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Helical finite-momentum superfluids

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I will discuss a "helical" superfluid, a nonzero-momentum condensate realized by frustrated bosonic on e.g., a honeycomb lattice. At a Bogoliubov level, such a novel state exhibits "smectic" fluctuation that are qualitatively stronger than that of a conventional superfluid. We develop a phase diagram and compute a variety of its physical properties, including the spectrum, structure factor, condensate depletion, momentum distribution, all of which are qualitatively distinct from that of a conventional superfluid. Interplay of fluctuations, interaction and lattice effects gives rise to the phenomenon of order-by-disorder, leading to a crossover from the smectic superfluid regime to the anisotropic XY superfluid phase. We complement the microscopic lattice analysis with a field theoretic description for such a helical superfluid, which we derive from microscopics and justify on general symmetry grounds, reassuringly finding full consistency. Possible experimental realizations are discussed.

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