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Evolution from BCS to BEC Superfluidity in Dilute Fermi Gases[1]

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I will review briefly some old results [1,2] of the evolution from BCS to BEC superfluidity in dilute Fermi gases, including critical temperature, order parameter amplitude, chemical potential and time dependent Ginzburg-Landau theory for the s-wave channel in three dimensions. Following this discussion, I will present new results for the BCS to BEC evolution of Fermi gases in the p-wave channel [3]. I will make comparisons between s-wave and p-wave superfluidity and point out the main differences between the two cases. Lastly, I will discuss supefluidity of s-wave and p-wave Fermi gases in a restricted two-dimensional geometry (one dimensional optical lattice), where a Berezinkii-Kosterlitz-Thouless-type transition is proposed as the system evolves from the weak to the strong attraction limit. In this case, I will show that spontaneous vortex-antivortex pairs form and that they can condense into a vortex-antivortex lattice at lower temperatures [4]. [1] C. A. R. Sa de Melo, M. Randeria, and J. R. Engelbrecht, PRL 71, 3202 (1993). [2] J. R. Engelbrecht, M. Randeria, and C. A. R. Sa de Melo, PRB 55, 15153 (1997). [3] M. Iskin, and C. A. R. Sa de Melo, cond-mat/0510300 (2005). [4] S. S. Botelho, and C. A. R. Sa de Melo, cond-mat/0509387 (2005).

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