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Superfluid density and gauge invariance in Larkin-Ovchinnikov-Fulde-Ferrell (LOFF) superfluid phases RUFUS BOYACK, BRANDON ANDERSON, KATHRYN LEVIN, James Franck Inst — The recent focus on finite wave-vector ordering in the high temperature superconductors and ultracold Fermi superfluids has led to renewed interest in LOFF and related pair-density wave phases. A central feature in describing a superfluid is the superfluid density, which in BCS theory is relatively straightforward to compute in a fully gauge invariant fashion. What distinguishes the LOFF phases are broken symmetries associated with the special wave-vector \mathbf{Q} . As a result the electromagnetic response, and in particular the superfluid density tensor, must be computed in a more sophisticated fashion. In particular, the collective mode contribution to the superfluid density, which is usually ignored in the literature, was included by Larkin and Ovchinnikov. Here we discuss these issues and show how to compute a proper gauge invariant electromagnetic response for these novel superfluid phases.

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