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Pushing the Limits of Monte Carlo Simulations for the 3d Ising Model JIAHAO XU, Center for Simulational Physics, University of Georgia, ALAN FERRENBERG, Information Technology Services, Miami University of Ohio, DAVID LANDAU, Center for Simulational Physics, University of Georgia
— While no analytic solution for the 3d Ising model exists, various numerical methods like series expansion, Monte Carlo and MCRG have provided precise information about the phase transition.[1] Using histogram techniques and quadruple precision Monte Carlo simulation that employs the Wolff cluster flipping algorithm with both 32-bit and 53-bit random number generators, we have investigated the critical behavior of the 3d Ising Model, with lattice sizes ranging from 16^3 to 1024^3. By analyzing data with cross-correlations[2] between various thermodynamic quantities obtained from the same data pool, e.g. logarithmic derivatives of magnetization and derivative of magnetization cumulant,[3] we have obtained the critical inverse temperature $K_c = 0.221\,654\,626(5)$ and the critical exponent of the correlation length $\nu = 0.629\,73(14)$ whose precisions are comparable to those from the latest theoretical predictions.

[1]For an overview of earlier work, see A. Pelissetto and E. Vicari, Phys. Rep. **368**, 549 (2002)
[2]M. Weigel and W. Janke, Phys. Rev. E **81**, 06672 (2010)
[3]A. M. Ferrenberg and D. P. Landau, Phys. Rev. B **44**, 5081 (1991)

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