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Phase Transitions in the $J_1 - J_2$ Ising Model on the Square Lattice¹

SONGBO JIN, ARNAB SEN, ANDERS SANDVIK, Boston University — The $J_1 - J_2$ Ising model on the square lattice is one of the simplest classical models to study the effects of competing interactions and the resulting phase transitions. In spite of previous studies, there remains a controversy regarding the nature of the transition into the “stripe” phase in this model for $J_2/J_1 > 0.5$. In this study, we use the Binder cumulant of the order parameter to address this question. We use the Wang-Landau and Metropolis algorithms to simulate the model in the relevant parameter space. From our numerics, we determine that the transition is first-order for $0.5 < J_2/J_1 < g_{tri}$ ($g_{tri} \approx 0.8$) and becomes continuous in nature for larger values of J_2/J_1 . We also discuss the order parameter distribution and correlation lengths at the first-order transition.

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