Topological Tools for Phase Transitions: Exploring the 2D Ising Model

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Phase transitions are important phenomena where system properties change significantly as external parameters, like temperature, vary. While traditional methods often rely on Hamiltonians to identify critical points, not all systems allow for a clear Hamiltonian definition. This talk presents a topological approach to studying phase transitions, using the 2D Ising model as a case study.

By running Monte Carlo simulations with Metropolis and Wolff updates, I analyze spin configurations at different temperatures. This helps reveal how topological features change near the critical temperature. The goal is to develop a universal framework for detecting phase transitions, even in systems without explicit Hamiltonians.

This work sets the stage for future studies, including applications to higher dimensions or more complex models.