THE CHINESE UNIVERSITY OF HONG KONG

Department of Physics

COLLOQUIUM

Synthetic Topological States of Matter in Atomic, Molecular, and Optical Physics

by

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Join ZOOM Meeting: https://qrgo.page.link/AL6y9

ALL INTERESTED ARE WELCOME
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Abstract

Highly tunable atomic, molecular, and optical systems have emerged as unique platforms to synthesize topological quantum matters. On the one hand, synthetic dimensions that are made of either internal states of atoms and molecules or tuning parameters in the Hamiltonians have allowed physicists to access important quantum phenomena unattainable in nature. For example, magnetic monopoles that do not exist in our physical world can be synthesized in laboratories. Moreover, the generalization of a magnetic monopole to five-dimensions, the so-called Yang monopole that was first proposed by Prof. C. N. Yang decades ago, has been recently delivered for the first time in experiments by tailoring laser-atom interactions. In this talk, I will show how mutual interactions between atoms may give rise to not only Yang monopoles but also a much broader range of intriguing topological defects. Furthermore, adding spatial dependence to laser-atom interactions will naturally lead to the rise of a synthetic Hall cylinder or a synthetic Hall torus with a net effective magnetic field through its surface. Such synthetic curved spaces host intriguing quantum phenomena ranging from symmetry protected band crossings to non-abelian Bloch oscillations.

On the other hand, dissipative dynamics have been implemented as a new means to access novel topological quantum states. Contrary to the usual thinking of dissipation leading to loss and decoherence, tailored dissipations have successfully delivered small clusters of fractional quantum Hall states of photons. I will discuss how to control anyons in quantum Hall clusters of photons using dissipative dynamics, which could be potentially turned into a realistic scheme to braid anyons, an essential step towards topological quantum computation.

[1] Phys. Rev. Lett. 120, 235302 (2018)
[2] Phys. Rev. Lett. 123, 260405 (2019)

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