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Quantum Monte Carlo Study of a Magnetic-Field-Driven 2D Superconductor-Insulator Transition[1] KWANGMOO KIM, DAVID STROUD, The Ohio State University — Using quantum Monte Carlo calculations of the $(2+1)$D XY model, we study the superconductor-insulator phase transition of a disordered 2D superconducting film vs. the applied magnetic field. The XY coupling is assumed to be $-J\cos(\theta_i - \theta_j - A_{ij})$, where A_{ij} has a standard deviation ΔA_{ij}. The critical coupling constant $K_c = \sqrt{[J/(2U)]_c}$ and the universal conductivity σ^* are found to increase monotonically with ΔA_{ij}. Beyond a certain critical value of ΔA_{ij}, the superfluid density vanishes for all K's, but a renormalized coupling constant g remains finite, suggesting a transition into a Bose glass phase. At a larger value of ΔA_{ij}, the system becomes a Mott insulator. The critical values are found to be $K_c = 0.490 \pm 0.001$ and $\sigma^*/\sigma_Q = 0.324 \pm 0.003$ when $\Delta A_{ij} = 1/2$; $K_c = 0.532 \pm 0.001$ and $\sigma^*/\sigma_Q = 0.494 \pm 0.011$ when $\Delta A_{ij} = 1/\sqrt{2}$; $K_c = 0.585 \pm 0.004$ when $\Delta A_{ij} = 0.854$; and $K_c = 0.630 \pm 0.002$ when $\Delta A_{ij} = \infty$. The last value, which represents a Bose glass to Mott insulator transition, is obtained from g, whereas the others represent a superconductor-to-insulator transition and are obtained from the superfluid density. We conclude that, for certain couplings, a disordered film may undergo a transition from superconductor to Bose glass to insulator with increasing field.

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