Vortex Loops and the Superfluid Phase Transition

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The role of vortex loops in the superfluid phase transition of liquid helium will be discussed in the talk. After a brief review of the basic properties of liquid helium and of phase transitions, a theory of the superfluid transition using vortex-loop renormalization methods will be outlined. The theory can now be used to calculate many of the thermodynamic properties near the critical temperature, and recent numerical simulations have verified a number of the predictions of the theory. Applications to other physical systems will also be discussed, including high-temperature superconductivity, center vortices and quark confinement, and cosmic strings.