1 Benchamrk week 6

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%.

1. Real guess of Δ and all parameters are free

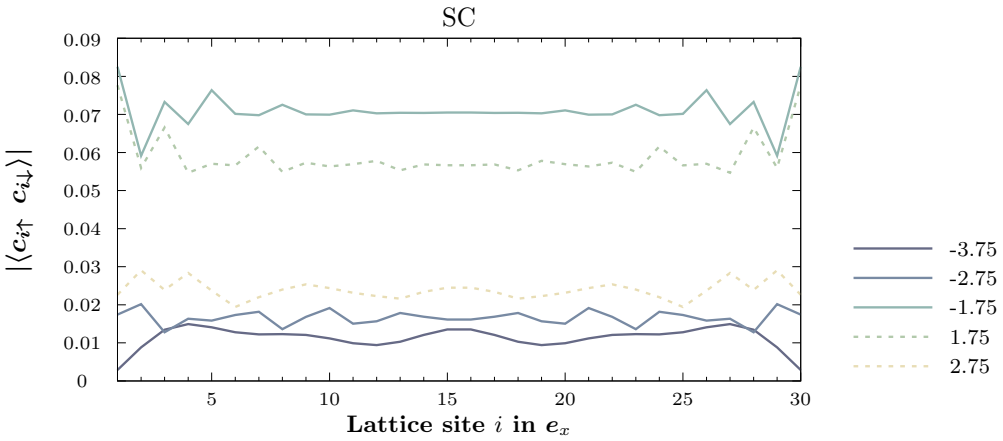

Figure 1

Here we can first denote unsymetric behaviour regardung the sign of μ. The value for the negative mu beeing higher than for their positive counterpart, we deduct that the Van Hove singularity has shifted towards the negative energies. Second the highest value where the algorithm doesn't converge towards zero is approx. 3.72 and the lowest is approx. -3.9, instead of the expected 4 and -4. So the density of state scales down on the energies and shifts itself to lower energies. From this we can read the following parameters

μ	-3.75	-2.75	-1.75	1.75	2.75	3.75
$\lvert\langle c_{i\uparrow}c_{i\downarrow}\rangle\rvert_0$	0.01	0.018	0.07	0.058	0.025	diarded

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

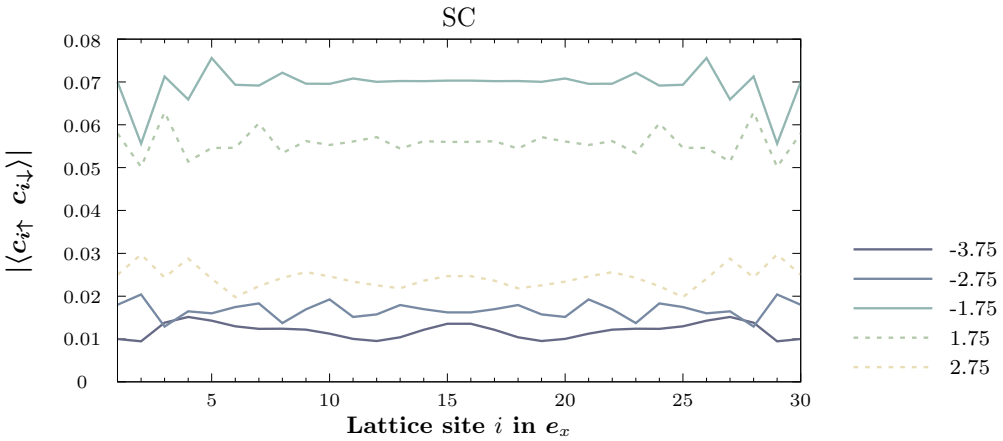

Figure 2

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

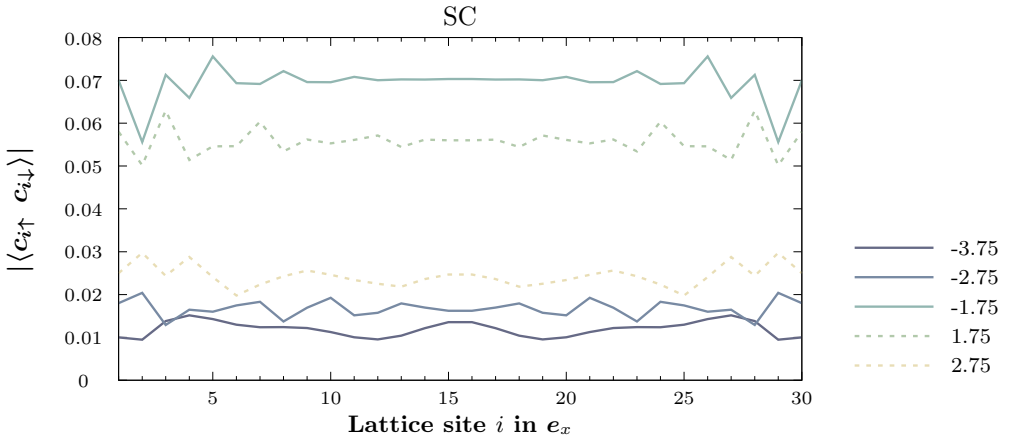

Figure 3

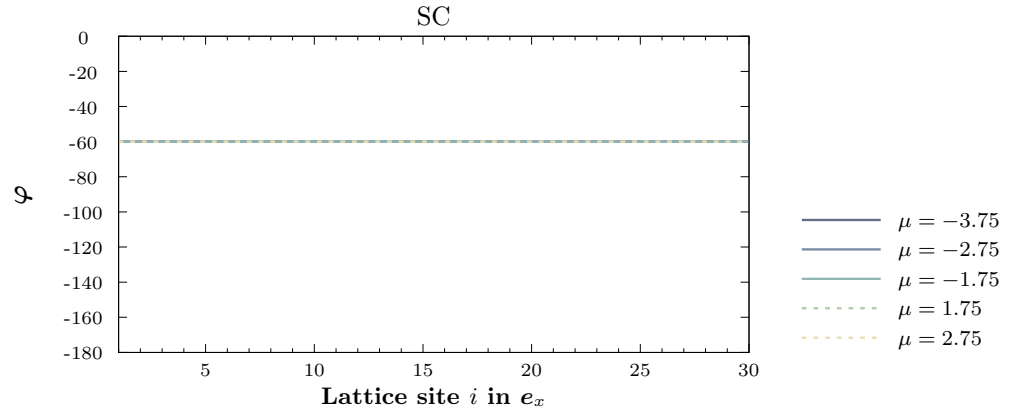

Figure 4

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

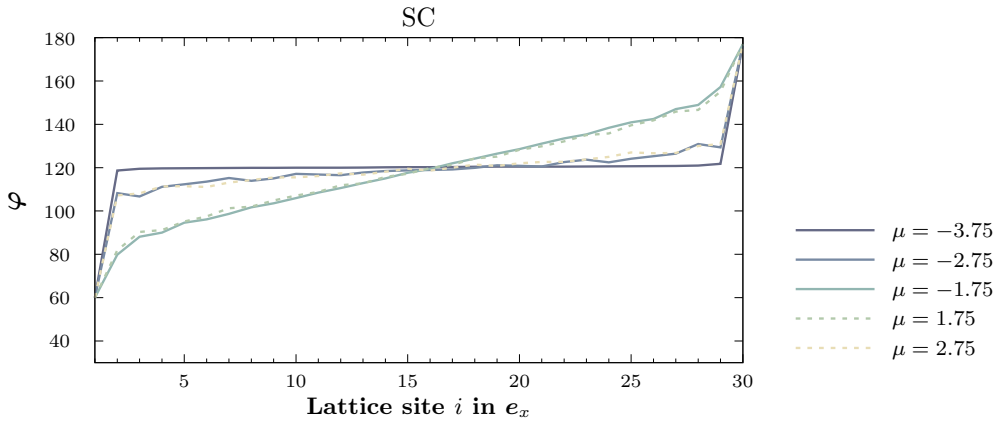

Figure 5: Using a start of $\pi/3$ on the sides and a gradient of 117deg.

And with a different starting phase:

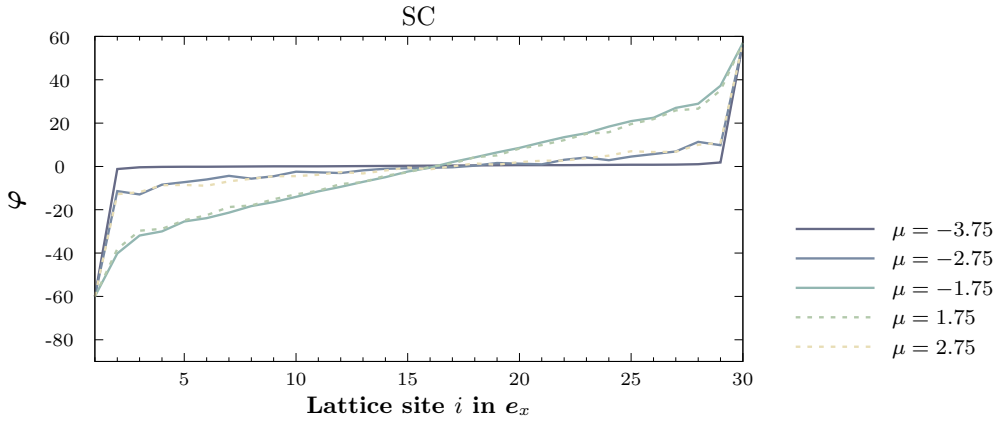

Figure 6: Using a start of $-\pi/3$ on the sides and a gradient of 117deg.

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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/";

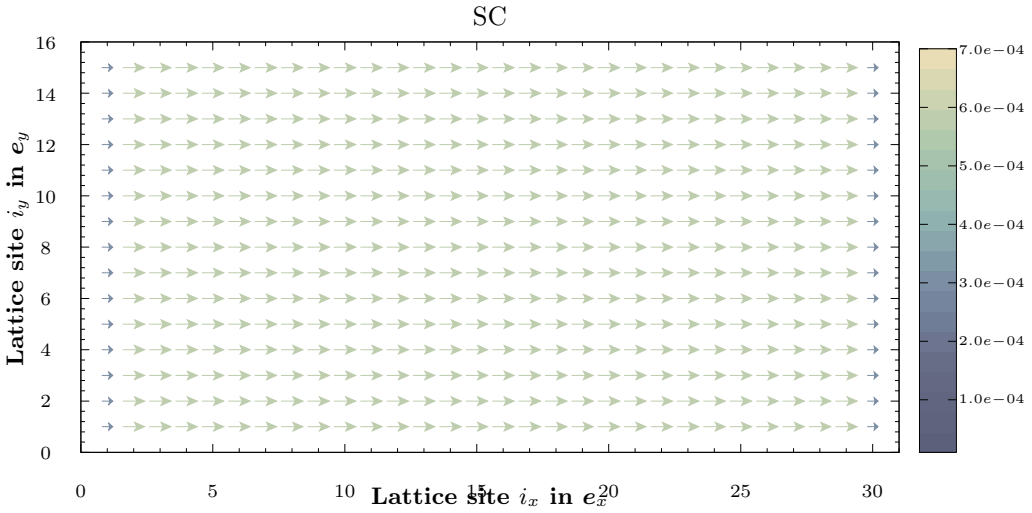

Figure 7: $\mu = -2.75$, using a start of $\pi/3$ on the sides and a gradient of 117deg.

And with a different starting phase:

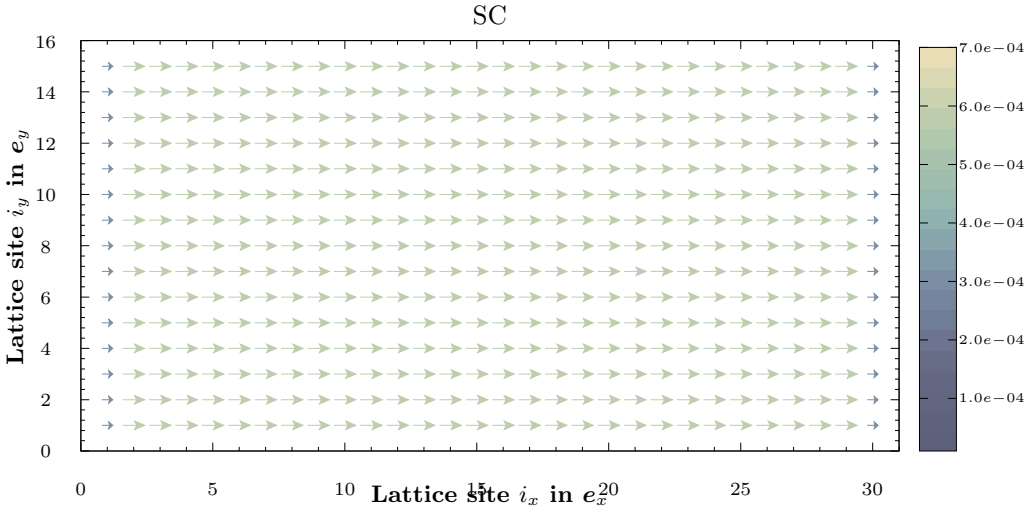

Figure 8: $\mu = -2.75$, using a start of $-\pi/3$ on the sides and a gradient of 117deg.

[2]

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/";

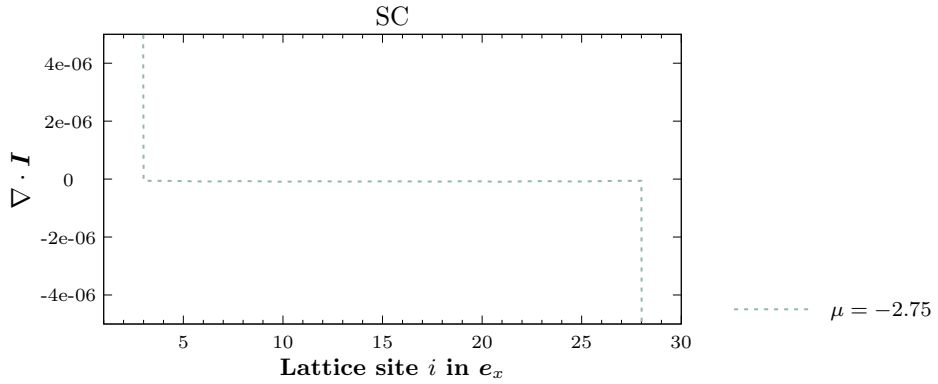

Figure 9: $\mu = -2.75$, using a start of $\pi/3$ on the sides and a gradient of 117deg.

And with a different starting phase:

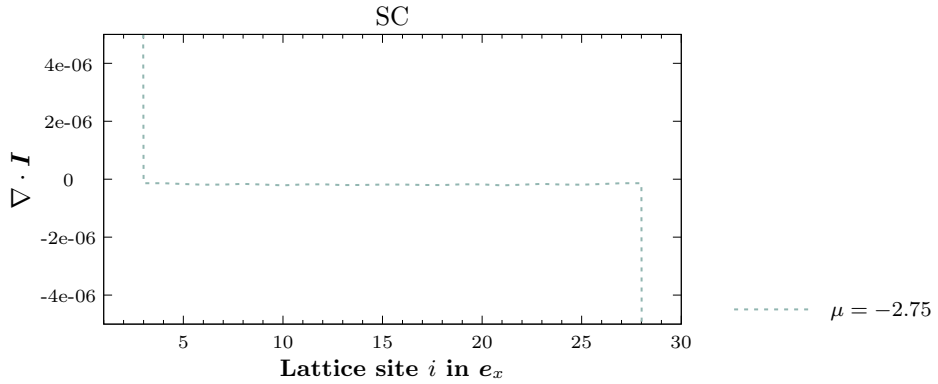

Figure 10: $\mu = -2.75$, using a start of $-\pi/3$ on the sides and a gradient of 117deg.

[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/";