1 Benchamrk week 5

Context: 30×15 SC with open boundary conditons.

We have a phase gradient of 117°. Starting from $\pi/2$. $T = 10^{-3}K$ and we iterrate until a relative change in both the real and imaginary part of Δ reach 0.001%.

The way matlab deals with the eigenvectors and eigenvalues seams strange. So if we take χ_n along with E_n like the theory does, the algorithm dosnt converge for:

1. Real guess of Δ and all parameters are free

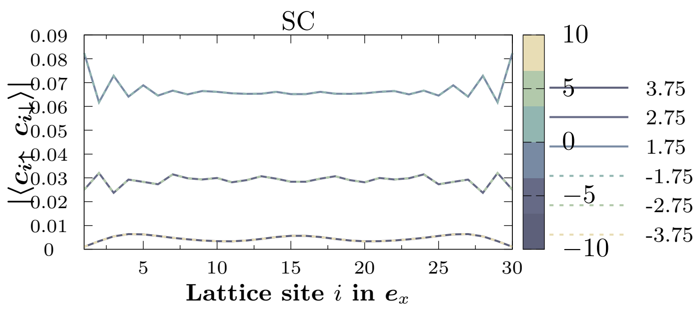

Figure 1

From this we can read the following parameters: $\mu = \pm 1.75 -> 0.0651$, $\mu = \pm 2.75 -> 0.02836$, $\mu = \pm 3.75 -> 0.00568$.
Using a longer SC of 45 sites. We can even preciser:

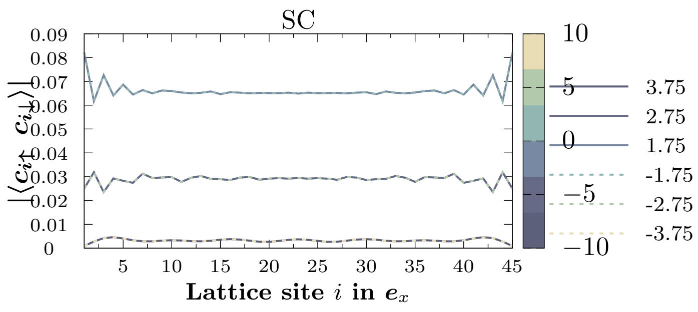

Figure 2

From this we can read the following parameters: $\mu = \pm 1.75 -> 0.0650$, $\mu = \pm 2.75 -> 0.02937$, $\mu = \pm 3.75 -> 0.003723$.
Until now everything works as expected :) so we can stick with the model of SC30 which is faster to compute.

2. Fixed norm of Δ on the side according to 1.

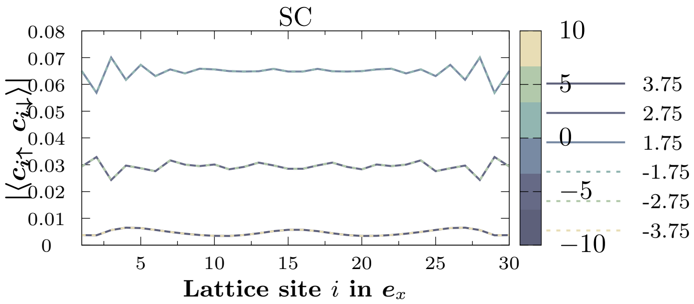

Figure 3

3.Fixed $|\Delta_0|$ and a phase of $\pi/3$ on the sides.

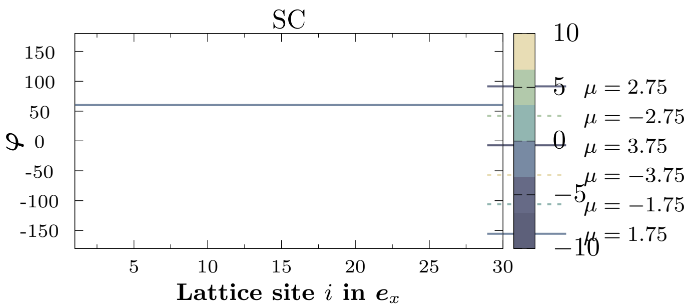

Figure 4

4.Fixed phase of $\pi/3$ on the sides left and a gradient of 117°.

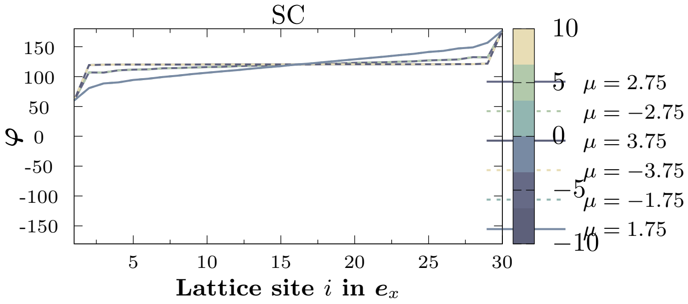

Figure 5: Using a start of $\pi/3$ on the sides and a gradient of 117deg.

And with a different starting phase:

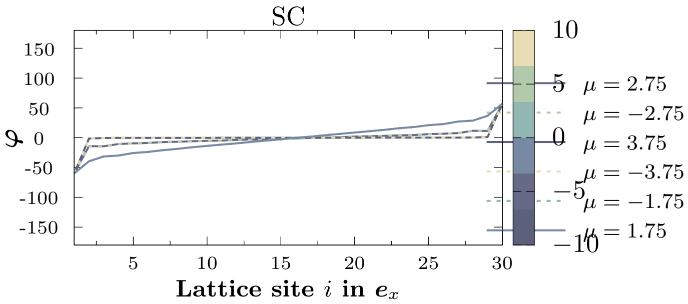

Figure 6: Using a start of $\pi/3$ on the sides and a gradient of 117deg.

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5. Phase start independance of the gradient.

The current is independant of the phase, lets for instance take $\mu = -2.75$:

[1]./generateGraph.ps1 -GnuScript "gpScripts/Currents/Currents_long_SC_NoBC.gp" -SimulationPath "./SC30/NotFourier/FixedLinearPhaseGradient/Phase117deg/diffMU" -LatexPath "/SC30/NotFourier/MeanLine_Phase/FixedLinearPhaseGradient/Phase117deg/allMU/starting_-1.0472/";

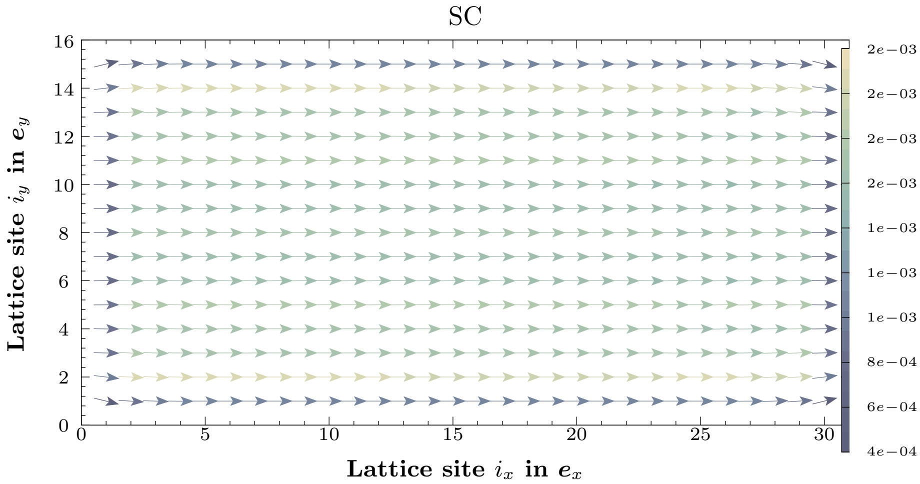

Figure 7: $\mu = -2.75$, using a start of $\pi/3$ on the sides and a gradient of 117deg.

And with a different starting phase:

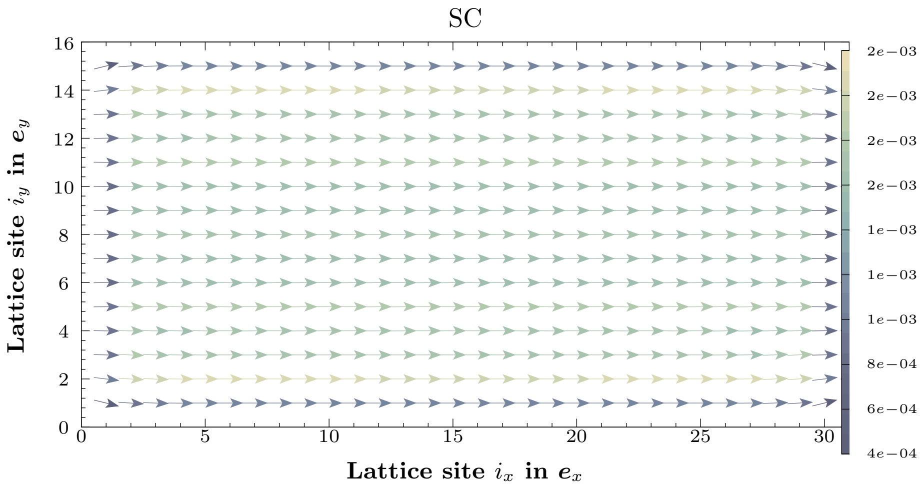

Figure 8: $\mu = -2.75$, using a start of $-\pi/3$ on the sides and a gradient of 117deg.

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As well as the continuity maps:

[2] ./generateGraph.ps1 -GnuScript "gpScripts/Currents/Currents_long_SC_NoBC.gp" -SimulationPath "/SC30/NotFourier/FixedLinearPhaseGradient/Phase117deg/diffMU/-2.75/Starting_at/-1.0472" -LatexPath "/SC30/NotFourier/Currents/FixedLinearPhaseGradient/Phase117deg/mu-2.75/starting_-1.0472/";

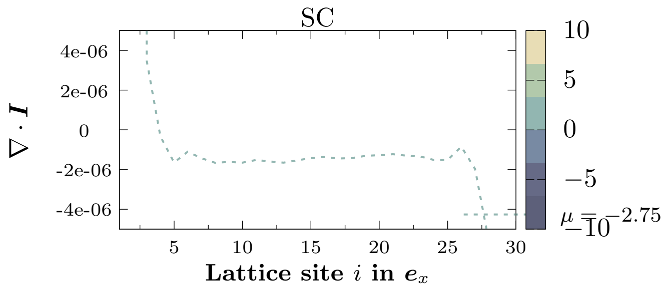

Figure 9: $\mu = -2.75$, using a start of $\pi/3$ on the sides and a gradient of 117deg.

And with a different starting phase:

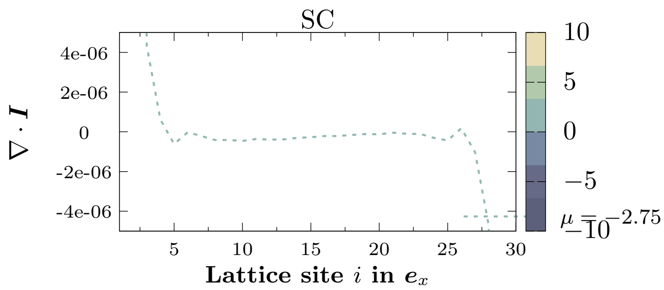

Figure 10: $\mu = -2.75$, using a start of $-\pi/3$ on the sides and a gradient of 117deg.

[3] As we see the current conservation ∇I is three to four order of magnitude lower than the current itself. On the sides we have some huge drop. Recalling the fact that the current should be directly proportional to the phase gradient, having this sudden phase change on the sides resuts in drop of current which is then not conserved anymore. The way we look at the gradient in a discrete way is $\nabla f_i = (f_{i+1} - f_{i-1})/2a$. Here we setted a to one and we ommited the factor $\frac{1}{2}$. This means the plots represent $2\nabla f_i$. This explains why the current conservation ∇I has an opposite sign on each side of the lattice when we look at the current flow's direction. For exemple on the left we have $f_{i+1} > f_{i-1}$ so $\nabla f_i > 0$.

[3] ./generateGraph.ps1 -GnuScript "gpScripts/MeanLine/MeanLine_continuity_long_SC.gp" -SimulationPath "/SC30/NotFourier/FixedLinearPhaseGradient/Phase117deg/diffMU/-2.75/Starting_at/-1.0472" -LatexPath "/SC30/NotFourier/Continuity/FixedLinearPhaseGradient/Phase117deg/mu-2.75/starting_-1.0472/";