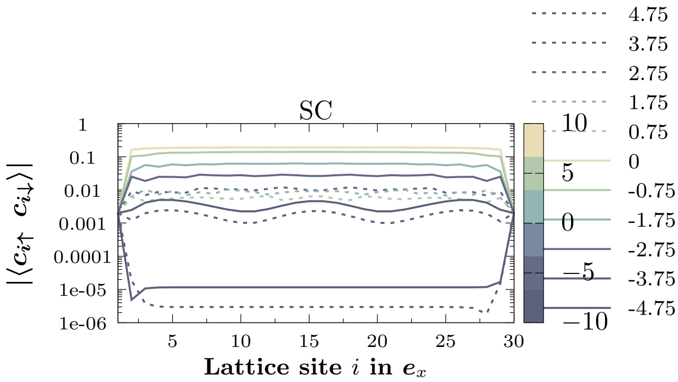
1 Benchmark

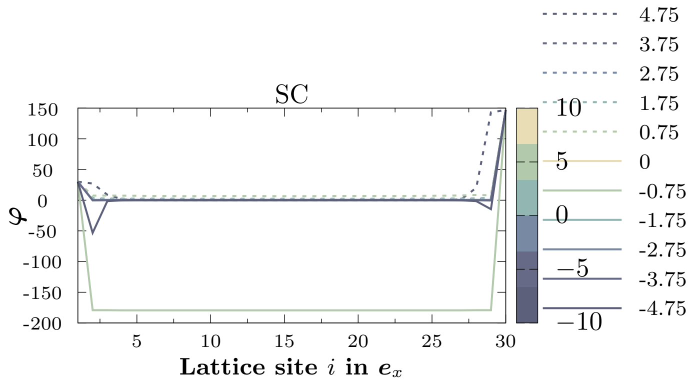
1.1 SC30

1.1.1 Length and arguement for different μ

Zero Phase ..



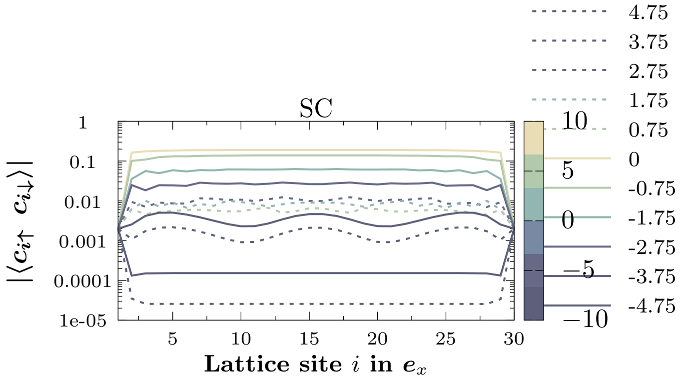
(a) Meanline. Surrounded with vaccuum for different mu. Zero Phase $\varphi = 117\,\text{deg}$



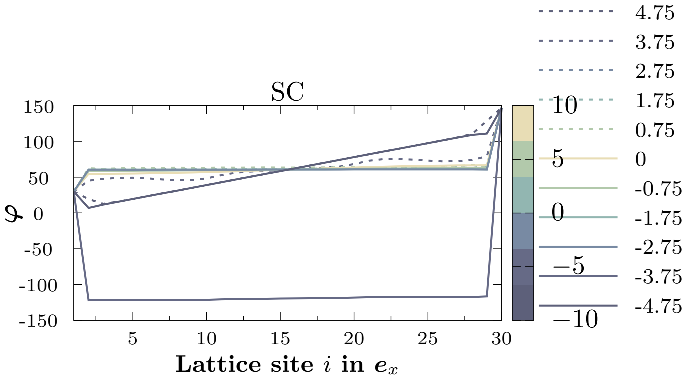
(b) Meanline of the phase. Surrounded with vaccuum for different mu. Zero Phase $\varphi = 117\,\text{deg}$

Figure 1: Using a model where the phase is set to **zero erverywhere but right and left side** on the start.

Linear Gradient ..



(a) Meanline. Surrounded with vaccuum for different mu. Phase Gradient $\varphi = 117\,\mathrm{deg}$



(b) Meanline of the phase. Surrounded with vaccuum for different mu. Phase Gradient $\varphi = 117\,\mathrm{deg}$

Figure 2: Using a model where the phase is set to be a **gradient from left to the right side** on the start.

The ability of the system to form Cooper pairs is heigher when the chemical potential approaches zero and reach a minimum whene $|\mu|$ get far from zero. According to `https://abhirup-m.github.io/assets/pdfs/tbm.pdf` when μ is positive, we fill up the band. We are going to stay with a filled band This $|\mu|$-dependence can be understood as follow. When the band is not filled $\mu < -4$ we have no electron to fill cooper pairs. When $\mu > 4$ there is no degree of freedom left for the electrons to move around (metal become an insulator) and we can't form Cooper pairs.
What we also see is that at the same $|\mu|$, the negative mu gives significantly more Cooper pairs than the positive one. A reason for it could be that the Fermi surface is smaller in the first case than the second one.

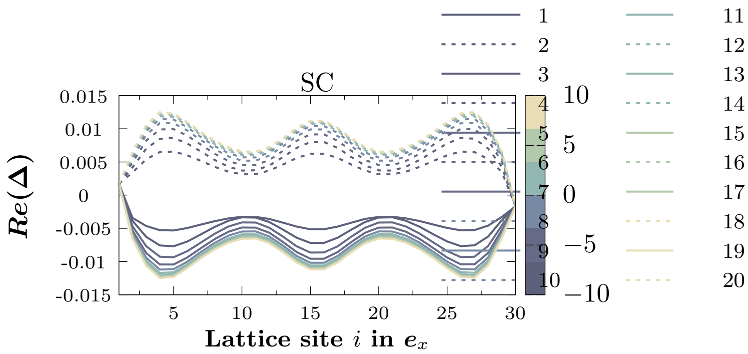
As we are going to see the $\mu = -3.75$ is not converging. The results alternates between its positive and negative value in the real part. This means the phase drop we have isn't realy a result, depending on when we stop, we get -120 or $-120 + 180 = 60$ which lays among the other curves.
We have $\pi/6$ on the left, then 0 then $\pi/6 + 117$ on the right. In the Zero phase, we have a drop to zero and then a jump to $\pi/6 + 117$.
Here we setup a linear gradient from $\pi/6$ to $\pi/6 + 117$. The phase has a plateau in the middle

and then jumps at the end. The heigher the $|\mu|$, the more the gradient is observable.

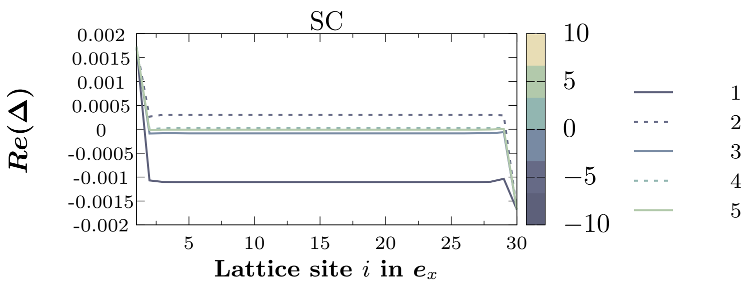
1.1.2 Convergence of the meanline

This section shows how the meanline converges for different μ and different phase setup. The key point is to see that $\mu = -3.75$ doesn't and then oscillates arround the same value. The more step, the closer the absolute value of the oscillation will be to end one. We also see the influence of the phase gradient oand the zero phase.

Zero Phase ..

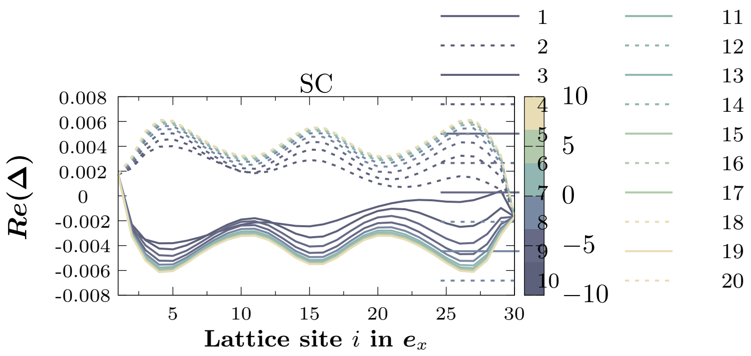


(a) Meanlines of $\mu = -3.75$ not converging. Surrounded with vaccuum for different mu. Zero Phase $\varphi = 117\,\mathrm{deg}$ over 20 iterations.

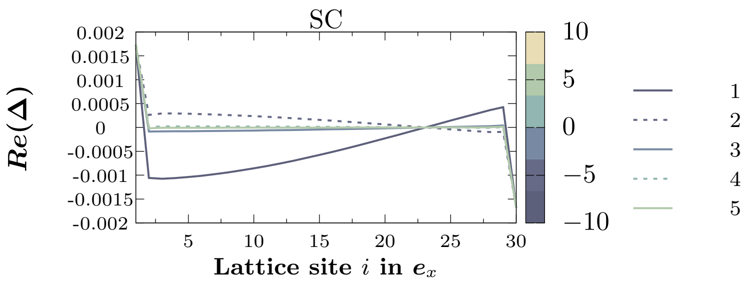


(b) Meanlines of $\mu = -4.75$ converging. Surrounded with vaccuum for different mu. Zero Phase $\varphi = 117\,\mathrm{deg}$ over 5 iterations.

Linear Gradient ..



(a) Meanlines of $\mu = -3.75$ not converging. Surrounded with vaccuum for different mu. LinearGradient Phase $\varphi = 117\,\text{deg}$ over 20 iterations.



(b) Meanlines of $\mu = -4.75$ not converging. Surrounded with vaccuum for different mu. LinearGradient Phase $\varphi = 117\,\text{deg}$ over 5 iterations.