北京大学量子材料科学中心

International Center for Quantum Materials, PKU

Weekly Seminar

Effective field theory approach to topological orders

Peng Ye

Sun Yat-sen University

Time: 3:00 pm, Apr.9, 2025 (Wednesday)

时间：2025年4月9日（周三）下午3:00

Venue: Room w563, Physics building, Peking University

地点：北京大学物理楼，西563会议室

Abstract

A general belief is that a many-body state with good thermodynamical limit should have a long-wavelength effective field theory description. Indeed, Ginzburg-Landau field theory gives a very good description of symmetry-breaking phases and phase transitions. In this talk, I will introduce the effective field theory approach to topological orders, mainly focusing on Abelian discrete gauge group as input information. I will start with the well-established 2+1 hydrodynamical Chern-Simons field theory and then move to 3+1 and 4+1 where topological excitations include spatially extended (non-local) objects, e.g., loops and membranes. From the effective field theory, we can construct topologically inequivalent Wilson operators for topological excitations, compute braiding statistics among excitations, extract fusion rules and “shrinking” rules. We can also study how symmetry is fractionalized on loops by the effective field theory approach. Finally, we end up with a unified diagrammatical descrption which generalizes the traditional pentagon equation and hexagon equation of 2+1 topological orders.

About the speaker

Peng Ye is currently a professor at Sun Yat-sen University (since August 2018), working in the field of quantum many-body theory. He earned his B.Sc. in Physics from Sun Yat-sen University in July 2007 and completed his PhD at the Institute for Advanced Study of Tsinghua University in July 2012. From September 2012 to August 2015, he worked as a postdoctoral researcher at the Perimeter Institute for Theoretical Physics in Canada. He then became a postdoctoral research associate and Gordon & Betty Moore fellow at of the Anthony J. Leggett Institute for Condensed Matter Theory and Department of Physics at the University of Illinois at Urbana-Champaign, USA, from August 2015 to August 2018.