Ashvin Vishwanath
George Vasmer Leverett Professor of Physics,
Department of Physics, Harvard University,
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Research Area: Condensed Matter Theory: Research interests - magnetism, superconductivity and topology in quantum materials. Classifying and characterizing novel phases and phase transitions. Theory of topological phases and their realization in solids and synthetic matter.

Education/Training:

Indian Institute of Technology, Kanpur	MSc.	1996	Physics
Princeton University [Thesis Advisor: F. D. M. Haldane]	Ph.D.	2001	Physics

Research and Professional Experience:

2016 – present Professor, Department of Physics, Harvard University.
2012 – 2016 Professor, Physics, UC Berkeley.
2008 – 2012 Associate Professor, Physics, UC Berkeley.
2004 – 2008 Assistant Professor, Physics, UC Berkeley.
2001 - 2004 Pappalardo Postdoctoral Fellow. MIT, USA.

Honors and Awards:

- Elected to the National Academy of Sciences, USA.
- Oliver E. Buckley Condensed Matter Physics Prize of the American Physical Society 2024
- Elected to the American Academy of Arts and Sciences 2021
- ICTS-Infosys Chandrasekhar Lecturer 2020
- Distinguished Alumnus Award, IIT Kanpur 2018
- Europhysics Prize 2016
- Clarivate Analytics Highly Cited Researcher 2017-2023
- Simons Investigator Award 2015-2025
- Guggenheim Fellowship 2014
- APS Fellow 2013
- A. P. Sloan Fellowship 2004

Significant Professional Activities:

1. **Director**: Simons Collaboration on Ultra Quantum Matter 2019-.

2. **Member,** Advisory Board, KITP Santa Barbara 2021-

3. **Member**, Scientific Advisory Committee, Simons Center for Geometry and Physics.

4. **Conferences Organized:**
   a. Boulder School for Condensed Matter Physics 2008*, 'Strongly Correlated Systems',*
   b. KITP Workshop on *"Quantum Spin Liquids and Frustrated Magnetism",* Fall 2012.

c. KITP Workshop on *"Topological Quantum Matter", Fall 2016.*
d. Winter Conference at Aspen (2018) *"Dualities".*
e. Simons Conferences on *Ultra Quantum Matter* (Feb 2018, August 2018).

Mentoring:

Graduate students (current):

Patrick Ledwith, Saranesh Prembabu, Rahul Sahai, Junkai Dong, Leo Lo , Anasuya Lyons, Ophelia Sommer.

Postdocs (current - including joint):

Ruben Verresen, Junyeong Ahn, Brendon Roberts, Zhu-Xi Luo, Jie Wang, Carolyn Zhang, Tomo Soejima, Manato Fujimoto.

Graduate Students (former):

Fa Wang (Pappalardo Fellow, MIT. => Associate Professor, Peking U.)
Thesis: Geometrical frustration in quantum and classical antiferromagnets.

Frank Yi Zhang (Stanford=> Bethe Fellow, Cornell=> Assistant Professor, PKU)
Thesis: Theory of Topological Phenomena in Condensed Matter Systems

Pavan Hosur (Stanford=> Assistant Professor U. of Houston)
Thesis: Consequences of non-trivial band topology in condensed matter systems

Haruki Watanabe (Pappalardo Fellow, MIT => Assistant Prof. U. of Tokyo)
Thesis: Spontaneous Symmetry Breaking in Nonrelativistic Systems

Itamar Kimchi (Pappalardo Fellow, MIT => Boulder=> Assistant Professor, GeorgiaTech)
Thesis: Spin-Orbit Coupled Quantum Magnetism in the 3D-Honeycomb Iridates

Philipp Dumitrescu (UTAustin=>Postdoc Flatiron Institute)
Thesis: Strongly Correlated Electron Systems Near Criticality: From Nodal Semimetals to High-Temperature Superconductors

Yasaman Bahri (Google Brain)
Thesis: Quantum Phenomena in Interacting Many-Body Systems: Topological Protection, Localization, and Non-Fermi Liquids

Hoi Chun Adrian Po (Pappalardo Fellow: MIT)
Thesis: Keeping it Real: An Alternative Picture for Symmetry and Topology in Condensed Matter Systems

Charles Zhaoxi Xiong (Voleon Group)
Thesis: Classification and Construction of Topological Phases of Quantum Matter

Jong Yeon Lee (Postdoc: KITP Santa Barbara)
Thesis: Fractionalization, Emergent Gauge Dynamics and Topology in Quantum Matter

Xue Yan Song (Moore Fellowship Postdoc: MIT)
Thesis: Emergent and topological phenomena in many-body systems: Quantum spin liquids and beyond

Shang Liu (Postdoc: KITP Santa Barbara)
Thesis: Symmetry, Topology and Entanglement in Quantum Many-Body Systems

Nathanan Tantivasadakarn (Sherman Fairchild Postdoctoral Scholar, Caltech)
Thesis: Exploring exact dualities in lattice models of topological phases of matter

Dan Borgnia (Postdoc: UC Berkeley)
Thesis: The Measure of a Phase

Ruihua Fan (Moore Postdoc, UC Berkeley)
Thesis: Quantum entanglement and dynamics in low-dimensional quantum many-body systems

Former Postdocs (including joint):

@UC Berkeley
Daniel Podolski (Associate Professor, Technion, Haifa)
Arun Paramekanti (Associate Professor, U. Toronto)
Benedikt Binz (Senior Specialist at FINMA)
Ying Ran (Associate Professor, Boston College)
Shinsei Ryu (Professor, Princeton University)

Pouyan Ghaemi (Assistant Professor, CUNY)
Ari Turner (Professor, Technion)
Tarun Grover (Assistant Professor, UC San Diego)
Lukasz Fidkowski (Associate Professor, University of Washington)
Sid Parameswaran (Professor, Oxford)

Xie Chen (Professor, Caltech)
Yuan Ming Lu (Associate Professor, Ohio State)
Andrew Potter (Assistant Professor, UT Austin)
Maksym Serbyn (Assistant Professor IST, Austria)
Snir Gazit (Assistant Professor, Jerusalem)
Norman Yao (Professor, Harvard University)

@Harvard U.
Yi Zhuang You (Assistant Professor, UC San Diego)
Yinchen He (Assistant Professor, Perimeter)
Chong Wang (Assistant Professor, Perimeter)
Vedika Khemani (Assistant Professor, Stanford University)
Sagar Vijay (Assistant Professor, UC Santa Barbara)

Zheng Zhu (Assistant Professor, KITS Beijing)
Hassan Shapourian (Postdoctoral Researcher, Microsoft Station Q)
Yingfei Gu (IFQ Postdoctoral Scholar, Caltech)
Robert Jan Slager (Group Leader, University of Cambridge)
Grisha Tarnopolski (Assistant Professor, CMU)

Eslam Khalaf (Assistant Professor, Harvard University)

Yahui Zhang (Assistant Professor, Johns Hopkins University)
Dan Parker (Assistant Professor, UC San Diego – Deferred to 2024)
Pavel Volkov (Assistant Professor, UConn)
Xueda Wen (Assistant Professor, Georgia Institute of Technology)

Publications:

233. Mohsin Iqbal, Nathanan Tantivasadakarn, Ruben Verresen, Sara L Campbell, Joan M Dreiling, Caroline Figgatt, John P Gaebler, Jacob Johansen, Michael Mills, Steven A Moses, Juan M Pino, Anthony Ransford, Mary Rowe, Peter Siegfried, Russell P Stutz, Michael Foss-Feig, Ashvin Vishwanath, Henrik Dreyer.
Non-Abelian topological order and anyons on a trapped-ion processor.
Nature, 626, 7999, 505-511 (2024).

232. PJ Ledwith, A Vishwanath, DE Parker
Vortexability: A unifying criterion for ideal fractional Chern insulators
Physical Review B 108 (20), 205144, 32, (2023)

231. GY Zhu, N Tantivasadakarn, A Vishwanath, S Trebst, R Verresen
Nishimori's cat: stable long-range entanglement from finite-depth unitaries and weak measurements
Physical Review Letters 131 (20), 200201, 30 (2023).

230. Fan, R., Sahay, R., & Vishwanath, A.
Extracting the quantum Hall conductance from a single bulk wave function.
Phys. Rev. Lett., 131, 186301 (2023).

229. Dong, J., Wang, J., Ledwith, P. J., Vishwanath, A., & Parker, D. E.,
Composite Fermi liquid at zero magnetic field in twisted $MoTe_2$.
Phys. Rev. Lett., 131, 136502 (2023).

228. Wen, X., Qi, M., Beaudry, A., Moreno, J., Pflaum, M. J., Spiegel, D., . . . Hermele, M.,
Flow of higher Berry curvature and bulk-boundary correspondence in parametrized quantum systems.
Phys. Rev. B, 108, 125147 (2023).

227. Zhang, Y.-H., Zhu, Z., & Vishwanath, A.,
XY transition and extraordinary boundary criticality from fractional exciton condensation in quantum Hall bilayer.*
Phys. Rev. X, 13, 031023 (2023).

226. Dong, J., Ledwith, P. J., Khalaf, E., Lee, J. Y., & Vishwanath,
A Many-body ground states from decomposition of ideal higher Chern bands: Applications to chirally twisted graphene multilayers.
Physical Review Research, 5(2), 023166 (2023).

225. Qiu, J.-X., Tzschaschel, C., Ahn, J., Gao, A., Li, H., Zhang, X.-Y., . . . Liu, Y.-F. et al.
Axion optical induction of antiferromagnetic order.
Nature Materials, 22(5), 583–590 (2023).

224. Shen, C., Ledwith, P. J., Watanabe, K., Taniguchi, T., Khalaf, E., Vishwanath, A., & Efetov, D. K.,
Dirac spectroscopy of strongly correlated phases in twisted trilayer graphene.
Nature Materials, 22(3), 316–321 (2023).

223. Tantivasadakarn, N., Thorngren, R., Vishwanath, A., & Verresen, R.
Building models of topological quantum criticality from pivot Hamiltonians.
SciPost Physics, 14(2), 01 (2023).

222. Tantivasadakarn, N., Thorngren, R., Vishwanath, A., & Verresen, R.
Pivot Hamiltonians as generators of symmetry and entanglement.
SciPost Physics, 14(2), 012 (2023).

221. Tantivasadakarn, N., Verresen, R., & Vishwanath, A.
Shortest route to non-abelian topological order on a quantum processor.
Physical Review Lett., 131(6), 060405 (2023).

220. Tantivasadakarn, N., Vishwanath, A., & Verresen, R.
Hierarchy of topological order from finite-depth unitaries, measurement, and feedforward.
PRX Quantum, 4(2), 020339 (2023).

219. Ahn, J., Xu, S.-Y., & Vishwanath, A.
Theory of optical axion electrodynamics and application to the Kerr effect in topological antiferromagnets.
Nature Communications, 13(1) (2022).

218. Verresen, R., & Vishwanath, A.
Unifying Kitaev magnets, kagomé dimer models, and ruby Rydberg spin liquids.
Phys. Rev. X, 12, (2022).

217. Balasubramanian, S., Galitski, V., & Vishwanath, A.
Classical vertex model dualities in a family of two-dimensional frustrated quantum antiferromagnets.
Phys. Rev. B, 106, 195127 (2022).

216. Borgnia, D. S., Vishwanath, A., & Slager, R.-J.
Rational approximations of quasiperiodicity via projected Green's functions.
Phys. Rev. B, 106, 054204, (2022).

215. Tantivasadakarn, N., & Vishwanath, A.
Symmetric finite-time preparation of cluster states via quantum pumps.

Phys. Rev. Lett., 129, 090501, (2022).

214. Gül, Ö., Ronen, Y., Lee, S. Y., Shapourian, H., Zauberman, J., Lee, Y. H., . . . Kim, P.
Andreev reflection in the fractional quantum Hall state.
Phys. Rev. X, 12, 021057 (2022).

213. Khalaf, E., Ledwith, P., & Vishwanath, A.
Symmetry constraints on superconductivity in twisted bilayer graphene: Fractional vortices, 4e condensates, or nonunitary pairing.
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212. Song, X.-Y., Zhang, Y.-H., & Vishwanath, A.
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Phys. Rev. B, 105, L201102 (2022).

211. Zhu, Z., Sheng, D. N., & Vishwanath, A.
Doped Mott insulators in the triangular-lattice Hubbard model.
Phys. Rev. B, 105, 205110 (2022).

210. Ledwith, P. J., Vishwanath, A., & Khalaf, E. ,
Family of ideal Chern flatbands with arbitrary Chern number in chiral twisted graphene multilayers.
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209. You, Y.-Z., & Vishwanath, A.
Kohn-Luttinger superconductivity and intervalley coherence in rhombohedral trilayer graphene.
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208. Hofmann, J. S., Khalaf, E., Vishwanath, A., Berg, E., & Lee, J. Y.
Fermionic Monte-Carlo study of a realistic model of twisted bilayer graphene.
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207. Ahn, J., Guo, G.-Y., Nagaosa, N., & Vishwanath, A.
Riemannian geometry of resonant optical responses.
Nature Physics, 18(3), 290–295 (2022).

206. Finney, J., Sharpe, A. L., Fox, E. J., Hsueh, C. L., Parker, D. E., Yankowitz, M., . . . Goldhaber-Gordon, D.
Unusual magnetotransport in twisted bilayer graphene.
Proceedings of the National Academy of Sciences, 119(16), e2118482119 (2022).

205. Khalaf, E., & Vishwanath, A.
Baby skyrmions in Chern ferromagnets and topological mechanism for spin-polaron formation in twisted bilayer graphene.
Nature Communications, 13(1), 6245 (2022).

204. Polshyn, H., Zhang, Y., Kumar, M. A., Soejima, T., Ledwith, P., Watanabe, K., . . . Vishwanath, A, Zaletel, M. P., Young, A. F.
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203. Wen, X., Gu, Y., Vishwanath, A., & Fan, R.
Periodically, Quasi-periodically, and Randomly Driven Conformal Field Theories (II): Furstenberg's Theorem and Exceptions to Heating Phases.
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202. Shapourian, H., Liu, S., Kudler-Flam, J., & Vishwanath, A.
Entanglement negativity spectrum of random mixed states: A diagrammatic approach.
PRX Quantum, 2(3), 030347 (2021).

201. Verresen, R., Lukin, M. D., & Vishwanath, A.
Prediction of toric code topological order from Rydberg blockade.
Physical Review X, 11(3), 031005 (2021).

200. Thorngren, R., Vishwanath, A., & Verresen, R.
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Physical Review B, 104(7), 075132 (2021).

199. Wang, L.-L., Po, H. C., Slager, R.-J., & Vishwanath, A.
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198. Liu, X., Chiu, C.-L., Lee, J. Y., Farahi, G., Watanabe, K., Taniguchi, T., . . . Yazdani,
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197. Krishnan, A., Vishwanath, A., & Po, H. C. (2021).
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Physical Review B, 104(8), 085128 (2021).

196. Lake, E., Senthil, T., & Vishwanath, A.
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Physical Review B, 104(1), 014517.(2021).

195. Fan, R., Vijay, S., Vishwanath, A., & You, Y.-Z.
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Physical Review B, 103(17), 174309 (2021).

194. Khalaf, E., Chatterjee, S., Bultinck, N., Zaletel, M. P., & Vishwanath, A.
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193. Song, X.-Y., He, Y.-C., Vishwanath, A., & Wang, C.
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192. Song, X.-Y., Vishwanath, A., & Zhang, Y.-H.
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Phys. Rev. B, 103, (2021).

191. Wen, X., Fan, R., Vishwanath, A., & Gu, Y.
Periodically, quasi-periodically, and randomly driven conformal field theories.
Phys. Rev. Research, 3, 023044, (2021).

190. Hao, Z., Zimmerman, A., Ledwith, P., Khalaf, E., Najafabadi, D. H., Watanabe, K., . . . Vishwanath, A., Kim, P.
Electric field–tunable superconductivity in alternating-twist magic-angle trilayer graphene.
Science 371(6534) 1133–1138 (2021).

189. Liu, S., Khalaf, E., Lee, J. Y., & Vishwanath, A.
Nematic topological semimetal and insulator in magic-angle bilayer graphene at charge neutrality.
Physical Review Research 3(1), 013033 (2021).

188. Riberolles, S. X., Trevisan, T. V., Kuthanazhi, B., Heitmann, T., Ye, F., Johnston, D. C., . . . Kreyssig, A.et al.
Magnetic crystalline-symmetry-protected axion electrodynamics and field-tunable unpinned Dirac cones in EuIn2As2.
Nature Communications,12(1), 1–7 (2021).

187. Song, X.-Y., He, Y.-C., Vishwanath, A., & Wang, C.
Electric polarization as a nonquantized topological response and boundary Luttinger theorem.
Physical Review Research 3(2), 023011(2021).

186. Bultinck, N., Khalaf, E., Liu, S., Chatterjee, S., Vishwanath, A., & Zaletel, M. P.
Ground state and hidden symmetry of magic-angle graphene at even integer filling.
Physical Review X,10(3), 031034 (2020).

185. Fan, R., Gu, Y., Vishwanath, A., & Wen, X.
Emergent spatial structure and entanglement localization in Floquet conformal field theory.
Physical Review X,10(3), 031036 (2020).

184. Jo, N. H., Wang, L.-L., Slager, R.-J., Yan, J., Wu, Y., Lee, K., . . . Kaminski, A.
Intrinsic axion insulating behavior in antiferromagnetic $MnBi_6Te_{10}$.
Physical Review B,102(4), 045130 (2020).

183. Ledwith, P. J., Tarnopolsky, G., Khalaf, E., & Vishwanath, A.
Fractional Chern insulator states in twisted bilayer graphene: An analytical approach.
Physical Review Research, 2(2), 023237 (2020).

182. Liu, X., Hao, Z., Khalaf, E., Lee, J. Y., Ronen, Y., Yoo, H., . . . Vishwanath, A. et al.
Tunable spin-polarized correlated states in twisted double bilayer graphene.
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181. Y.-H. Zhang & A. Vishwanath,
Type-II t-J model in superconducting nickelate $Nd_{1-x}Sr_xNiO_2$,
Physical Review Research, 2 pp. 023112 (2020).

180. D. Wang, F. Tang, H. C. Po, A. Vishwanath and X. G. Wan,
XFe_4Ge_2 (X = Y, Lu) and Mn_3Pt: Filling-enforced magnetic topological metals,
Physical Review B, 101 (2020).

179. X. Y. Song, Y. C. He, A. Vishwanath and C. Wang,
From Spinon Band Topology to the Symmetry Quantum Numbers of Monopoles in Dirac Spin Liquids,
Physical Review X, 10 (2020).

178. Y. Z. You and A. Vishwanath,
Superconductivity from valley fluctuations and approximate SO(4) symmetry in a weak coupling theory of twisted bilayer graphene,
NPJ Quantum Materials, 4 (2019).

177. D. Wang, F. Tang, J. L. Ji, W. Q. Zhang, A. Vishwanath, H. C. Po and X. G. Wan,
Two-dimensional topological materials discovery by symmetry-indicator method,
Physical Review B, 100 (2019).

176. G. Tarnopolsky, A. J. Kruchkov and A. Vishwanath,
Origin of Magic Angles in Twisted Bilayer Graphene,
Physical Review Letters, 122 (2019).

175. F. Tang, H. C. Po, A. Vishwanath and X. G. Wan,
Comprehensive search for topological materials using symmetry indicators,
Nature, 566 (2019), pp. 486-+.

174. F. Tang, H. C. Po, A. Vishwanath and X. G. Wan,
Topological materials discovery by large-order symmetry indicators,
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173. F. Tang, H. C. Po, A. Vishwanath and X. G. Wan,
Efficient topological materials discovery using symmetry indicators,
Nature Physics, 15 pp. 470-+ (2019),

172. X. Y. Song, C. Wang, A. Vishwanath and Y. C. He,
Unifying description of competing orders in two-dimensional quantum magnets,
Nature Communications, 10 (2019).

171. H. C. Po, L. J. Zou, T. Senthil and A. Vishwanath,
Faithful tight-binding models and fragile topology of magic-angle bilayer graphene,
Physical Review B, 99 (2019).

170. S. Liu, A. Vishwanath and E. Khalaf,
Shift Insulators: Rotation-Protected Two-Dimensional Topological Crystalline Insulators,
Physical Review X, 9 (2019).

169. J. Y. Lee, Y. Z. You, S. Sachdev and A. Vishwanath,
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168. J. Y. Lee, E. Khalaf, S. Liu, X. M. Liu, Z. Y. Hao, P. Kim and A. Vishwanath,
Theory of correlated insulating behaviour and spin-triplet superconductivity in twisted double bilayer graphene,
Nature Communications, 10 (2019).

167. J. Y. Lee, J. Ahn, H. Y. Zhou and A. Vishwanath,
Topological Correspondence between Hermitian and Non-Hermitian Systems: Anomalous Dynamics,
Physical Review Letters, 123 (2019).

166. E. Khalaf, A. J. Kruchkov, G. Tarnopolsky and A. Vishwanath,
Magic angle hierarchy in twisted graphene multilayers,
Physical Review B, 100 (2019).

165. P. Hosur, S. A. Parameswaran and A. Vishwanath,
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Physical Review Letters, 123 (2019).

164. L. Fidkowski, H. C. Po, A. C. Potter and A. Vishwanath,
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Physical Review B, 99 (2019).

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162. L. J. Zou, H. C. Po, A. Vishwanath and T. Senthil,
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161. Y. Z. You, Y. C. He, C. K. Xu and A. Vishwanath,
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160. Y. Z. You, Y. C. He, A. Vishwanath and C. K. Xu,
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Physical Review B, 97 (2018).

159. N. Y. Yao, M. P. Zaletel, D. M. Stamper-Kurn and A. Vishwanath,
A quantum dipolar spin liquid,
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158. X. Yang, S. H. Jiang, A. Vishwanath and Y. Ran,
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157. H. Watanabe, H. C. Poe and A. Vishwanath,
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155. N. Tantivasadakarn and A. Vishwanath,
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Physical Review B, 98 (2018).

154. C. Potter, A. Vishwanath and L. Fidkowski,
Infinite family of three-dimensional Floquet topological paramagnets,
Physical Review B, 97 (2018).

153. H. C. Po, L. J. Zou, A. Vishwanath and T. Senthil,
Origin of Mott Insulating Behavior and Superconductivity in Twisted Bilayer Graphene,
Physical Review X, 8 (2018).

152. H. C. Po, H. Watanabe and A. Vishwanath,
Fragile Topology and Wannier Obstructions,

Physical Review Letters, 121 (2018).

151. N. Ma, G. Y. Sun, Y. Z. You, C. K. Xu, A. Vishwanath, A. W. Sandvik and Z. Y. Meng,
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150. J. Y. Lee, C. Wang, M. P. Zaletel, A. Vishwanath and Y. C. He,
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149. J. Y. Lee, A. M. Turner and A. Vishwanath,
Building symmetry-enriched topological phases from a bipartite lattice construction and anyon condensation,
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148. V. Khemani, A. Vishwanath and D. A. Huse,
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Physical Review X, 8 (2018).

147. E. Khalaf, H. C. Po, A. Vishwanath and H. Watanabe,
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146. K. Gotlieb, C. Y. Lin, M. Serbyn, W. T. Zhang, C. L. Smallwood, C. Jozwiak, H. Eisaki, Z. Hussain, A. Vishwanath and A. Lanzara,
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144. R. Chen, H. C. Po, J. B. Neaton and A. Vishwanath,
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Nature Physics, 14 (2018), pp. 55-+.

143. N. P. Armitage, E. J. Mele and A. Vishwanath,
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142. G. Affeldt, T. Hogan, J. D. Denlinger, A. Vishwanath, S. D. Wilson and A. Lanzara,
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141. J. Zhang, P. W. Hess, A. Kyprianidis, P. Becker, A. Lee, J. Smith, G. Pagano, I. D. Potirniche, A. C. Potter, A. Vishwanath, N. Y. Yao and C. Monroe,
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Discrete Time Crystals: Rigidity, Criticality, and Realizations,
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