DY 13: Statistical physics III (general)

Time: Tuesday 14:45–15:45 Location: ZEU 255

DY 13.1 Tue 14:45 ZEU 255

Searching phase transitions in lattice triangulations — •Johannes Reinhard and Klaus Mecke — Institut für Theoretische Physik Universität Erlangen-Nürnberg, Staudtstrasse 7, 91058 Erlangen, Germany

The number of unimodular triangulations of the planar grid with size $m \times n$ scales as $\sim e^{s_0 mn}$. This allows the definition of a statistical model of random planar graphs in analogy to the Ising model. Instead of spin configurations on a fixed grid we consider triangulations with random edge lengths and coordination numbers at each grid point. The Hamiltonian of a triangulation includes the sum over all edge lengths and powers of the coordination numbers. We study the geometric and topological properties of this ensemble of lattice triangulations by a Monte-Carlo simulation based on an ergodic edge-flip dynamics. A transition is observed between a disordered and an ordered state of triangulations.

DY 13.2 Tue 15:00 ZEU 255

Ground states of $2d$ $\pm J$ Ising spin glasses via stationary Fokker-Planck sampling — •Oliver Melchert and Alexander K. Hartmann — Institut für Physik, Universität Oldenburg, Carl-von-Ossietzky Strasse 9-11, 26111 Oldenburg, Germany

We investigate the performance of the recently proposed stationary Fokker-Planck sampling method considering a combinatorial optimization problem from statistical physics. The algorithmic procedure relies upon the numerical solution of a linear second order differential equation that depends on a diffusion-like parameter D. We apply it to the problem of finding ground states of $2d$ Ising spin glasses for the $\pm$J$-$Model. We consider square lattices with side length up to $L = 24$ with two different types of boundary conditions and compare the results to those obtained by exact methods. A particular value of D is found that yields an optimal performance of the algorithm. We compare this optimal value of D to a percolation transition, which occurs when studying the connected clusters of spins flipped by the algorithm. Nevertheless, even for moderate lattice sizes, the algorithm has more and more problems to find the exact ground states. This means that the approach, at least in its standard form, seems to be inferior to other approaches like parallel tempering.

DY 13.3 Tue 15:15 ZEU 255

GPU Accelerated Monte Carlo Simulation of the 2D and 3D Ising Model — •Tobias Preis[1,2], Peter Virnau[1], Wolfgang Paul[1], and Johannes J. Schneider[1] — [1]Department of Physics, Mathematics and Computer Science, Johannes Gutenberg University of Mainz - Staudinger Weg 7, D-55099 Mainz, Germany — [2]Artemis Capital Asset Management GmbH - Gartenstr. 14, D-65558 Holzheim, Germany

The compute unified device architecture (CUDA) is a fundamentally new programming approach for performing scientific calculations on a graphics processing unit (GPU) as a data-parallel computing device. The programming interface allows to implement algorithms using extensions to standard C language. First, we apply this new technology to Monte Carlo simulations of the two dimensional ferromagnetic square lattice Ising model. By implementing a variant of the checkerboard algorithm, results are obtained up to 60 times faster on the GPU than on a current CPU core. An implementation of the three dimensional ferromagnetic cubic lattice Ising model on a GPU is able to generate results up to 35 times faster than on a current CPU core. As proof of concept we calculate the critical temperature of the 2D and 3D Ising model using finite size scaling techniques. Theoretical results for the 2D Ising model and previous simulation results for the 3D Ising model can be reproduced.

DY 13.4 Tue 15:30 ZEU 255

Phase space description of spin dynamics — William Coffey[1], Yuri Kalmykov[2], •Bernard Mulligan[3], and Serguey Titov[4] — [1]Trinity College, Dublin, Ireland — [2]Université de Perpignan, France — [3]Max Planck Institute for the Physics of Complex Systems, Dresden — [4]Russian Academy of Sciences, Russia

The spin system with Hamiltonian $\hat{H}_S = -\xi \hat{S}_Z - \sigma \hat{S}_Z^2$ (ξ and σ are external and internal field parameters) is treated as an example of the phase space description of spin dynamics using a master equation for the quasiprobability distribution function of spin orientations in the representation (phase) space of the polar angles (analogous to the Wigner phase space distribution for translational motion). The master equation yields (via the Wigner-Stratonovich transformation of the density matrix) the solution as a Fourier series in the spherical harmonics with Fourier coefficients given by the statistical moments in a manner analogous to the classical distribution. The relaxation time of the longitudinal component of the spin can be estimated using a quantum generalization of the classical integral relaxation time via the stationary distribution and diffusion coefficient of the master equation.