# Off diagonal long range order (ODLRO) of composite bosons, formed by two fermions with repulsive behavior

This repository is found at https://github.com/dsmic/ODLROofRepulsiveFermions

This python script uses torchquad to do Monte Carlo integrations on multiparticle wave functions of bosons, formed by two fermions with repulsive behavior. This is a very basic approach and any comments in the issues are appreciated.

We use a simple two particle wave function with "repulsion" for the two different particles a and b

$$\phi_c(a,b) = 1 - e^{-(a-b)^2}$$

From this we define a multiparticle wave function

$$\phi((a_1,a_2,...,a_n),(b_1,b_2,...,b_n)) = \prod_{i=1}^{n} \phi_c(a_i,b_i)$$

This wave function has to symmetrized with respect to the particles a and b

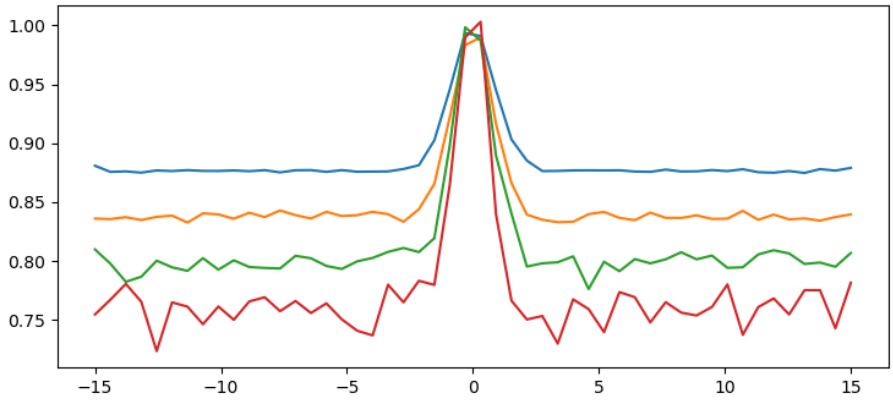
$$\phi_s((a_1,a_2,...,a_n),(b_1,b_2,...,b_n)) = \sum_{i,j} s(P_i(a)) \cdot s(P_j(b)) \cdot \phi(P_i(a),P_i(b))$$

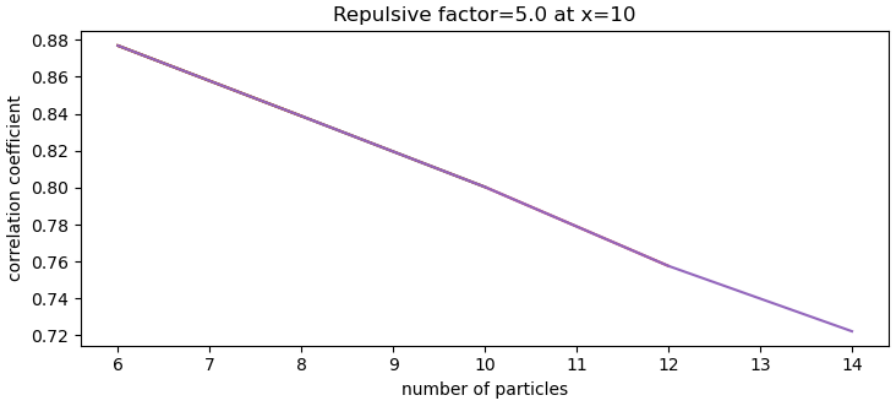
with $P_i(a)$ and $P_j(b)$ being the permutations of the particles a and b and $s(P)$ being the signatures of the permutation with values 1 and -1.

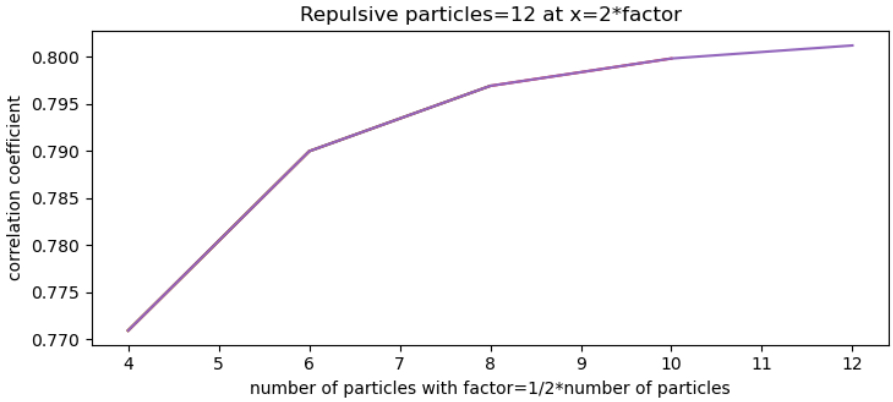
The wave function is used with periodic boundary conditions $-\pi$ to $\pi$ multiplied with "factor".

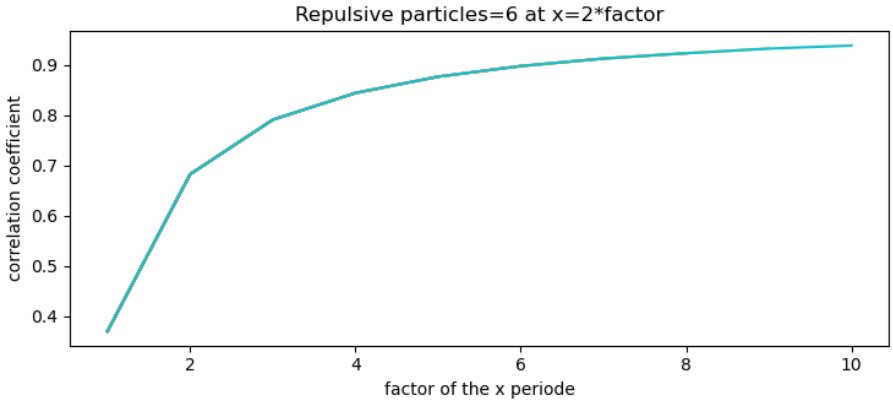
We analyse the off diagonal correlation function

$$g_2(x) = \frac{\rho_{ab}(0,0;x,x)}{\sqrt{\rho_{ab}(0,0;0,0)\rho_{ab}(x,x;x,x)}}$$






This looks like these systems show off diagonal long range order (ODLRO). It seems even possible to add momentum to the $\phi_c$ wave function without harming ODLRO.

References:

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