Denmark
- MIT, Geometric Representation Theory Seminar May 2017
- UC Santa Cruz, Colloquium February 2017
- ESI, Conference “Geometry and Representation Theory” January 2017
Vienna, Austria
- UC Davis, Algebra and Discrete Mathematics Seminar November 2016
- Brown University, Theoretical Physics Seminar November 2016
- Uppsala Universitet, Representation Theory Conference 2016 June 2016
Uppsala, Sweden
- Northeastern University March 2016
Geometry, Physics, and Representation theory Seminar
- SCGP, Program “Geometric representation theory” January 2016
- Temple University, Algebra Seminar November 2015
- Yale University, Geometry, Symmetry and Physics Seminar April 2015
- Tokyo University, Infinite Analysis Seminar January 2015
Tokyo, Japan
- RIMS, Representation Theory Seminar January 2015
Kyoto, Japan
- CUNY, Representation Theory Seminar October 2014
- Northeastern University, Graduate student seminar April 2014
- MIT-NEU, Graduate seminar on February 2014
Quantum Cohomology and Representation Theory
- ETH Zurich, Talks in theoretical sciences November 2013
Zurich, Switzerland
- Northeastern University, Graduate student seminar April 2013

- Harvard-MIT, Graduate student seminar in Geometric Representation Theory April 2012
- Harvard-MIT, Graduate student seminar in Geometric Representation Theory September 2011
- Harvard-MIT, Graduate student seminar in Geometric Representation Theory April 2011
- Harvard-MIT, Graduate student seminar in Geometric Representation Theory February 2011
- Hebrew University, Representation theory Seminar Jerusalem, Israel October 2010
- Boston University, Geometry Seminar April 2010
- MIT, Infinite Dimensional Algebra Seminar March 2010
- Clay Mathematics Institute Workshop “Macdonald Polynomials and Geometry” March 2010

Professional Activities

• Grant reviews

- Served on the NSF review panel 2025
- Served as an external reviewer for the Croatian Science Foundation 2024
- Served as an external reviewer for INdAM Consolidator Grant 2024
- Served as an external reviewer for NSERC Discovery Grants 2023
- Served on the NSF review panel 2021
- Served as an external reviewer for NSERC Discovery Grants 2021
- Served on the NSF review panel 2016

• Editorial service

Referee for the following journals:

- Advances in Mathematics
- Algebras and Representation Theory
- American Journal of Mathematics
- Annales scientifiques de l'École normale supérieure
- Arkiv för Matematik
- Bulletin of the London Mathematical Society
- Canadian Journal of Mathematics
- Communications in Mathematical Physics
- Crelle
- European Physical Journal C
- Duke Mathematical Journal
- Forum of Mathematics, Sigma
- Glasgow Mathematical Journal
- International Mathematics Research Notices
- Inventiones mathematicae
- Journal de l'École polytechnique–Mathématiques
- Journal of Algebra

- Journal of Algebra and its Applications
- Journal of Pure and Applied Algebra
- Journal of the London Mathematical Society
- Journal of the American Mathematical Society
- Letters in Mathematical Physics
- Mathematische Annalen
- Moscow Mathematical Journal
- Nuclear Physics B
- Proceedings of the London Mathematical Society
- Publications Mathématiques de l’IHÉS
- Representation Theory (electronic journal of the AMS)
- Revista Matemática Iberoamericana
- Selecta Mathematica (New Series)
- SIGMA
- Transformation Groups

Reviewer for:

- Mathematical Reviews
- zbMATH Open

• **Seminars**

- Coorganizing *Mathematical Physics* seminar at Purdue since 2021
- Coorganized Yale seminar *Geometry, Symmetry and Physics* 2017–2020
- Organized *SCGP Postdoc* seminar 2015–2016

• **Conferences organized**

- Coorganizing AMS Sectional Meeting at University of Denver August 2025
- Coorganizing ICMU mini-courses in mathematics for Ukrainian students since 2024
- Coorganized AMS Sectional Meeting at San Francisco State University May 2024
- Coorganized AMS Sectional Meeting at Purdue University March 2022
- Coorganized AMS Sectional Meeting at Purdue University April, 2020
Cancelled due to COVID-19

• **Community Service**

- Judge for the 2025 Purdue Undergraduate Research Conference April 2025
- Judge for the 37th Annual Hoosier Science and Engineering Fair April 2025
- Judge for the 2024 Purdue Undergraduate Research Conference April 2024
- Judge for the 36th Annual Hoosier Science and Engineering Fair April 2024
- Judge for the 2023 Purdue Undergraduate Research Conference April 2023
- Judge for the 34th Annual Hoosier Science and Engineering Fair April 2022
- Judge for the 2022 Purdue Undergraduate Research Conference April 2022

- **Department and University Service**

- Member of the University Senate 2024–2027
- Member of the Student Affairs Committee 2024–2027