Abstract Submitted
for the MAR06 Meeting of
The American Physical Society

Continuous Phase Transition of the Fully Frustrated 3D XY Model with a Magnetic Field in the [111] Direction[1] KWANGMOO KIM, DAVID STROUD, The Ohio State University — We study the fully frustrated three-dimensional XY model on a simple cubic lattice. This model describes a 3D array of superconducting grains in an applied magnetic field $\mathbf{H} = (\Phi_0/a^2)(1/2, 1/2, 1/2)$. Using standard Metropolis Monte Carlo simulations with periodic boundary conditions, we obtain the internal energy U, the specific heat C_V, and the helicity modulus γ of our system. Our results support the conclusion that our system has a continuous phase transition between two liquid-like phases. Disorder in the low-temperature phase is suggested by the behavior of the vortex density-density correlation function at a very low temperature, $T = 0.01J/k_{\mathrm{B}}$. By contrast, previous results for $\mathbf{H} = (\Phi_0/a^2)(1/3, 1/3, 1/3)$ indicate a first-order phase transition. Mean-field theory suggests a possible explanation for the liquid-like low-temperature phase: there are four degenerate unstable modes at the mean-field transition temperature T_c^{MF}. We also use finite-size scaling and two renormalization group methods to determine the critical exponents α, v, and ν for C_V, γ, and the correlation length ξ. We compare our values of these critical exponents with those for other phase transitions.

[1]This work was supported by NSF Grant DMR04-13395. All calculations were carried out on the P4 Cluster at the Ohio Supercomputer Center.

Kwangmoo Kim
The Ohio State University

Date submitted: 01 Dec 2005 Electronic form version 1.4