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Self consistent theories of superfluid density and collective modes in BCS-BEC RUFUS BOYACK, BRANDON ANDERSON, CHIEN-TE WU, KATHRYN LEVIN, James Franck Inst — Establishing fully self consistent and sum rule compatible response functions in strongly correlated Fermi superfluids has been a historically challenging subject. In this talk, we present recent progress pertaining to response functions in many-body Fermi systems. We note that even in strict BCS theory, the textbook derivation of density and current response functions in the gradient expansion breaks certain conservation laws such as the compressibility sum rule. To include additional contributions that preserve all expected conservation laws, we show how to exploit Ward identities within two different t-matrix schemes. In this way we address the density-density response (including collective modes) and the superfluid density. Finally, we characterize approximations made in the literature where some consistency requirements have been dropped.

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