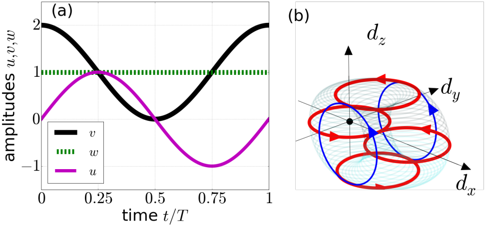
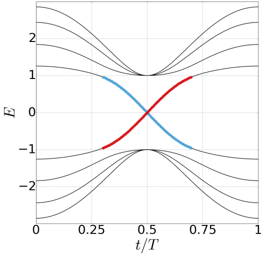
The figures represent the $\bar{v} = 1$ case of the pump sequence defined by

$$
\begin{aligned}
u(t) &= \sin(2\pi t/T), \\
v(t) &= \bar{v} + \cos(2\pi t/T), \\
w(t) &= 1,
\end{aligned}
$$



in Rice-Mele model with N=4 unit cells.

Do you expect to see any qualitative difference in the energy-vs-time graph, if $\bar{v} = 1$ is changed to $\bar{v} = 1.5$?

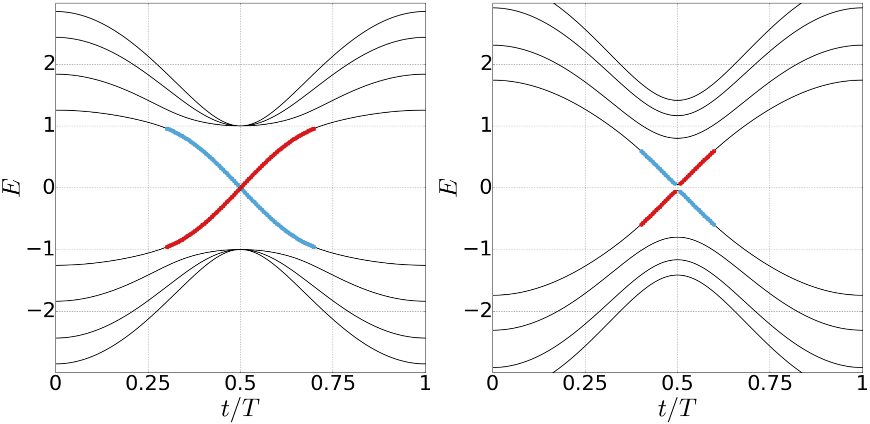


a) No

b) Yes: bulk states become degenerate

c) Yes: all degeneracies are lifted at t=0.5 T

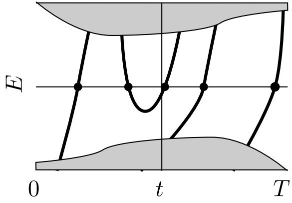
d) Yes: two edge states appear on both edges



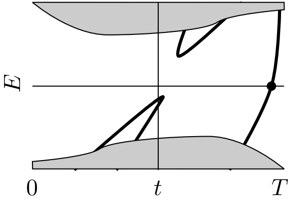
$\bar{v} = 1$ $\bar{v} = 1.5$

Which of these can be a plot of states at a single edge?

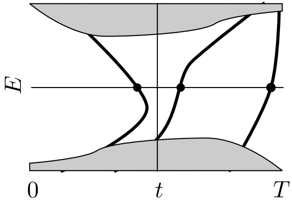
a)



b)

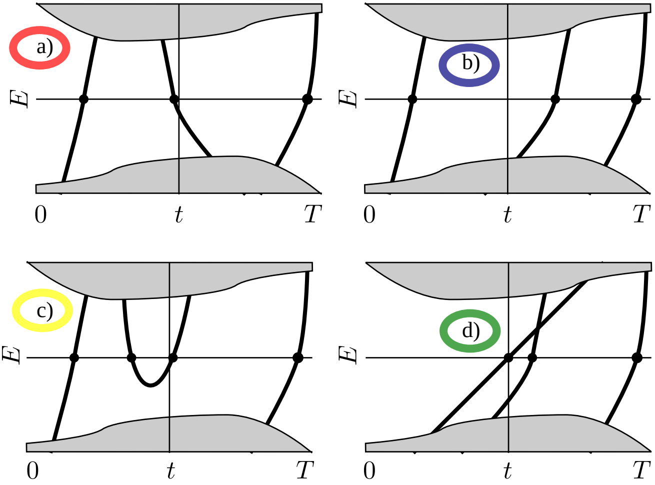


c)



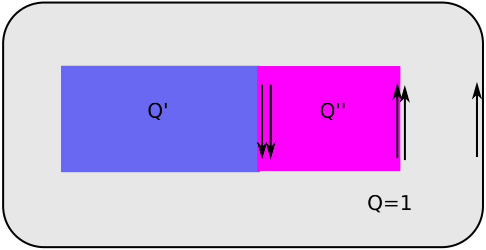
d) None of the above

Which of these can be a plot of states at a single edge of an insulator with Chern number 2?



We marked topologically protected edgestates at three edges.
There could be more on the edges that are not marked.

What is the Chern number Q' of the blue region?



a) Q'=0

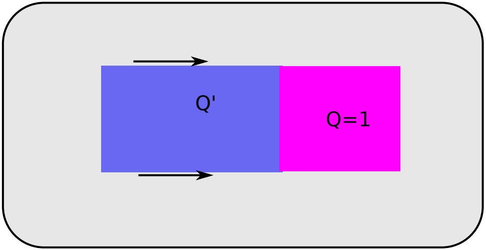
b) Q'=1

c) There can not be such a configuration

d) Q' is indetermined (not enough information)

We marked topologically protected edge states at three edges. There could be more on the edges that are not marked.

What is the Chern number Q' of the blue region?



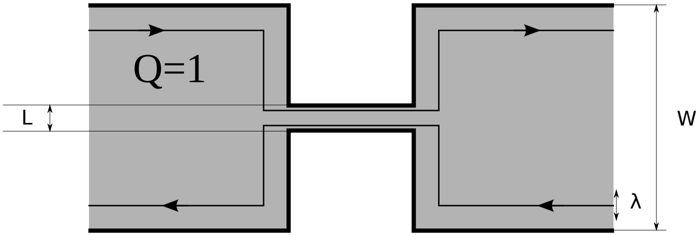
a) Q'=0

b) Q'=1

c) There can not be such a configuration

d) Q' is indetermined (not enough information)

Under what condition do you expect that an electron arriving in an edge state will be perfectly transmitted through this constriction?
λ is the penetration depth of edge states towards the bulk.



a) $W \gg L$ and $W \gg \lambda$

b) Chern number is nonzero $\Longrightarrow$ edge states are protected independent of the shape of the system.

c) $W \gg L$ and $L \gg \lambda$

d) $W \gg \lambda$

The QWZ model has spin dependent hopping amplitudes:

$$H_{QWZ} = u\sigma_z + \sin k_x \sigma_x + \sin k_y \sigma_y + (\cos k_x + \cos k_y)\sigma_z$$

Consider a simplified model:

$$H = u\sigma_z + \sin k_x \sigma_x + \sin k_y \sigma_y + v(\cos k_x + \cos k_y)\sigma_0$$

Which parameter tunes the Chern number of the simplified system?
Assume the system to be an insulator.

a) v

b) u

c) This model cannot be an insulator

d) The Chern number must always be 0

Modify the QWZ model: change hopping along x to next nearest neighbor hopping.
How does this change the number of edge states along x=N_x and along y=N_y?
The number of edge states...

$$H = (u + \cos 2k_x + \cos k_y)\sigma_z + \sin 2k_x \sigma_x + \sin k_y \sigma_y$$

a) ... along x does not change but their velocity does.
$\Longrightarrow$ N_y is also unchanged.

b) ... along y doubles
$\Longrightarrow$ N_x also doubles.

c) ... increases along x, but N_y is unchanged.

d) ... doubles along y, but N_x is unchanged.

We fold a lattice model with a Chern number of +1 to the shape of a Moebius strip. The edge states on two opposite edges...

A) Propagate in the same direction

B) Propagate in the opposite direction

C) Direction of propagation depends on position along the edge

D) Do not exist any more (are gapped out)