

Xie Chen

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Academic Appointments

2024.3 – now	Eddleman Professor of Theoretical Physics	Caltech
2019.11 – now	Professor	California Institute of Technology
2017.7 – 2019.10	Associate professor	California Institute of Technology
2014.7 – 2017.6	Assistant professor	California Institute of Technology
2012.8 – 2014.6	Miller research fellow	University of California, Berkeley

Education

2006.9 – 2012.7	Ph.D. in theoretical physics	Massachusetts Institute of Technology
2002.9 – 2006.6	B. Sc. in physics	Tsinghua University

Research Interest

Topological phenomena in strongly correlated quantum many-body systems.

Topics include: topological defects and non-invertible symmetry; fracton order; symmetry protected topological order; symmetry fractionalization; quantum dynamics and information scrambling; tensor network representation; quantum information applications.

Awards and Honors

- 2021 Simons Investigator
- 2020 New Horizon in Physics Prize
- 2018 APS Outstanding Referee.
- 2017 Caltech Graduate Student Council Excellence in Teaching Award.
- 2017 Sloan Research Fellowship.
- 2017 National Science Foundation Faculty Early Career Award.
- 2012 Miller Research Fellowships from the Miller Institute for Basic Research in Science of UC Berkeley.

Publications

Preprint

1. David T. Stephen, **XC**, “Fusion of one-dimensional gapped phases and their domain walls”, arXiv:2403.19068.
2. **XC**, Michael Hermele, David T. Stephen, “Sequential Adiabatic Generation of Chiral Topological States”, arXiv:2402.03433.
3. Avi Vadar, Zongyuan Wang, Arpit Dua, Wilbur Shirley, **XC**, “Composite subsystem symmetries and decoration of sub-dimensional excitations”, arXiv:2312.04467.
4. Nathanan Tantivasadakarn, **XC**, “String operators for Cheshire strings in topological phases”, arXiv:2307.03180.
5. **XC**, Ho Tat Lam, Xiuqi Ma, “Ground State Degeneracy of Infinite-Component Chern-Simons-Maxwell Theories”, arXiv:2306.00291.

6. **XC**, Ho Tat Lam, Xiuqi Ma, “Gapless Infinite-component Chern-Simons-Maxwell Theories”, arXiv:2211.10458.
7. Max A. Metlitski, Lukasz Fidkowski, **XC**, Ashvin Vishwanath, “Interaction effects on 3D topological superconductors: surface topological order from vortex condensation, the 16-fold way and fermionic Kramers doublets”, arXiv:1406.3032.

Published

8. **XC**, Arpit Dua, Michael Hermele, David T. Stephen, Nathanan Tantivasadakarn, Robijn Vanhove, Jing-Yu Zhao, “Sequential Quantum Circuits as Maps between Gapped Phases”, *Phys. Rev. B* 109, 075116 (2024).
9. Zongyuan Wang, Xiuqi Ma, David T. Stephen, Michael Hermele, **XC**, “Renormalization of Ising cage-net model and generalized foliation”, *Phys. Rev. B* 108, 035148 (2023).
10. Xiuqi Ma, Ananth Malladi, Zongyuan Wang, Zhenghan Wang, **XC**, “Ground state degeneracy of the Ising cage-net model”, *Phys. Rev. B* 107, 085123 (2023).
11. **XC**, Arpit Dua, Po-Shen Hsin, Chao-Ming Jian, Wilbur Shirley, Cenke Xu, “Loops in 4+1d Topological Phases”, *SciPost Phys.* 15, 001 (2023).
12. Kevin Slagle, Yue Liu, David Aasen, Hannes Pichler, Roger S. K. Mong, **XC**, Manuel Endres, Jason Alicea, “Quantum spin liquids bootstrapped from Ising criticality in Rydberg arrays”, *Phys. Rev. B* 106, 115122 (2022).
13. Kevin Slagle, David Aasen, Hannes Pichler, Roger S. K. Mong, Paul Fendley, **XC**, Manuel Endres, Jason Alicea, “Microscopic characterization of Ising conformal field theory in Rydberg chains”, *Phys. Rev. B* 104, 235109 (2021).
14. Xiuqi Ma, Wilbur Shirley, Meng Cheng, Michael Levin, John McGreevy, **XC**, “Fractonic order in infinite-component Chern-Simons gauge theories”, *Phys. Rev. B* 105, 195124 (2022).
15. Kevin Slagle, David Aasen, Hannes Pichler, Roger S. K. Mong, Paul Fendley, **XC**, Manuel Endres, Jason Alicea, “Microscopic characterization of Ising conformal field theory in Rydberg chains”, *Phys. Rev. B* 104, 235109 (2021).
16. Nandagopal Manoj, Kevin Slagle, Wilbur Shirley, **XC**, “Screw dislocations in the X-cube fracton model”, *SciPost Phys.* 10, 094 (2021).
17. Sean Hartnoll, Subir Sachdev, Tadashi Takayanagi, **XC**, Eva Silverstein and Julian Sonner, “Quantum connections”, *Nat Rev Phys* (2021).
18. Wilbur Shirley, Kevin Slagle, **XC**, “Twisted foliated fracton phases”, *Phys. Rev. B* **102**, 115103 (2020).
19. Michael Pretko, **XC**, Yizhi You, “Fracton Phases of Matter”, *International Journal of Modern Physics A*, 35, 06, 2030003 (2020).
20. Taige Wang, Wilbur Shirley, **XC**, “Foliated fracton order in the Majorana checkerboard model”, *Phys. Rev. B* 100, 085127 (2019).
21. Wilbur Shirley, Kevin Slagle, **XC**, “Foliated fracton order from gauging subsystem symmetries”, *SciPost Phys.* 6, 041 (2019).
22. Wilbur Shirley, Kevin Slagle, **XC**, “Foliated fracton order in the checkerboard model”, *Phys. Rev. B* 99, 115123 (2019).
23. Wilbur Shirley, Kevin Slagle, **XC**, “Fractional excitations in foliated fracton phases”, *Annals of Physics*, 410, 167922 (2019).
24. Wilbur Shirley, Kevin Slagle, **XC**, “Universal entanglement signatures of foliated fracton phases”, *SciPost Phys.* 6, 015 (2019).

25. Yong-Liang Zhang, Yichen Huang, **XC**, “Information scrambling in chaotic systems with dissipation”, *Phys. Rev. B* 99, 014303 (2019).
26. Mehmet Burak Sahinoglu, Sujeet Shukla, Feng Bi, **XC**, “Matrix Product Representation of Locality Preserving Unitaries”, *Phys. Rev. B* 98, 245122 (2018).
27. Zitao Wang, Shang-Qiang Ning, **XC**, “Exactly Solvable Model for Two Dimensional Topological Superconductor”, *Phys. Rev. B* 98, 094502 (2018).
28. Wilbur Shirley, Kevin Slagle, Zhenghan Wang, **XC**, “Fracton Models on General Three-Dimensional Manifolds”, *Phys. Rev. X* 8, 031051 (2018).
29. Sujeet Shukla, Mehmet Burak Sahinoglu, Frank Pollmann, **XC**, “Boson condensation and instability in the tensor network representation of string-net states”, *Phys. Rev. B* 98, 125112 (2018).
30. Han Ma, Michael Hermele, **XC**, “Fracton topological order from Higgs and partial confinement mechanisms of rank-two gauge theory”, *Phys. Rev. B* 98, 035111 (2018).
31. Han Ma, Ethan Lake, **XC**, Michael Hermele, “Fracton topological order via coupled layers”, *Phys. Rev. B* 95, 245126 (2017).
32. Zitao Wang, **XC**, “Twisted gauge theories in 3D Walker-Wang models”, *Phys. Rev. B* 95, 115142 (2017).
33. **XC**, “Symmetry fractionalization in two dimensional topological phases”, *Reviews in Physics*, 2, 3, (2017).
34. Yi-Chen Huang, Yong-Liang Zhang, **XC**, “Out-of-time-ordered correlator in many-body localized systems”, *Ann. Phys. (Berlin)*, (2016).
35. **XC**, Michael Hermele, “Symmetry fractionalization and anomaly detection in three-dimensional topological phases”, *Phys. Rev. B* 94, 195120, (2016).
36. Michael Hermele, **XC**, “Flux-Fusion Anomaly Test and Bosonic Topological Crystalline Insulators”, *Phys. Rev. X* 6, 041006 (2016).
37. Fiona Burnell, **XC**, Alexei Kitaev, Max Metlitski, Ashvin Vishwanath, “Time reversal invariant gapped boundaries of the double semion state”, *Phys. Rev. B* 93, 235161 (2016).
38. **XC**, Ashvin Vishwanath, “‘Gauging’ time reversal symmetry in tensor network states”, *Phys. Rev. X* 5, 041034 (2015).
39. **XC**, Fiona J. Burnell, Ashvin Vishwanath, Lukasz Fidkowski, “Anomalous Symmetry Fractionalization and Surface Topological Order”, *Phys. Rev. X* 5, 041013 (2015).
40. Yi-Chen Huang, **XC**, “Quantum circuit complexity of one-dimensional topological phases”, *Phys. Rev. B* 91, 195143 (2015).
41. F. J. Burnell, **XC**, Lukasz Fidkowski, Ashvin Vishwanath, “Exactly Soluble Model of a 3D Symmetry Protected Topological Phase of Bosons with Surface Topological Order”, *Phys. Rev. B* 90, 245122 (2014).
42. **XC**, Yuan-Ming Lu, Ashvin Vishwanath, “Symmetry protected topological phases from decorated domain walls”, *Nature Communications* 5, Article number 3507 (2014).
43. **XC**, Lukasz Fidkowski, Ashvin Vishwanath, “Symmetry Enforced Non-Abelian Topological Order at the Surface of a Topological Insulator”, *Phys. Rev. B* 89, 165132 (2014).
44. Ching-Yu Huang, **XC**, Frank Pollmann, “Detection of Symmetry Enriched Topological Phases”, *Phys. Rev. B* 90, 045142 (2014).
45. Ching-Yu Huang, **XC**, Feng-Li Lin, “Symmetry Protected Quantum State Renormalization”, *Phys. Rev. B* 88, 205124 (2013).
46. Lukasz Fidkowski, **XC**, Ashvin Vishwanath, “Non-Abelian Topological Order on the Surface of a 3D Topological Superconductor from an Exactly Solved Model”, *Phys. Rev. X* 3, 041016

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47. **XC**, Fa Wang, Yuan-Ming Lu, Dung-Hai Lee, “Critical theories of phase transition between symmetry protected topological states and their relation to the gapless boundary theories”, *Nucl. Phys. B* 873, 248–259 (2013).
48. **XC**, Zheng-Cheng Gu, Zheng-Xin Liu, Xiao-Gang Wen, “Symmetry Protected Topological Orders in Interacting Bosonic Systems”, *Science* 338, 1604 (2012).
49. **XC**, Xiao-Gang Wen, “Chiral symmetry on the edge of 2D symmetry protected topological phases”, *Phys. Rev. B* 86, 235135 (2012).
50. Yu-Ju Chiu, **XC**, Isaac L. Chuang, “Fermionic Measurement-based Quantum Computation”, *Phys. Rev. A* 87, 012305 (2012).
51. **XC**, Zheng-Cheng Gu, Zheng-Xin Liu, Xiao-Gang Wen, “Symmetry protected topological orders and the group cohomology of their symmetry group”, *Phys. Rev. B* 87, 155114 (2011).
52. **XC**, Zheng-Xin Liu, Xiao-Gang Wen, “Two-dimensional symmetry protected topological orders and their protected gapless edge excitations”, *Phys. Rev. B* 84, 235141 (2011). (Editor’s Suggestion)
53. Zheng-Xin Liu, **XC**, Xiao-Gang Wen, “Symmetry protected topological orders of 1D spin systems with D2+T symmetry”, *Phys. Rev. B* 84, 195145 (2011).
54. **XC**, Zheng-Cheng Gu, Xiao-Gang Wen, “Complete classification of 1D gapped quantum phases in interacting spin systems”, *Phys. Rev. B* 84, 235128 (2011).
55. Samuel A. Ocko, **XC**, Bei Zeng, Beni Yoshida, Zhengfeng Ji, Mary Beth Ruskai, Isaac L. Chuang, “Quantum Codes give Counterexamples to the Unique Pre-image Conjecture of the N-representability Problem”, *Phys. Rev. Lett.* 106, 110501 (2011).
56. **XC**, Zheng-Cheng Gu, and Xiao-Gang Wen, “Classification of Gapped Symmetric Phases in One-dimensional Spin Systems”, *Phys. Rev. B* 83, 035107 (2011). (Editor’s Suggestion)
57. Jianxin Chen, **XC**, Runyao Duan, Zhengfeng Ji, and Bei Zeng, “No-go Theorem for One-way Quantum Computing on Naturally Occurring Two-level Systems”, *Phys. Rev. A* 83, 050301 (2011). (Rapid Communication)
58. **XC**, Zheng-Cheng Gu, and Xiao-Gang Wen, “Local Unitary Transformation, Long-Range Quantum Entanglement, Wave Function Renormalization, and Topological Order”, *Phys. Rev. B* 82, 155138 (2010). (Editor’s Suggestion)
59. **XC**, Bei Zeng, Zheng-Cheng Gu, Isaac L. Chuang, Xiao-Gang Wen, “Tensor Product Representation of Topological Ordered Phase: Necessary Symmetry Conditions”, *Phys. Rev. B* 82, 165119 (2010).
60. **XC**, Runyao Duan, Zhengfeng Ji, Bei Zeng, “Quantum State Reduction for Universal Measurement based Computation”, *Phys. Rev. Lett.* **105**(2), 020502 (2010).
61. **XC**, Bei Zeng, Zhengcheng Gu, Beni Yoshida, Isaac L. Chuang, “Gapped Two-body Hamiltonian whose Unique Ground State is Universal for One-way Quantum Computation”, *Phys. Rev. Lett.* 102, 220501 (2009). (Featured by synopsis on physics.aps.org)
62. **XC**, Bei Zeng, Isaac L. Chuang, “Nonbinary Codeword Stabilized Quantum Codes”, *Phys. Rev. A* 78, 062315 (2008).
63. **XC**, Hyeyoun Chung, Andrew W. Cross, Bei Zeng, Isaac L. Chuang, “Subsystem Stabilizer Codes cannot have a Universal Set of Transversal Gates for Even One Encoded Qudit”, *Phys. Rev. A* 78, 012353 (2008).
64. Bei Zeng, **XC**, and Isaac L. Chuang, “Semi-Clifford Operations, Structure of Ck Hierarchy, and Gate Complexity for Fault-Tolerant Quantum Computation”, *Phys. Rev. A* 77, 042313 (2008).

65. XC, Shuang Nan Zhang, Guo Qiang Ding, “Propeller Driven Spectral State Transition in LMXB 4U 1608-52”, *Astrophys.J.* 650, 299(2006).

Book

Book title: Quantum Information Meets Quantum Matter -- From Quantum Entanglement to Topological Phase in Many-Body Systems

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