

JITCP Seminar

THE UNIVERSITY OF HONG KONG

HKU-UCAS JOINT INSTITUTE OF THEORETICAL AND COMPUTATIONAL PHYSICS

[Thursday afternoon, 4:00 pm, In Person]

Fractonic superfluidity: Exotic symmetry-breaking orders with higher moment conservation

Prof. Peng YE

Sun Yat-sen University

While the traditional symmetry-breaking orders (SSB), e.g., superfluidity, can be theoretically obtained by considering a Mexican hat that spontaneously breaks global symmetry, e.g., $U(1)$ in the ground states. In this talk, I will introduce a new type of SSB orders in which the broken symmetry is called “higher-rank symmetry” that transforms boson operators in a way that the group parameters are allowed to depend on space coordinates while the Hamiltonian still keeps invariant without the need of gauge degrees of freedom. We consider concrete examples dubbed “fractonic superfluids” in which higher rank $U(1)$ symmetry is spontaneously broken. The associated conserved quantities are both total particle number and total higher moments (e.g., dipoles, angular moments, quadrupoles). We construct minimal Hamiltonians, and study many properties of these many-body systems, e.g., Noether currents, GP equations, ODLRO against quantum fluctuations at various dimensions, and symmetry defects as well as their thermally activated proliferation that leads to hierarchical KT transitions. In addition to our systematic concrete model studies, more recently, there have been exciting updates in the community, including general discussions on Mermin-Wagner theorem and SSB of higher moment conservation in high energy physics, and realization on Hubbard models.

References:

- [1]arXiv:1911.02876. Phys. Rev. Research 2, 023267 (2020).
- [2]arXiv:2010.03261. Phys. Rev. Research 3, 013226 (2021).
- [3]arXiv:2104.03237. Phys. Rev. Research 3, 043176 (2021).
- [4]arXiv:2201.08597 [5]arXiv:2203.06984. Chin. Phys. Lett. 39, 057101 (2022).

About the speaker:

Peng Ye is currently a professor at the School of Physics of Sun Yat-sen University since August 2018. His main research interest is quantum many-body theory. In July 2007, he obtained B. Sc. in Physics in Sun Yat-sen University. In July, 2012, he obtained PhD at Institute for Advanced Study, Tsinghua University. From Sep. 2012 to Aug. 2015, he was a Postdoctoral Researcher in the Perimeter Institute for Theoretical Physics, Waterloo, Ontario, Canada. From Aug. 2015 to Aug. 2018, he was a Postdoctoral Research Associate and Gordon & Betty Moore Postdoctoral Scholar) of the Institute for Condensed Matter Theory, University of Illinois at Urbana-Champaign, USA.

In Person Seminar

Thursday, February 16, 2023, 4:00 pm

Room 522, 5/F, Chong Yuet Ming Physics Building, The University of Hong Kong

Host: Professor Gang CHEN, The University of Hong Kong

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