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Effecvt of Disorder on BCS-BEC Crossover in a Two-dimensional Ultracold Fermi Gas[1] B. TANATAR, Bilkent University, AYAN KHAN, Pusan National University, SAURABH BASU, IIT Guwahati — We study the BCS-BEC crossover in a two-dimensional ultracold gas of fermionic atoms in the presence of a weak white noise-like random disorder, whose effects are incorporated in the mean-field treatment via Gaussian fluctuations. Self-consistent computation of the physical properties such as the gap parameter and the condensate fraction reveal that the weakly coupled superfluid is unaffected by disorder, whereas the molecular BEC phase is found to be significantly renormalized as the pairing interaction is continuously tuned from a weak to a strong coupling regime. The unitary (crossover) regime, that lies intermediate to the BCS and BEC phases, described by a dimensionless parameter $1/k_F a$, where $-1 \leq 1/k_F a \leq 1$ denotes the region of crossover, shows a monotonic increase of the pairing gap across the crossover, whereas the condensate fraction data is distinct with a non-monotonic behavior. The downturn in the latter result occurs at the crossover regime with a gradual depletion on the BEC side. A non-monotonic feature in the condensate fraction data has been noted earlier, in clean systems. Motivated by this result, we discuss the stability of a disordered fermionic superfluid in the crossover regime.

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