PHYSICS 250 QUANTUM MONTE CARLO FALL 1999

Assignment One

Due Wednesday, October 13.

[1.] Write a program which computes the exact partition function and energy expectation value of a system with 3 discrete energy levels. (Note: If you feel sufficiently confident, write your program to do an arbitrary number of levels which the user can input. Likewise, do the same for problem 2).

[2.] Write a Monte Carlo program which computes the energy expectation value for the same system as problem one stochastically. Make a plot of E(T) versus temperature T which has the exact result as a solid curve and monte carlo results at some appropriate set of temperatures to show the code is working. Do your runs for levels $E_1 = 2, E_2 = 3, E_3 = 7$.

[3.] Briefly interpret your results physically.

Assignment Two

Due Wednesday, October 20.

[1.] Modify your monte carlo program from the previous assignment to compute the specific heat by the "fluctuation method". Likewise, compute the specific heat exactly.

[2.] Compare the exact and monte carlo values for the specific heat for the three level system in Assignment 1 at the temperature T = 3. Try running your monte carlo code at T = 2.95 and T = 3.05 and getting the specific heat by a finite difference of the energy. Does it work?

[3.] Write a monte carlo program to compute the first four moments of x for the Energy $E(x) = \frac{1}{2}kx^2 + \frac{1}{4}ax^4$. Check against the analytic results for a = 0. Can you think of any checks to do for $a \neq 0$?