

北京大学高能物理研究中心

【系列讲座】理论物理中的广义对称性 Generalized Symmetries in Theoretical Physics

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广义对称性与量子场论中的应用

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1、Higher-form symmetries

- Topological formulation of symmetries
- 't Hooft anomaly and anomaly theory
- Examples in QFT: U(1) Maxwell's theory, SU(N) gauge theory, 3d Chern-Simons theory, 6d/5d superconformal field theories
- Computations of higher-form symmetries of QFTs from string theory

2、Higher-group symmetries and non-invertible symmetries

- Basics of higher-category theory
- 2-groups and n-groups
- 2-group gauge theories
- Examples in QFT: gauging of finite global symmetries
- Non-invertible symmetries and examples in QFT

参考文献:

- 1、 Davide Gaiotto, Anton Kapustin, Nathan Seiberg, and Brian Willett. "Generalized global symmetries." arXiv: 1412.5148.
- 2、 Ryo Yokokura, "An introduction to higher-form symmetries".
- 3、 David Tong, "Gauge theory".
- 4、 Federica Albertini, Michele Del Zotto, inaki Garcia Etxebarria, and Saghar S. Hosseini. "Higher Form Symmetries and M-theory." arXiv:2005.12831.
- 5、 David R. Morrison, Sakura Schafer-Nameki, and Brian Willett. "Higher-form symmetries in 5d." arXiv:2005.12296.
- 6、 John C. Baez, and John Huerta. "An Invitation to Higher Gauge Theory." arXiv:1003.4485.
- 7、 Kenneth S. Brown, Cohomology of groups. Vol. 87. Springer Science & Business Media, 2012.
- 8、 Francesco Benini, Clay Cordova, and Po-Shen Hsin. "On 2-Group Global Symmetries and Their Anomalies." arXiv:1803.09336.
- 9、 Yuji Tachikawa, "On gauging finite subgroups." arXiv:1712.09542.
- 10、 Fabio Apruzzi, Lakshya Bhardwaj, Jihwan Oh, and Sakura Schafer-Nameki. "The Global Form of Flavor Symmetries and 2-Group Symmetries in 5d SCFTs." arXiv:2105.08724.

凝聚态观点下的广义对称性

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1. 't Hooft anomaly of higher-form symmetries and topological phases of matter
 - 't Hooft anomalies and symmetry protected topological phases in one higher dimension
 - Higher-form symmetry protected topological phases
 - Cohomology classifications in lower dimensions
 - Cobordism classifications
2. Higher-group symmetries and non-invertible symmetries in topological phases
 - 2-group symmetry in symmetry-enriched gauge theories
 - Non-invertible symmetry from gauging non-Abelian group symmetry in 1+1D
 - Fusion categories as non-invertible symmetries in 1+1D
 - Non-invertible symmetries in 2+1D

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2. Chen, X., Gu, Z. C., Liu, Z. X., & Wen, X. G. (2011). Symmetry protected topological orders and the group cohomology of their symmetry group. arXiv preprint arXiv:1106.4772.
3. Senthil, T. (2014). Symmetry Protected Topological phases of Quantum Matter. arXiv preprint arXiv:1405.4015.
4. Kitaev, A. Y. (2008). Fault-tolerant quantum computation by anyons. arXiv preprint quant-ph/9707021.
5. Kapustin, A. (2014). Symmetry protected topological phases, anomalies, and cobordisms: beyond group cohomology. arXiv preprint arXiv:1403.1467.
6. Xiong, C. Z. (2017). Minimalist approach to the classification of symmetry protected topological phases. arXiv preprint arXiv:1701.00004.
7. Thorngren, R., & von Keyserlingk, C. (2015). Higher SPT's and a generalization of anomaly in-flow. arXiv preprint arXiv:1511.02929.
8. Wan, Z., & Wang, J. (2018). Higher anomalies, higher symmetries, and cobordisms I: classification of higher-symmetry-protected topological states and their boundary fermionic/bosonic anomalies via a generalized cobordism theory. arXiv preprint arXiv:1812.11967.
9. Appendix E of Kitaev, A. (2008). Anyons in an exactly solved model and beyond.

arXiv preprint cond-mat/0506438.

10. Bhardwaj, L., & Tachikawa, Y. (2017). On finite symmetries and their gauging in two dimensions. arXiv preprint arXiv:1704.02330.