H. Zhai: *Exotic Superfluid in Ultracold Atomic Gases from Synthetic Gauge Fields*

Superfluidity of bosons is usually characterized by the off-diagonal long-range order of single boson operator, while we are interested in finding unconventional superfluids in which single boson operator does not exhibit long-range order, but boson pairs or even triple bosons exhibit long-range order. We propose two of such examples in ultracold atomic systems. The first is bosons with Rashba spin-orbit coupling. The ground state is a superfluid with stripe order, while the large single particle ground state degeneracy leads to significant fluctuations, which melt stripe order and give rise to boson-paired superfluid. The second example is bosons in Kagome lattice with frustration, where the lowest band is completely flat. At the lowest temperature bosons all condense in the K-point, while at finite temperature thermal fluctuations melt the Z3 order and lead to a trion superfluid phase. These two examples indicate a universal route toward a class of exotic superfluid phase.

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