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The Effects of Parallel Tempering on the Autocorrelation Time in Simulations of the Two-Dimensional Ising Spin Glass JENNIFER E. HOULE, SUSAN R. MCKAY, Department of Physics and Astronomy, University of Maine — The two-dimensional Ising spin glass is a notoriously difficult system to simulate, since the autocorrelation time becomes extremely long as the system approaches zero temperature. [1] Thus, this system is an ideal testing ground for algorithms designed to circumvent the difficulties inherent in simulating a frustrated system with an intricate free energy landscape. In this study, we have applied parallel tempering [2,3] to the bimodal spin glass on a square lattice in two dimensions. Our results show that the autocorrelation time can be substantially shortened through this approach, so the simulations yield realistic system properties in substantially fewer Monte Carlo steps. The algorithmic impact on calculated system properties varies. For example, internal energies computed using conventional and parallel tempering show excellent agreement even at low temperatures, whereas the Edwards-Anderson order parameter is more accurately obtained with parallel tempering. 1. W.L. McMillan, Phys. Rev. B, **28** 5216, 1983. 2. K. Hukushima and K. Nemoto, J. Phys. Soc. Japan, **65** 1604, 1996. 3. H.G. Katzgraber and L.W. Lee, Phys. Rev. B, **71** 134404, 2005.

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