THE CHINESE UNIVERSITY OF HONG KONG

Department of Physics

COLLOQUIUM

Exact Bosonization in All Dimensions

by

Dr. Yu-An CHEN (陳昱安博士)
Joint Quantum Institute and
Condensed Matter Theory Center
University of Maryland, USA

Date: November 8, 2022 (Tuesday)
Time: 10:00 - 11:00 a.m.
Join ZOOM Meeting: https://bit.ly/3W5A0EA

ALL INTERESTED ARE WELCOME

****

Abstract

This talk introduces generalized Jordan–Wigner transformation for arbitrary dimensions. This gives a duality between all fermionic systems and spin models (a new class of Z2 gauge theories), which can be interpreted as a stabilizer code. This mapping preserves the locality and has an explicit dependence on the choice of spin structure. This exact bosonization utilizes Kitaev's surface code (toric code) and imposes gauge constraints to restrict onto the subspace of emergent fermions. We identify the algebra of physical fermions with the sub-algebra of Pauli matrices generated by the emergent fermions in Kitaev's surface code. In the spacetime picture, this mapping comes from the topological Chern-Simon action for (2+1)D or the Steenrod square action for general dimensions. Our construction directly connects topological quantum field theories and quantum codes. For fermionic quantum simulation, we can optimize fermion-to-qubit mappings for various properties, i.e., the code distance and the qubit-fermion ratio.

References:

Annals of Physics 393, 234-253 (2018) (https://arxiv.org/abs/1711.00515)
Physical Review B 100 (24), 245127 (2019) (https://arxiv.org/abs/1807.07081)
Physical Review Research 2 (3), 033527 (2020) (https://doi.org/10.1103/PhysRevResearch.2.033527)

Enquiries: 3943 6303