Computational Manybody Physics

Problem Set #4

1. Use the exact diagonalization to a J_1-J_2 chain

$$H = J_1 \sum_i \mathbf{S}_i \cdot \mathbf{S}_{i+1} + J_2 \sum_i \mathbf{S}_i \cdot \mathbf{S}_{i+2} \tag{1}$$

   (a) Compute the ground state energy for $N = 32$ as a function of $g = J_2/J_1$.

   (b) Plot the spin and dimer correlations defined as

$$D(r) = \langle B_i B_{i+r} \rangle = \langle (\mathbf{S}_i \cdot \mathbf{S}_{i+1})(\mathbf{S}_{i+r} \cdot \mathbf{S}_{i+1+r}) \rangle. \tag{2}$$

   at three different coupling ratios $g = 0, g_c \approx 0.2411, 0.4$.