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Berezinskii-Kosterlitz-Thouless Phase Transition in 2D Spin-Orbit Coupled Fulde-Ferrell Superfluids YONG XU, CHUANWEI ZHANG, The University of Texas at Dallas — The experimental observation of traditional Zeeman-field induced Fulde-Ferrell-Larkin-Ovchinnikov (FFLO) superfluids has been hindered by various challenges, in particular, the requirement of low dimension systems. In 2D, it is well known that finite temperature phase fluctuations lead to extremely small Berezinskii-Kosterlitz-Thouless (BKT) transition temperature, raising serious concern regarding the observability of 2D FFLO superfluids. Recently, it was shown that FFLO superfluids can be realized using a Rashba spin-orbit coupled Fermi gas subject to Zeeman fields, which may also support topological excitations such as Majorana fermions in 2D. Here we address the finite temperature BKT transition issue in this system, which may exhibits gapped, gapless, topological, and gapless topological FF phases. We find a large BKT transition temperature due to large effective superfluid densities, making it possible to observe 2D FF superfluids at finite temperature. In addition, we show that gapless FF superfluids can be stable due to their positive superfluid densities. These findings pave the way for the experimental observation of 2D gapped and gapless FF superfluids and their associated topological excitations at finite temperature.

Yong Xu
The University of Texas at Dallas

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