Computational Manybody Physics

Suggested Projects

- Classical Monte Carlo
    1. Kinetic Monte Carlo: A. B. Bortz and M. H. Kalos and J. L. Lebowitz, "A new algorithm for Monte Carlo simulation of Ising spin systems", Journal of Computational Physics **17**, 10 (1975)
    2. Wang-Landau Algorithm: Fugao Wang and D. P. Landau, "Efficient, Multiple-Range Random Walk Algorithm to Calculate the Density of States", Phys. Rev. Lett. **86**, 2050 (2001)
    3. Parallel tempering algorithm: David J. Earl and Michael W. Deem (2005) "Parallel tempering: Theory, applications, and new perspectives", Phys. Chem. Chem. Phys., 7, 3910 (2005).
    4. Multicanonical Monte Carlo: Bernd A. Berg and Thomas Neuhaus , "Multicanonical ensemble: A new approach to simulate first-order phase transitions", Phys. Rev. Lett. **68**, 9 (1992); B. A Berg, "Introduction to multicanonical Monte Carlo", arXiv: cond-mat/9909236
- Exact Diagonalization
    1. Dynamical Correlation Functions
    2. Finite Temperature Lanczos Method
- DMRG
    1. Transfer-Matrix DMRG: Stefan Glocke, Andreas Klümper, and Jesko Sirker, "The density-matrix renormalization group applied to transfer matrices: Static and dynamical properties of one-dimensional quantum systems at finite temperature", arXiv: cond-mat/0610689, Lecture Notes in Physics, Vol. 739: Computational Many-Particle Physics (Springer, Berlin, 2008)
    2. Finite Temperature DMRG
    3. Time-dependent DMRG
- Quantum Monte Carlo
    1. Parallel tempering SSE: R.G. Melko, "Simulations of quantum XXZ models on two-dimensional frustrated lattices", J. Phys. Condens. Matter **19**, 145203 (2007).
    2. Stochastic cluster series expansion: Kim Louis and C. Gros , "Stochastic cluster series expansion for quantum spin systems", Phys. Rev. B **70**, 100410(R) (2004).
    3. Hybrid Monte Carlo
    4. Variational Monte Carlo

5. Auxiliary field Monte Carlo
6. Directed loop algorithm in SSE
7. Worm Algorithm
8. Determinant Monte Carlo
9. Diffusion Monte Carlo