

Du Pei

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EMPLOYMENT

- Associate Professor, 2022-current.
 - Centre for Quantum Mathematics, University of Southern Denmark.
- Postdoctoral Fellow, 2020–2022.
 - Center for Mathematical Sciences and Applications, Harvard University.
- Postdoctoral Fellow, Fall 2019.
 - Mathematical Sciences Research Institute.
- Visiting Scholar, Fall 2019.
 - Department of Mathematics, UC Berkeley.
- QGM-Caltech Joint Postdoc, 2016–2019.
 - Center for Quantum Geometry of Moduli Spaces, Aarhus University.
 - Walter Burke Institute for Theoretical Physics, California Institute of Technology.

FUTURE VISITING POSITION

- Chern Professor, Simons Laufer Mathematical Sciences Institute, Fall 2026.
- Sabbatical member, Institute for Advanced Study, Spring 2027.

EDUCATION

- California Institute of Technology, Ph.D. in Physics, 2011–2016.
- Peking University, B.Sc. in Physics, 2007–2011.

RESEARCH INTEREST

I use ideas motivated by quantum physics to discover new structures and tackle old problems in mathematics. At the same time, I apply advanced mathematical tools to better understand algebraic, geometric, topological and categorical structures in quantum field theories. Some of my specific interests include:

- topological quantum field theory
- quantum phases of matter
- geometry of moduli spaces
- new invariants of 3- and 4-manifolds
- categorification and quantization

GRANTS & AWARDS

2024 Co-PI for Innovation Fund Denmark grant: “*Topological Photonic Quantum Computing and its Applications.*”

- 2023 Co-Investigator for Simons Collaboration: “*New structures in low-dimensional topology.*”
- 2022 Villum Young Investigator grant: “*New Invariants in Low-Dimensional Topology via Quantum Field Theory.*”
- 2014 GEAR travel award for Graduate Internship, from NSF grants: “*RNMS: Geometric Structures and Representation Varieties.*”

PUBLICATIONS & PREPRINTS

- “Gauge theory and skein modules.” arXiv:2601.16213 [hep-th].
- “Generalized symmetry of $T[M]$ theories, II.” *Journal of High Energy Physics*, 05 (2026) 087, arXiv:2511.13696 [hep-th] (with S. Gukov, P. S. Hsin)
- “E-strings and Four-Manifolds,” arXiv:2511.11807 [hep-th] (with D. H. Wu)
- “A new approach to (3+1)-dimensional TQFTs via topological modular forms,” arXiv:2509.12402 [math.AT] (with S. Gukov, V. Krushkal, and L. Meier)
- “On mixed’t Hooft anomalies of emergent symmetries,” *Journal of High Energy Physics*, 07 (2026) 195 arXiv:2506.06432 [hep-th] (with W. Gu and X. Yu)
- “Branes and DAHA Representations,” Springer (2023) arXiv:2206.03565 [hep-th] (with S. Gukov, P. Koroteev, S. Nawata, and I. Saberi,)
- “Holomorphic CFTs and topological modular forms,” *Commun. Math. Phys.* **401**, 325–332 (2023). arXiv:2112.10724 [hep-th] (with Y.-H. Lin)
- “Symmetries of 2d TQFTs and Equivariant Verlinde Formulae for General Groups,” arXiv:2111.08032 [hep-th] (with S. Gukov, C. Reid, and A. Shehper)
- “On Phases of 3d $N=2$ Chern-Simons-Matter Theories,” *Nuclear Physics B*, 973, (2021) arXiv:2105.02247 [hep-th] (with W. Gu and M. Zhang)
- “Generalized Symmetries of $T[M]$ Theories, I,” *Journal of High Energy Physics*, (2021) 232. arXiv:2010.15890 [hep-th] (with S. Gukov, and P.-S. Hsin)
- “Rozansky–Witten geometry of Coulomb branches and logarithmic knot invariants,” *Journal of Geometry and Physics*, Volume 168, October 2021, 104311. arXiv:2005.05347 [hep-th] (with S. Gukov, P.-S. Hsin, H. Nakajima, S. Park, and N. Sopenko)
- “Trialities of Minimally Supersymmetric 2d Gauge Theories,” *Journal of High Energy Physics*, (2020) 79. arXiv:1910.13455 [hep-th] (with S. Gukov and P. Putrov)
- “4-manifolds and topological modular forms,” *Journal of High Energy Physics*, (2021) 84. arXiv:1811.07884 [hep-th], (with S. Gukov, P. Putrov and C. Vafa)
- “Identities for Poincaré polynomials via Kostant cascades,” *Journal of Lie Theory*, **30**, No. 4, 1131–1160, (2020) arXiv:1810.05615 [math.CO] (with J. E. Andersen and J. C. Jantzen)
- “3d TQFTs from Argyres–Douglas theories,” *Journal of Physics A*, **53**, No. 43, (2020), arXiv:1809.04638 [hep-th] (with M. Dedushenko, S. Gukov, H. Nakajima and K. Ye)
- “Mirror symmetry with branes by equivariant Verlinde formulae,” *Geometry and Physics: A Festschrift in honour of Nigel Hitchin*, Volume 1, Chapter 9, arXiv:1712.04408 [math.AG] (with T. Hausel and A. Mellit)
- “Argyres–Douglas theories, chiral algebras and wild Hitchin characters,” *Journal of High Energy Physics*, **1** (2018): 150. arXiv:1701.08782 [hep-th] (with L. Fredrickson, W. Yan and K. Ye)
- “BPS spectra and 3-manifold invariants,” *J. Knot Theor. Ramifications* **29** 02, 2040003 (2020) arXiv:1701.06567 [hep-th]. (with S. Gukov, P. Putrov and C. Vafa)

- “The Verlinde formula for Higgs bundles,” arXiv:1608.01761 [math.AG]. (with J. E. Andersen and S. Gukov)
- “Equivariant Verlinde algebra from superconformal index and Argyres–Seiberg duality,” *Communications in Mathematical Physics*, **357.3** (2018): 1215-1251. arXiv:1605.06528 [hep-th]. (with S. Gukov, W. Yan and K. Ye)
- “A 3d-3d appetizer,” *Journal of High Energy Physics*, **11** (2016): 8. arXiv:1503.04809 [hep-th]. (with K. Ye)
- “Equivariant Verlinde formula from fivebranes and vortices,” *Communications in Mathematical Physics*, **355.1** (2017): 1-50. arXiv:1501.01310 [hep-th] (with S. Gukov)

LECTURE SERIES

- 07/2025 *Mini-course “On the space of quantum field theories,”* Yau Mathematical Science Center, Tsinghua University, Beijing, China.
- 08/2024 *Mini-course on “Quantum field theory and topological modular forms,”* Summer School at Southeastern University, Nanjing, China.
- 10/2022 *Mini-course on “VOAs from higher-dimensional QFTs,”* School and workshop on “Quantum symmetries: Tensor categories, Topological quantum field theories, Vertex algebras”, CRM, Montreal.
- 08/2022 *Mini-course on “Invariants of Manifolds from 6d QFTs,”* School on Physical Mathematics of Quantum Field Theory, UMass Amherst.
- 06/2022 *Mini-course on “Mirror symmetry and Higgs moduli spaces,”* Workshop-School on Mirror Symmetry and Moduli Spaces, Lisbon.
- 11/2020 *Mini-course on “TQFTs from Coulomb Branches,”* School–Conference on Vertex Algebras and Tensor Categories, Higher School of Economics, Moscow/Zoom.
- 10/2019 *Mini-course on “Invariants of Manifolds from Non-Gauge Theories,”* School and Workshop on Gauge Theories and Differential Invariants, ICTP, Trieste.
- 08/2019 *Mini-course on “Physics and geometry of BPS states,”* Introductory Workshop: Holomorphic Differentials in Mathematics and Physics, MSRI.
- 07/2018 *Mini-course on “Verlinde formula for complex Chern–Simons theory,”* Summer School on Geometry, Quantum Topology and Asymptotics, Geneva.
- 10/2015 *Mini-course on “New TQFTs and equivariant integration over the moduli space of Higgs bundles,”* NS@50, Chennai Mathematical Institute.

SELECTED CONFERENCE TALKS

- 09/2026 *“6d theories and 4-manifolds,”* Workshop on Gauge Theory, Topology, and Physics, OIST, Okinawa, Japan.
- 08/2026 *“On the classification of 2d TQFTs with time-reversal symmetry,”* Physics and Mathematics of Generalized Symmetry in QFT, Kavli IPMU, Japan.
- 08/2026 *“On classifications of defects in quantum field theories,”* Workshop on Generalized Symmetries in HEP and CMP 2026, Institute of Physics, Chinese Academy of Sciences, Beijing, China.
- 08/2026 *“Gauge theory and skein modules,”* International Congress of Basic Science, BIMSA, Beijing, China.

- 07/2026 “*On boundary conditions of quantum field theories*,” Elliptic objects, von Neumann algebras, and Functorial Field Theory, Bernoulli Center, EPFL, Switzerland.
- 06/2026 “*Gauge theory and skein modules*,” String–Math 2026, Edinburgh, United Kingdom.
- 07/2025 “*On boundary conditions and phases of quantum field theories*,” International Congress of Basic Science, BIMSA, Beijing, China.
- 06/2024 “*Topological modular forms and phases of quantum field theories*,” BPS Dynamics and Quantum Mathematics, Galileo Galilei Institute, Florence, Italy.
- 01/2024 “*On new invariants and phases of supersymmetric quantum field theories*,” Workshop on String Theory and Quantum Field Theory 2024, Fudan University, Shanghai, China.
- 08/2023 “*Brane quantization and DAHA representations*,” workshop on Mathematics Inspired by String Theory, CUHK, Hong Kong.
- 08/2022 “*Quantum Field Theory and Topological Modular Forms*,” Simons Summer Workshop, SCGP.
- 07/2022 “*Wall-Crossing from Higgs Bundles to Vortices*,” Conference on Enumerative Invariants, Quantum Fields and String Theory Correspondences, Institut Mittag-Leffler.
- 11/2021 “*TQFTs from Coulomb Branches*,” Banff workshop on Quantum Field Theories and Quantum Topology Beyond Semisimplicity.
- 07/2021 “*New Invariants of Manifolds from String Theory*,” Simons Summer Workshop.
- 06/2021 “*Verlinde Formula, Brane Quantization, and Mirror Symmetry*,” School on Mirror Symmetry and Moduli Spaces 2021.
- 01/2021 “*Quantization of Coulomb Branches and Double Affine Hecke Algebras*,” JMM Special Session on Quantum Algebra and Geometry.
- 11/2020 “*Modularities from fivebranes*,” KITP program on Modularity in Quantum Systems, Santa Barbara/Zoom.
- 10/2020 “*Branes in the moduli space of Higgs bundles*,” Workshop on Special holonomy and branes, American Institute of Mathematics, San Jose/Zoom.
- 07/2020 “*On compactifications of 6d relative theories*,” String–Math 2020, South Africa/Zoom.
- 02/2020 “*BPS states and 3d TQFTs*,” Workshop on Topological and Geometric Recursion, Institute of the Mathematical Sciences of the Americas, Miami.
- 10/2019 “*4d symplectic duality*,” Workshop on 3d Mirror Symmetry and AGT Conjecture, IASM, Zhejiang University.
- 09/2019 “*4-manifolds and topological modular forms*,” Workshop on 4-manifolds, Max Planck Institute for Mathematics, Bonn.
- 06/2019 “*3d TQFTs from 4d CFTs*,” Workshop on Mathematics and Physics of Knots, Mittag-Leffler Institute.
- 06/2019 “*New TQFTs from DAHA (Part 2)*,” Conference on Geometric Representation Theory and Low-Dimensional Topology, ICMS Edinburgh.
- 06/2019 “*Taming the Non-Unitary Zoo with Wild Higgs Bundles*,” New Developments in Quantum Topology, Berkeley.
- 06/2019 “*Introduction to q -series $\hat{Z}_a(M_3; q)$* ,” New Developments in Quantum Topology, Berkeley.
- 03/2019 “*3d TQFTs from non-Lagrangian theories*,” Workshop on Higher Symmetries: Theory and Applications, Aspen Center for Physics.

- 03/2019 “*Practical computation for q -series $\hat{Z}_a$* ,” workshop on Modularity and 3-manifolds, ICERM, Providence.
- 02/2019 “*Modular tensor categories from wild Higgs bundles*,” Workshop on Holomorphic Differentials in Mathematics and Physics, Simons Center for Geometry and Physics.
- 02/2019 “*Non-unitary modular categories from the Coulomb branch*,” Workshop on Representation theory, gauge theory, and integrable systems, Kavli IPMU
- 11/2018 “*On new homological and homotopy-theoretic invariants of manifolds*,” Program on Quantum Knot Invariants and Supersymmetric Gauge Theories, KITP.
- 09/2018 “*Wild Higgs bundles and modular categories*,” Workshop on Geometry and Physics of Quantum Curves, Banff, Canada.
- 07/2018 “*On mirror symmetry of (B, A, A) -branes*,” Conference on Quantum Fields, Geometry and Representation Theory, ICTS, Bangalore.
- 07/2018 “*2d TQFTs labeled by three-manifolds*,” CQ3MI Summer School and Workshop, University of Southern California.
- 04/2018 “*On categorification of the WRT invariant*,” Workshop on Categorification in Mathematical Physics, Simons Center for Geometry and Physics.
- 03/2018 “*2d TQFTs from 3-manifolds*,” Conference on Quantum Knot Homology and Supersymmetric Gauge Theories, Aspen Center for Physics.
- 01/2018 “*BPS spectra and invariants for 3- and 4-manifolds*,” Winter School on Partition Functions and Automorphic Forms, JINR.
- 01/2017 “*Wild Hitchin characters*,” workshop on Quantization and Moduli Spaces, University of Luxembourg.
- 09/2016 “*The Verlinde formula for Higgs bundles*,” Hitchin70: Differential Geometry and Quantization, Aarhus University.
- 10/2015 “*Branes and mirror symmetry in the Hitchin moduli space*,” NS@50: Fifty Years of the Narasimhan–Seshadri Theorem, Chennai Mathematical Institute.
- 11/2014 “*Equivariant integration over the Hitchin moduli space*,” Gauged Sigma-Models in Two Dimensions, Simons Center of Geometry and Physics.

COLLOQUIA

- 05/2024 “*Hidden algebraic structures in geometry from quantum field theory*,” Geometry and Physics Colloquia, Uppsala University, Sweden.
- 07/2022 “*On Hidden Mathematical Structures from Quantum Field Theories*,” Johannes Gutenberg Universität Mainz, Germany.
- 05/2021 “*Hidden Algebraic Structures in Geometry from Fivebranes*,” Pure Maths Colloquium, University of Sheffield.
- 02/2021 “*On Quantization of Coulomb Branches*,” Mathematical colloquium, BMSTU Moscow.
- 12/2020 “*Hidden algebraic structures in geometry from fivebranes*,” Mathematics Colloquium, UCLA.
- 02/2020 “*New developments in physical mathematics*,” University of Amsterdam.
- 04/2019 “*New developments in physical mathematics*,” Humboldt University of Berlin.
- 11/2018 “*4-manifolds and topological modular forms*,” Max Planck Institute for Mathematics, Bonn.

SELECTED SEMINARS

- 05/2026 “*Gauge theory and skein modules*,” Algebra, Geometry and Topology Seminar, ISTA, Klosterneuburg, Austria.
- 12/2025 “*On moduli spaces of $T[M]$ theories*,” Yau Center, Southeast University, online.
- 04/2024 “*Informal Seminar about Generalized Symmetries and Dimensional Reduction*,” Geometry and Physics seminar series, Uppsala University, Sweden.
- 03/2024 “*On new invariants and phases of supersymmetric quantum field theories*,” Center for Quantum and Topological Systems, NYU Abu Dhabi.
- 11/2022 “*Conformal field theories and topological modular forms*,” Particle Theory Seminar, Cornell University.
- 05/2021 “*On Phases of 3d $N=2$ Chern-Simons-Matter Theories*,” Caltech High Energy Theory Journal Club.
- 11/2020 “*Polarizations and symmetries of $T[M]$ theories*,” Oxford String Theory Journal Club.
- 11/2020 “*Integrability from fivebranes*,” Geometry and Mathematical Physics Seminar, SISSA, Italy.
- 11/2019 “*On new homological and homotopy-theoretic invariants of manifolds*,” String-Math Seminar, UC Berkeley.
- 05/2019 “*Brane Quantization and Representations of DAHA*,” iGAP Seminar, ICTP, Trieste.
- 02/2019 “*Modular tensor categories from the Coulomb branch*,” Symplectic Geometry, Gauge Theory, and Categorification Seminar, Columbia University.
- 09/2018 “*Higgs bundles, branes and mirror symmetry*,” Séminaire de la Tortue, University of Geneva.

ORGANIZATIONAL ACTIVITIES

- Special session on “Invariants of manifolds from quantum field theory and string theory” at 29th Nordic Congress of Mathematicians, 2023.
- Workshop on “Generalized Cohomology and Physics,” ICTP, Trieste, 2021.
- Colloquium Series at CMSA, Harvard, Fall 2021–present.
- Seminar series on “Quantum Matter in Mathematics and Physics” at CMSA Harvard, 2020–2021.
- Mathematical Physics seminar at CMSA Harvard, Summer 2020.

PROFESSIONAL SERVICE

- Editor for *Advances in Theoretical and Mathematical Physics*.
- Referee for *Journal of Differential Geometry*, *Communications in Mathematical Physics*, *Letters in Mathematical Physics*, *Reviews in Mathematical Physics*, *Journal of High Energy Physics*, etc.