

Yifei Zhu

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Department of Mathematics  
Southern University of Science and Technology  
Shenzhen, Guangdong 518055  
People's Republic of China

Email: [zhuyf@sustech.edu.cn](mailto:zhuyf@sustech.edu.cn)  
Office: College of Science M705  
Phone: +86-755-8801 5911  
<https://faculty.sustech.edu.cn/zhuyf/>

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## POSITIONS

**Southern University of Science and Technology**, Shenzhen, Guangdong, China

Tenure-track assistant professor, February 2020 to present

Visiting assistant professor, December 2016 to January 2020

**Academy of Mathematics and Systems Science, Chinese Academy of Sciences**, Beijing, China

Visiting scholar, October 2016 to January 2017

**Northwestern University**, Evanston, Illinois, USA

Visiting assistant professor, September 2013 to August 2016

Mentor: Paul Goerss

## EDUCATION

**University of Minnesota**, Twin Cities, Minnesota, USA

Ph.D. in Mathematics, June 2013

Advisor: Tyler Lawson

**Peking University**, Beijing, China

B.S. in Mathematics, July 2007

## RESEARCH INTERESTS

Interactions of algebraic topology with algebraic geometry and number theory, especially moduli spaces from spectral algebraic geometry in the context of the Langlands program, as well as applications of topology and geometry to interdisciplinary research, including condensed-matter physics and materials science, time series analysis, human-computer interaction, and systems science.

## PUBLICATIONS

*Topological classification for intersection singularities of exceptional surfaces in pseudo-Hermitian systems*

Second corresponding author, with Hongwei Jia, Ruo-Yang Zhang, Jing Hu, Yixin Xiao, Shuang Zhang, and C. T. Chan.

Communications Physics **6** (2023), 293.

DOI: [10.1038/s42005-023-01417-4](https://doi.org/10.1038/s42005-023-01417-4)

*Non-Hermitian swallowtail catastrophe revealing transitions among diverse topological singularities*

First corresponding author, with Jing Hu, Ruo-Yang Zhang, Yixiao Wang, Xiaoping Ouyang, Hongwei Jia, and C. T. Chan.

Nature Physics **19** (2023), 1098–1103.

DOI: [10.1038/s41567-023-02048-w](https://doi.org/10.1038/s41567-023-02048-w)

*Norm coherence for descent of level structures on formal deformations*

Journal of Pure and Applied Algebra **224** (2020), no. 10, 106382, 35 pp.

DOI: [10.1016/j.jpaa.2020.106382](https://doi.org/10.1016/j.jpaa.2020.106382)

*The Hecke algebra action and the Rezk logarithm on Morava E-theory of height 2*

Transactions of the American Mathematical Society **373** (2020), no. 5, 3733–3764.

DOI: [10.1090/tran/8032](https://doi.org/10.1090/tran/8032)

*Semistable models for modular curves and power operations for Morava E-theories of height 2*

Advances in Mathematics **354** (2019), 106758, 29 pp.

DOI: [10.1016/j.aim.2019.106758](https://doi.org/10.1016/j.aim.2019.106758)

*Morava E-homology of Bousfield–Kuhn functors on odd-dimensional spheres*

Proceedings of the American Mathematical Society **146** (2018), no. 1, 449–458.

DOI: [10.1090/proc/13727](https://doi.org/10.1090/proc/13727)

*The power operation structure on Morava E-theory of height 2 at the prime 3*

Algebraic and Geometric Topology **14** (2014), no. 2, 953–977.

DOI: [10.2140/agt.2014.14.953](https://doi.org/10.2140/agt.2014.14.953)

## RESEARCH GRANTS

- 2024–2025      Guangdong Provincial Key Laboratory of Interdisciplinary Research and Application for Data Science grant, *Topological time series analysis and deep learning*.
- 2024–2027      National Natural Science Foundation of China (NSFC) General Program grant 12371069, *Methods of algebraic topology to study moduli spaces: with applications to homotopy theory, condensed matter physics, and time series analysis*.
- 2023–2025      Guangdong Basic and Applied Basic Research Foundation (2023A1515030289) *Computations, structures, and applications in unstable chromatic homotopy theory*.
- 2018–2020      NSFC Young Scientists Fund grant 11701263, *Methods of algebraic geometry and number theory in algebraic topology*.
- 2018–present    Finance Commission of Shenzhen Municipality start-up research grant.

## AWARDS AND FELLOWSHIPS

- 2020            Fourth Young Faculty Teaching Competition, Second place, Southern University of Science and Technology.
- 2017–2022      Overseas High-Caliber Personnel (Level C) fellowship, Shenzhen.
- 2007–2013      Teaching assistantship, University of Minnesota.
- 2007            Outstanding Graduating Student award, Peking University.
- 2005–2006      Outstanding Student award, School of Mathematical Sciences, Peking University.

## CONFERENCE PRESENTATIONS

*Topological analysis and deep learning of human speech data*

First Symposium on Artificial Intelligence and Mathematics, Tongji University, Xiamen University, and Chongqing University of Technology, Chongqing, July 2024, scheduled.

*Higher-periodic homotopy types through Lubin–Tate towers*

Conference and Workshop on Perfection, Beijing International Center for Mathematical Research, Peking University, Beijing, June 2024, scheduled.

*Topology and geometry of non-Hermitian Möbius bands and their deformations*

Capital Normal University 2024 Topology Symposium, Beijing, May 2024.

*Topological combined machine learning for consonant recognition*

BIMSA Workshop on Digraph Topology and GLMY Theory, Yanqi Lake Beijing Institute of Mathematical Sciences and Applications, Beijing, November 2023.

*Topological time series analysis and deep learning with applications*

Hangzhou Workshop on Topological Data Analysis, Hangzhou, October 2023.

*Topological time series analysis with applications*

The 21st Annual Meeting of China Society for Industrial and Applied Mathematics, Kunming, October 2023.

*Moduli, moduli, moduli*

International Workshop on Algebraic Topology, Beijing International Center for Mathematical Research, Peking University, Beijing, July 2023.

*Topological invariants for stratified singular moduli spaces of non-Hermitian Hamiltonians with applications to condensed matter physics and photonics*

The 9th International Congress of Chinese Mathematicians, jointly hosted by Yau Mathematical Sciences Center, Department of Mathematical Sciences of Tsinghua University, Academy of Mathematics and Systems Science of the Chinese Academy of Sciences, and Yanqi Lake Beijing Institute of Mathematical Sciences and Applications, Nanjing, August 2022, postponed.

*Combinatorial cell decomposition and cohomology of compactified moduli for hyperbolic surfaces*

2021 National Conference on Algebraic and Geometric Topology, Chinese Academy of Sciences, Beijing, August 2021, postponed.

*Generalized modular forms in topology*

Conference on Low Dimensional Topology, Shenzhen International Center for Mathematics, Shenzhen, November 2020.

*Algebraic topology and arithmetic*

Fudan-Guanghua International Forum for Young Scholars, Fudan University, Shanghai,

December 2019.

*Algebraic topology and arithmetic*

2019 Young Mathematician Forum, Beijing International Center for Mathematical Research, Peking University, Beijing, December 2019.

*Power operations in elliptic cohomology and related arithmetic topics*

Special Session on Algebraic and Geometric Topology, AMS–CMS Joint International Meeting, Fudan University, Shanghai, June 2018.

*Toward calculating unstable higher-periodic homotopy types*

International Workshop on Algebraic Topology, Southern University of Science and Technology, Shenzhen, June 2018.

*Symmetry encoded by norm maps*

International Workshop on Loop Spaces, Supersymmetry and Index Theory, Chern Institute of Mathematics, Nankai University, Tianjin, July 2017.

*Algebraic geometry of ring spectra and multiplicative invariants for families of manifolds*

Workshop on Algebraic and Geometric Topology, Nankai University, Tianjin, June 2017.

*Toward calculating unstable higher-periodic homotopy types*

AMS Special Session on Homotopy Theory, Sectional Meeting, Bloomington, April 2017, scheduled.

Session on chromatic power operations, with P. Nelson and P. VanKoughnett

Operations in Highly Structured Homology Theories, Banff, May 2016.

*Modular equations for Lubin–Tate formal groups at chromatic level 2*

AMS Session on Algebraic Geometry, Joint Meetings, Seattle, January 2016.

*Power operation calculations in elliptic cohomology*

AMS Special Session on Homotopy Theory, Joint Meetings, Baltimore, January 2014.

CONFERENCE ORGANIZING

Workshop on Computer-Assisted Research in Geometry and Topology

International conference, 5 days.

Joint organizer with F. Fang, S. Garoufalidis, G. Wang, and Z. Xu.

Tianyuan Mathematics Research Center, Chaishitan, September 9–13, 2024, scheduled.

#### [International Workshop on Algebraic Topology \(IWoaT\) 2024](#)

International conference, 5 days.

Joint organizer with H.J. Kong, G. Li, W. Lin, Y. Lu, X.D. Shi, G. Wang, Z. Xu, and F. Zou.

Shanghai Center for Mathematical Sciences, Fudan University, July 2–6, 2024, scheduled.

#### [IWoaT Summer School on Motivic Stable Homotopy Theory](#)

International conference, 5 days.

Joint organizer with H.J. Kong, G. Li, W. Lin, Y. Lu, X.D. Shi, G. Wang, Z. Xu, and F. Zou.

Shanghai Center for Mathematical Sciences, Fudan University, June 23–27, 2024, scheduled.

#### [IWoaT 2023](#)

International conference, 5 days, 80 participants.

Joint organizer with H.J. Kong, G. Li, R. Liu, X.D. Shi, G. Wang, and Z. Xu.

Beijing International Center for Mathematical Research, Peking University, July 24–28, 2023.

#### [IWoaT Summer School on Operads, Spectra, and Multiplicative Structures](#)

International conference, 6 days, 100 participants.

Joint organizer with H.J. Kong, G. Li, J. Li, W. Lin, Y. Lu, X.D. Shi, G. Wang, J. Wu, Z. Xu, and F. Zou.

Yanqi Lake Beijing Institute of Mathematical Sciences and Applications, August 14–19, 2023.

#### [IWoaT Winter School on Motivic Stable Homotopy Theory and Synthetic Spectra](#)

International conference, 5 days, 40 participants.

Joint organizer with H.J. Kong, G. Li, W. Lin, Y. Lu, X.D. Shi, G. Wang, Z. Xu, and F. Zou.

Southern University of Science and Technology, December 19–23, 2023.

#### [Mini-Workshop on Topology and Arithmetic](#)

Domestic conference, 3 days, 60 participants.

Joint organizer with H. Gao, J. Guo, and T. Liang.

Department of Mathematics and Shenzhen International Center for Mathematics, Southern University of Science and Technology, August 7–9, 2023.

### Arithmetic and Topology

International conference, 2 days.

Joint organizer with H. Gao.

Department of Mathematics and Shenzhen International Center for Mathematics, Southern University of Science and Technology, December 16–17, 2022, online.

### IWoAT Summer School on Chromatic Homotopy Theory and Higher Algebra

International conference, 12 days, 190 participants.

Joint organizer with H.J. Kong, Z. Lü, P. May, X.D. Shi, G. Wang, J. Wu, and Z. Xu.

Shanghai Center for Mathematical Sciences & School of Mathematical Sciences, Fudan University, and Yanqi Lake Beijing Institute of Mathematical Sciences and Applications, August 15–26, 2022, online.

### IWoAT Summer School on Equivariant Homotopy Theory and Junior Researcher Forum

International conference, 12 days, 90 participants.

Joint organizer with A. Beaudry, M. Behrens, D. Isaksen, H.J. Kong, Z. Lü, X.D. Shi, G. Wang, and Z. Xu.

Shanghai Center for Mathematical Sciences, Fudan University, July 19–30, 2021, hybrid.

### IWoAT 2020

International conference, 5 days.

Joint organizer with A. Beaudry, M. Behrens, D. Isaksen, H.J. Kong, R. Liu, X.D. Shi, G. Wang, and Z. Xu.

Beijing International Center for Mathematical Research, Peking University, August 17–21, 2020, postponed.

### IWoAT Summer School on Higher (Infinity-Categorical) Algebra and Its Applications

International conference, 5 days.

Joint organizer with A. Beaudry, M. Behrens, D. Isaksen, H.J. Kong, Z. Lü, X.D. Shi, G. Wang, and Z. Xu.

Shanghai Center for Mathematical Sciences, Fudan University, August 10–14, 2020, postponed.

### IWoAT 2019

International conference, 3 days, 140 participants.

Joint organizer with A. Beaudry, M. Behrens, D. Isaksen, H.J. Kong, Z. Lü, G. Wang, and Z. Xu.

Shanghai Center for Mathematical Sciences, Fudan University, August 19–21, 2019.

### IWoAT Summer School on Equivariant Homotopy Theory

International conference, 5 days, 140 participants.

Joint organizer with A. Beaudry, M. Behrens, D. Isaksen, H.J. Kong, Z. Lü, G. Wang, and Z. Xu.

Shanghai Center for Mathematical Sciences, Fudan University, August 13–17, 2019.

### Special Session on Algebraic and Geometric Topology, AMS–CMS Joint International Meeting

International conference, 4 days, 50 participants.

Joint organizer with M. Hill, Z. Lü, and J. Ma.

Fudan University, June 11–14, 2018.

### IWoAT 2018

International conference, 4 days, 70 participants.

Joint organizer (principal) with A. Beaudry, M. Behrens, Z. Huan, H. Miller, N. Stapleton, G. Wang, and Z. Xu.

Southern University of Science and Technology, June 6–9, 2018.

### Operations in Highly Structured Homology Theories

International conference, 5 days, 40 participants.

Organizer for Session on Chromatic Power Operations.

Banff International Research Station, May 22–27, 2016.

### SEMINAR TALKS

*Topological time series analysis and deep learning with applications*

Beijing Normal University – Hong Kong Baptist University United International College,  
November 2023.

*Topology of stratified singular moduli spaces for physical systems*



Westlake University, November 2022.

*Topological time series analysis: with applications to biomedical and speech signal processing*  
Hangzhou Normal University, November 2022.

*Spectral moduli problems and unstable chromatic homotopy theory*  
Beijing Normal University Topology Seminar, January 2022, online.

*A topological classification for intersection singularities of exceptional surfaces in pseudo-Hermitian systems*  
Beijing Normal University Topology Seminar, January 2022, online.

*Algebraic topology and arithmetic*  
Southern University of Science and Technology, December 2019.

*Power operations in elliptic cohomology and semistable models for modular curves*  
Chinese Academy of Sciences Topology Seminar, November 2018.

*Toward calculating unstable higher-periodic homotopy types*  
Electronic Computational Homotopy Theory Seminar, April 2018, online.

*Power operations in elliptic cohomology and moduli of elliptic curves*  
Nankai University, November 2016.

*Toward calculating unstable higher-periodic homotopy types*  
Chinese Academy of Sciences Topology Seminar, November 2016.

*Power operation calculations in elliptic cohomology*  
Southern University of Science and Technology, October 2016.

*Modular equations and Hecke operators for local elliptic spectra*  
University of Chicago Topology Seminar, January 2016.

*Local moduli for elliptic spectra*  
University of Notre Dame Topology Seminar, January 2016.

*Computing power operations for Morava E-theory of height 2 at a prime*

University of Rochester Topology Seminar, October 2015.

*The Hecke algebra action on Morava E-theory of height 2*

University of Illinois Urbana-Champaign Topology Seminar, October 2014.

*Finite subgroups of a formal group of height 2 over  $\mathbb{F}_9$*

University of Louisiana at Lafayette Topology Seminar, March 2014.

*A formal group of height 2 over  $\mathbb{F}_9$*

Northwestern University Topology Seminar, October 2013.

*Power operations in height-2 Morava E-theory and its  $K(1)$ -localization*

University of Illinois Urbana-Champaign Topology Seminar, September 2013.

*Power operations in an elliptic cohomology theory*

University of Minnesota Topology Seminar, April 2013.

*Computing power operations in Morava E-theory at height 2 for the prime 3*

Wayne State University Topology Seminar, March 2013.

*The structure of power operations in Morava E-theory at height 2 for the prime 3*

University of Chicago Algebraic Topology Seminar, March 2013.

*Computing power operations for Morava E-theory of height 2 at the prime 3*

University of Virginia Topology Seminar, February 2013.

#### SELECTED CONFERENCES AND WORKSHOPS

Workshop on New Frontiers of Topology

Tianyuan Mathematics Research Center, Chaishitan, September 9–13, 2023.

Workshop on Arithmetic Topology

Pacific Institute for the Mathematical Sciences, University of British Columbia, Vancouver,  
June 10–14, 2019.

Arbeitsgemeinschaft: Topological Cyclic Homology

Mathematisches Forschungsinstitut, Oberwolfach, April 1–7, 2018.

West Coast Algebraic Topology Summer School

On connections between algebraic topology and number theory.

University of Oregon, Eugene, August 8–12, 2016.

Operations in Highly Structured Homology Theories

Organizer and speaker, Session on Chromatic Power Operations.

Banff International Research Station, May 22–27, 2016.

Conference on Topology and Geometry

Hausdorff Center for Mathematics, Bonn, August 17–21, 2015, scheduled.

Mid-Atlantic Topology Conference—in honor of Nick Kuhn

University of Virginia, Charlottesville, April 25–26, 2015.

West Coast Algebraic Topology Summer School

University of Washington, Seattle, August 26–28, 2011.

New Contexts in Homotopy Theory—in honor of Peter May

University of Chicago, Chicago, October 16–18, 2009.

#### SEMINAR ORGANIZING

2020–present    Southern University of Science and Technology (SUSTech),  
                         [Applied and Computational Topology Seminar](#)

2017–present    SUSTech, [Topology Seminar](#)  
                         Joint organizer with S. Garoufalidis.

2011–2012      University of Minnesota, Student Topology Seminar  
                         Joint organizer with D. Bashkirov, R. Hank, and E. Manlove.

#### REFEREEING

Chinese Annals of Mathematics. Series B

Frontiers of Mathematics

Geometry & Topology  
International Mathematics Research Notices  
Journal of the Australian Mathematical Society  
Journal of Topology  
Peking Mathematical Journal  
Science China Mathematics  
Transactions of the American Mathematical Society

### REVIEWING

MathSciNet (nine reviews currently published)  
zbMATH Open (seven reviews currently published)

### COMMITTEE WORK

2024–present University library committee  
2023–present Undergraduate education committee  
2020–present [Mathematics colloquium](#) committee

### TEACHING EXPERIENCE

#### **Southern University of Science and Technology**

- Courses taught:
  - MA323 Topology
  - MAT8021 Algebraic Topology (graduate level)
  - MA423 Seminar in Geometry and Topology
  - MA327 Differential Geometry
  - MAT8024 Differentiable Manifolds (graduate level)
  - MA107A Linear Algebra
  - MA101A Mathematical Analysis I
  - MA102A Mathematical Analysis II
  - MA301 Functions of Real Variables
  - MAT8010 Combinatorics (graduate level)
  - MA215 Probability Theory
- Postdoc mentoring: Pengcheng Li (2021–2023), Shiwo Deng (2021–2023, primary mentor: Fuquan Fang).
- Graduate advising: Jizhang Liu (2019–2021), Yifan Wu (2020–present), Xuecai Ma (2020–2024), Weiqiu Liang (2020–2021), Siheng Yi (2021–present), Yuqing Xing (2021 visited, primary advisor: Zhen Huan), Kecheng Shi (2021–2022 visited), Tongtong Liang (2021–

2023), Zhiwang Yu (2021–present, primary advisor: Fuquan Fang), Yingxin Li (2022–2023 visited), Jiacheng Liang (2022–2024), Qingrui Qu (2022–present), Zhonglin Wu (2022–2024, co-advisor: Disheng Xu), Wenhui Yang (2023–present), Zeyang Ding (2023–present), Yunhao Sun (2023–present, co-advisor: Xiaowen Hu), Peng Huang (2023–present, co-advisor: Pengcheng Li), Hanwen Zhao (2021–present), Zhou Fang (2023–present, primary advisor: Liang Kong).

- Undergraduate advising: Jizhang Liu (2017–2019), Yaxi Zhu (2018–2020), Zican Gao (2018–2019), Tongtong Liang (2019–2021), Ruijun Lin (2019–2021), Wenbo Liao (2019–2021), Jinghao Yu (2019–2021), Xiabing Ruan (2019–2021), Mingjie Wang (2020–2023), Linfeng Xu (2020–2022), Lingfeng Liu (2020–2022), Ruoyu Xu (2020–2022), Shuo Ling (2020–2023), Miaosen Jiao (2020–2023), Zijing Zhu (2020–2023), Yukai Wang (2020–2021), Hongxiang Zhao (2021–2023), Pingyao Feng (2021–2024), Rongming Yin (2022–2024), Zian Zhao (2022–2024), Ziyin Hu (2022–2024), Zeyang Ding (2022–2023), Zhichao Wang (2022–present), Jinghua Xi (2022–present), Yangqing Li (2022 visited), Jiacheng Liang (2022 visited), Yuanding Li (2023 visited), Yuhe Qin (2023–present), Xinyi Yu (2023–present), Wenhan Tan (2023–present), Yuzheng Ma (2023–present), Zihan Chen (2023–present), Shen Li (2023–present), Haiyu Zhang (2023–2024), Chenlu Huang (2023–2024).
- Fields Honors Class 2021, co-managing with B. Liu.
- Student recruiting, including design of computer-based standardized tests; undergraduate Linear Algebra standardized tests; graduate Geometry and Topology preliminary written exams.
- Tutorial fellow, Shuli College, currently advising 3 students of Class 2023, 3 students of Class 2022, 3 students of Class 2021, and 3 students of Class 2020. Led a panel discussion on math course study for freshmen of the College in Fall 2018 with three teaching-track faculty members.

## Northwestern University

- Courses taught:
  - Math 230 Differential Calculus of Multivariable Functions
  - Math 234 Multiple Integration and Vector Calculus
  - Math 240 Linear Algebra
  - Math 300 Foundations of Higher Mathematics
- Regularly served as course coordinator for Math 230—the most-enrolled calculus course with the largest instructor group.
- Served as faculty mentor for Math 230's *Gateway Science Workshop* program for two consecutive terms, with recognition from the Provost.
- Involved in *Math Review Study Tables*—drop-in question and answer / group study sessions run prior to calculus exams in residence halls, initiated and co-sponsored by the Office of Residential Academic Initiatives and the Department of Mathematics.

- Involved in piloting the use of *Crowdmark*—a collaborative online grading and analytics platform, with recognition from the Mathematics Department Chair. Experienced with technology and administrative matters.
- Involved in transitioning common calculus course websites from *Blackboard* to *Canvas*.

### **University of Minnesota**

- Teaching assistant for courses:
  - Math 1151 Precalculus II
  - Math 1271 Calculus I
  - Math 2263 Multivariable Calculus
  - Math 8602 Real Analysis
- Teaching assistant training, 2007. One of two (among 15) international math graduate students who were exempted from language classes.