<u>Homework for July 31</u>

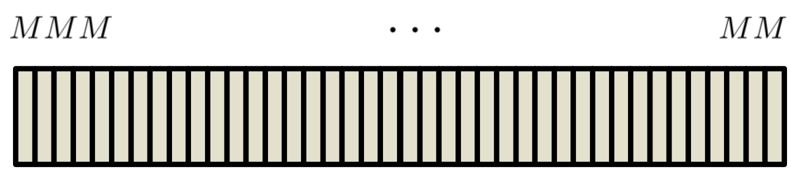
Consider the system of two-component fermions with zero-range attractive interactions.

$$M =: \exp\left[-H_{\text{free}}\alpha_t - C\alpha_t \sum_{n_x} \rho_{\uparrow}(n_x)\rho_{\downarrow}(n_x)\right]:$$

$$H_{\text{free}} = H_{\text{free}}^{\uparrow} + H_{\text{free}}^{\downarrow} =$$

$$= -\frac{1}{2m} \sum_{n_x, i=\uparrow,\downarrow} a_i^{\dagger}(n_x)\left[a_i(n_x+1) - 2a_i(n_x) + a_i(n_x-1)\right]$$

We consider one up spin and one down spin. Take the size of the periodic box to be $L = 6$ and choose $L_t = 50$. Do an exact (i.e., not Monte Carlo) calculation of the amplitude

$Z(L_t) = \langle \psi_{\text{init}} |$  $| \psi_{\text{init}} \rangle$

for the initial state with one up spin and down spin, each with zero momentum in the periodic box. For the parameters take

$$C = -0.200,\ m = 938.92\ \text{MeV},\ a = a_t = (100\ \text{MeV})^{-1}$$

Use the ratio of amplitudes with L_t and $L_t - 1$ time steps to determine an estimate for the energy using the relation

$$e^{-E(L_t)\alpha_t} = Z(L_t)/Z(L_t - 1)$$