Vortices and the Superfluid Phase Transition in d Dimensions

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The role of vortices in the superfluid phase transition will be discussed for general d dimensions, with d ranging between 2 and 4. A single set of recursions relations gives the results of Kosterlitz and Thouless in $d = 2$, reproduces the vortex-loop renormalization of Williams and Shenoy in $d = 3$, and approaches mean-field results in $d = 4$. Although the derivation of the recursion relations is phenomenological in nature, predictions for universal behavior in the scale dependence of the superfluid density near 4 - ϵ dimensions should be possible to test with perturbative RG calculations. Comparison to experimental results will be discussed, including thermodynamic properties such as the specific heat, and the dynamics of the transition. The crossover from $d = 2$ to $d = 3$ in helium films adsorbed in porous materials has allowed the first measurements of the vortex core size in submonolayer superfluids.

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