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Chiral and helical superfluid in cold atom system XIAOHUI LI, TINGPONG CHOY, TAI-KAI NG, The Hong Kong University of Science and Technology — Recently, a chiral spin superfluid has been proposed in weakly interacting boson systems [1]. In this work, we study the properties of bosonic superfluids in a cold atom system with two inequivalent band minima in momentum space related by time reversal symmetry. The system is mapped into an effective spinor-boson model. Without additional symmetries we show that in general there are two possible phases in this model, a ferromagnetic (easy axis) phase and a "x-y" (easy plane) phase. In the presence of nonzero k-space Berry curvature at the two band minima points, we show that the ferromagnetic state is "chiral" and the x-y state is "helical." The bulk and edge properties of these states are studied where the similarities and differences between the present bosonic superfluids and the corresponding fermionic superconductors are pointed out.

[1] Li, Xiaopeng and Natu, Stefan S and Paramekanti, Arun and Sarma, S Das. "Chiral spin superfluidity and spontaneous spin Hall effect of interacting bosons." *arXiv preprint arXiv:1405.6715*, 2014.

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