Application of the parallel multicanonical method to lattice gas condensation

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We present the speedup from a novel parallel implementation of the multicanonical method on the example of lattice gas in two and three dimensions. In this approach, all cores perform independent equilibrium runs with identical weights, collecting their sampled histograms after each iteration in order to estimate consecutive weights. These weights are distributed onto all cores again, repeating the procedure until the weights are converged. This procedure benefits from a minimum of communication while distributing the necessary amount of statistics efficiently. The final time series is obtained from independent simulations with the converged weights.

Using this method allows us to study the temperature dependence for a variety of large and complex systems. In this case, a gas is modeled by particles on the lattice that interact only with their nearest neighbors. For a fixed density this model is equivalent to the Ising model with fixed magnetization. We compare our results to an analytic prediction for equilibrium droplet formation, showing that a single macroscopic droplet forms only above a critical density.