

# Sunghyuk Park

## Curriculum Vitae

Harvard University  
Department of Mathematics  
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## Research Interests

Geometry and topology inspired by quantum physics (physical mathematics);  
TQFTs, topological string theory, complex Chern-Simons theory, skein modules, link homologies, Heegaard Floer homology, categorification

## Employment

**Postdoctoral Fellow**, *Harvard University*, 2023–2026.

Benjamin Peirce Fellow in the Department of Mathematics & Simons Collaboration Postdoctoral Fellow at CMSA  
Mentor: Prof. Dan Freed.

**Postdoctoral Fellow**, *University of Texas at Austin*, 2022–2023.

Simons Collaboration Postdoctoral Fellow in the Department of Mathematics  
Mentor: Prof. Dan Freed.

## Education

**PhD in Mathematics**, *California Institute of Technology*, 2017–2022.

Thesis: “3-manifolds,  $q$ -series, and topological strings”  
Adviser: Prof. Sergei Gukov.

**BS in Mathematics**, *Korea Advanced Institute of Science and Technology*, 2014–2017.

Summa Cum Laude, Valedictorian

**High School Diploma**, *Korea Science Academy of KAIST*, 2011–2014.

## Publications

**Branches, quivers, and ideals for knot complements,**

*with Tobias Ekholm, Angus Gruen, Sergei Gukov, Piotr Kucharski, Marko Stošić, and Piotr Sułkowski.*  
Journal of Geometry and Physics 177 (2022), 104520  
[arXiv:2110.13768](https://arxiv.org/abs/2110.13768) [hep-th].

**Cobordism invariants from BPS  $q$ -series,** *with Sergei Gukov and Pavel Putrov.*

Annales Henri Poincaré 22 (2021), 4173-4203.  
[arXiv:2009.11874](https://arxiv.org/abs/2009.11874) [hep-th].

**$\widehat{Z}$  at large  $N$ : from curve counts to quantum modularity,**

*with Tobias Ekholm, Angus Gruen, Sergei Gukov, Piotr Kucharski, and Piotr Sułkowski.*  
Communications in Mathematical Physics 396 (2022), 143–186

arXiv:2005.13349 [hep-th].

**Rozansky-Witten geometry of Coulomb branches and logarithmic knot invariants**,  
*with Sergei Gukov, Po-Shen Hsin, Hiraku Nakajima, Du Pei, and Nikita Sopenko.*  
Journal of Geometry and Physics 168 (2021), 104311.  
arXiv:2005.05347 [hep-th].

**Large color R-matrix for knot complements and strange identities.**  
Journal of Knot Theory and Its Ramifications 29 (2020), no. 14, 2050097.  
arXiv:2004.02087 [math.GT].

**3d-3d correspondence for mapping tori**, *with Sungbong Chun, Sergei Gukov, and Nikita Sopenko.*  
Journal of High Energy Physics 09 (2020), 152.  
arXiv:1911.08456 [hep-th].

**Higher rank  $\hat{Z}$  and  $F_K$ .**  
Symmetry, Integrability and Geometry: Methods and Applications (SIGMA) 16 (2020), 044.  
arXiv:1909.13002 [math.GT].

**Prague clocks**, *with Chan Bae, John Conway, and Lukas Kohlhase.*  
The Mathematical Intelligencer 38 (2016), 37–39.

## Preprints

**Knot lattice homology and q-series invariants for plumbed knot complements**,  
*with Ross Akhmechet and Peter K. Johnson*  
arXiv:2403.14461 [math.GT].

**3d quantum trace map**, *with Samuel Panitch*  
arXiv:2403.12850 [math.GT].

**Inverted state sums, inverted Habiro series, and indefinite theta functions.**  
arXiv:2106.03942 [math.GT].

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## Honors

Junior Scientific Leader at Simons Semester “Knots, Homologies, and Physics”, University of Warsaw, 2024.

Junior Fellowship for the program “Knots, Strings, Symplectic Geometry and Dualities”, Institut Mittag-Leffler, 2020.

Scott Russell Johnson Prize for Excellence in Graduate Studies, Caltech, 2020.

Scott Russell Johnson Prize for Excellence in First-Year Graduate Studies, Caltech, 2018.

Kwanjeong Educational Foundation Scholarship, 2017-2022.

Valedictorian at KAIST graduation ceremony; Minister’s Award awarded by the Minister of Science and Information and Communication Technologies of South Korea, 2017

KAIST Presidential Fellowship, KAIST, 2016-2017.

First Place in National Undergraduate Mathematics Competition, Korean Mathematical Society, 2015.

Korean Presidential Science Scholarship for Overseas Study, 2014. (declined)

Talent Medal of Korea (Presidential Award) awarded by the President of South Korea, 2013.

## Professional Service

### Referee for:

Communications in Mathematical Physics – 2 times,  
Crelle (Journal für die reine und angewandte Mathematik),  
Experimental Mathematics,  
Journal of High Energy Physics,  
Letters in Mathematical Physics,  
SIGMA (Symmetry, Integrability and Geometry: Methods and Applications) – 4 times.

### Reviewer for:

Mathematical Reviews (MathSciNet),  
zbMATH Open (Zentralblatt MATH) – 6 times.

## Teaching and Mentoring

*Instructor at Harvard, 2023-2026.*

- Math 112: **Introductory Real Analysis**, Spring 2025.
- Math 264R: **Quantum Topology** (graduate topics course), Spring 2024.

*Instructor at UT Austin, 2022-2023.*

- M408S: **Integral Calculus for Science**, Fall 2022.

*Supervised Undergraduate Students at Caltech*

- Alberto Ricardo Cavallar Oriol, February-July 2022,  
visiting student from Polytechnic University of Catalonia, Undergraduate Thesis.

*Teaching Assistant at Caltech, 2017-2022.*

- Recitations, grading homework and exams, office hours, typing up solutions
- Math 11: **Mathematical Writing**, Spring 2022. Instructor: Tom Graber
  - Math 1a: **Calculus of One Variable**, Fall 2021, head TA, double. Instructor: Nets Katz
  - Math 1a: **Calculus of One Variable**, Fall 2020, double. Instructor: Nets Katz
  - Math 5c: **Introduction to Abstract Algebra**, Spring 2020. Instructor: Elena Mantovan
  - Math 121a: **Combinatorial Analysis**, Winter 2020. Instructor: Mykhaylo Tyomkyn
  - Math 121a: **Combinatorial Analysis**, Fall 2018. Instructor: Ben Krause
  - Math 3: **Introduction to Probability and Statistics**, Winter 2018. Instructor: Kim Border

*Teaching Assistant at PCMI Summer Session 2019, PCMI, July 2019.*

Problem sessions for the lecture series by Pavel Putrov

*Teaching Assistant at KAIST, 2015-2017.*

Office hours, tutoring

- Calculus I
- General physics I

*Teaching Assistant at Korean Mathematical Olympiad Winter School, KAIST, January 2016.*

Problem sessions, grading exams

## Organization

### Conferences

*Arithmetic and Summability in Geometry and Physics,*

with Amina Abdurrahman, Veronica Fantini, Elba Garcia-Failde, and Campbell Wheeler, CIRM, TBA 2025.

### Seminars

*Question and Answer Seminar,*

with Dan Freed, Harvard CMSA, Fall 2023-Spring 2024.

<https://cmsa.fas.harvard.edu/events-archive/category/cmsaqa/>

*Factorization Algebras in Quantum Field Theory Learning Seminar,*

with Tamir Hemo, Caltech, Fall 2019.

[https://www.its.caltech.edu/~themo/factorization\\_seminar/factorization.html](https://www.its.caltech.edu/~themo/factorization_seminar/factorization.html)

## Invited Talks

### Conferences / Workshops

Recent Developments in TQFT, BIMSAs, September 2024.

2024 Richmond Geometry Meeting, VCU, August 2024.

New Structures in Low-Dimensional Topology 2024 Summer School, Renyi Institute, July 2024.

Summary workshop: Knots, homologies and physics, University of Warsaw, May 2024.

Learning workshop: Knots, homologies and physics, University of Warsaw, March 2024.

Meeting on Plumblings and Spectra, Caltech, March 2024.

AMS Special Session: Mock Modular Forms, Physics, and Applications, January 2024.

Symplectic Geometry, Low Dimensional Topology, and Quantum Fields, University of Oxford, September 2023.

Merging Categorification, Gauge Theory, and Physics, Hotel Belalp, September 2023.

Learning Workshop on BPS States and 3-Manifolds, ICTP, February 2023.

Field Theories and Vertex Algebras, Lake Arrowhead Resort and Spa, October 2022.

String Math 2022, University of Warsaw, July 2022.

AMS Special Session on Q-series, Number Theory and Quantum Topology, May 2022.

### Research Seminars

Geometry, Algebra and Physics Seminar, KIAS, April 2024.

Geometry and Topology Seminar, MIT, October 2023.

Gauge Theory and Topology Seminar, Harvard University, October 2023.

Geometry and Physics Seminar, Boston University, October 2023.

Geometry Seminar, UT Austin, April 2022.

String-Math Seminar, UC Berkeley, March 2022.

Quantum Topology Seminar, Indiana University Bloomington, January 2022.

Geometry Seminar, University of Virginia, January 2022.

Algebra Seminar, University of Southern California, October 2021.

Strings and QFTs for Eurasian Time Zone, Fudan University, December 2020.

Geometry and Physics Seminar, Harvard CMSA, June 2020.

Moscow-Beijing Topology Seminar, June 2020.

Topology Seminar, Stanford University, January 2020.

### Expository Lectures

Lectures on Theoretical Physics for Latin American Students, ICTP Physics Without Frontiers, November 2023.