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Efficient cluster Monte Carlo algorithm for Ising spin glasses in more than two space dimensions ANDREW J. OCHOA, ZHENG ZHU, HELMUT G. KATZGRABER, Texas A&M University — A cluster algorithm that speeds up slow dynamics in simulations of nonplanar Ising spin glasses away from criticality is urgently needed. In theory, the cluster algorithm proposed by Houdayer poses no advantage over local moves in systems with a percolation threshold below 50%, such as cubic lattices. However, we show that the frustration present in Ising spin glasses prevents the growth of system-spanning clusters at temperatures roughly below the characteristic energy scale J of the problem. Adding Houdayer cluster moves to simulations of Ising spin glasses for $T \sim J$ produces a speedup that grows with the system size over conventional local moves. We show results for the nonplanar quasi-two-dimensional Chimera graph of the D-Wave Two quantum annealer, as well as conventional three-dimensional Ising spin glasses, where in both cases the addition of cluster moves speeds up thermalization visibly in the physically-interesting low temperature regime.

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