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Disorder effects in the evolution from BCS to BEC superfluidity[1]

LI HAN, CARLOS A. R. SA DE MELO, Georgia Institute of Technology — We discuss the effects of disorder on the critical temperature of superfluids during the evolution from BCS to BEC. For s-wave superfluids we find that the critical temperature is weakly affected by disorder in the BCS regime as described in Andersons theorem, even less affected by disorder at zero chemical potential (near unitarity), but strongly affected by disorder in the BEC regime, where Anderson's theorem does not apply. This suggests that the superfluid is more robust to the effects of disorder at the interaction parameter where the chemical potential vanishes (close to unitarity). We construct a three dimensional phase diagram of critical temperature, disorder and interaction parameter [1], and show that there are regions of localized superfluidity, as well as insulating regions due to Anderson localization of fermions (BCS regime) and molecular bosons (BEC regime). The phase diagram for higher angular momentum (e.g. p-wave and d-wave) is also analyzed, where the effects of disorder are much more dramatic in the BCS regime in comparison to the s-wave case because pair breaking is strong, while the disorder effects in BEC regime are similar to what occurs in the s-wave case.

[1] Li Han, C. A. R. Sa de Melo, arXiv:0812.xxxx

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