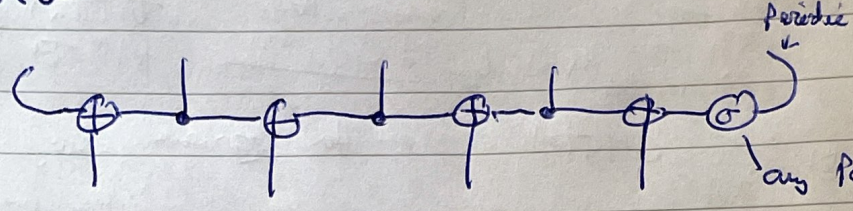
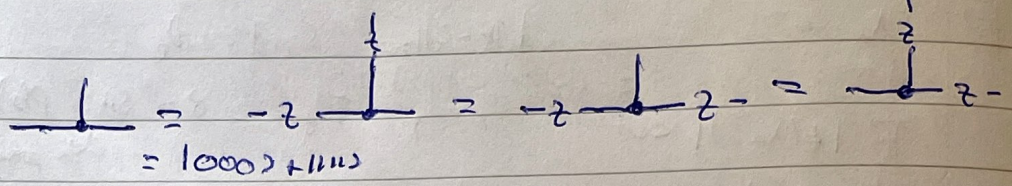
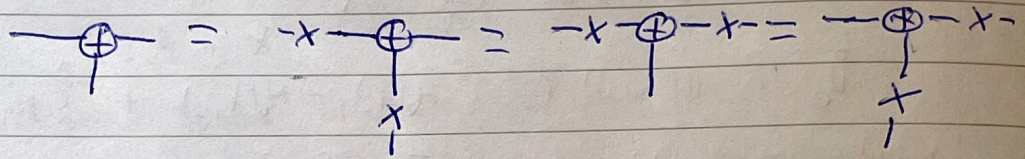
KW

MPO identifier. →

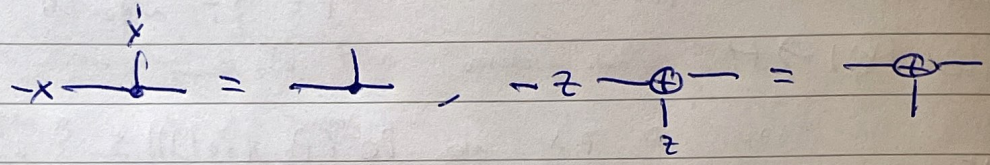


where

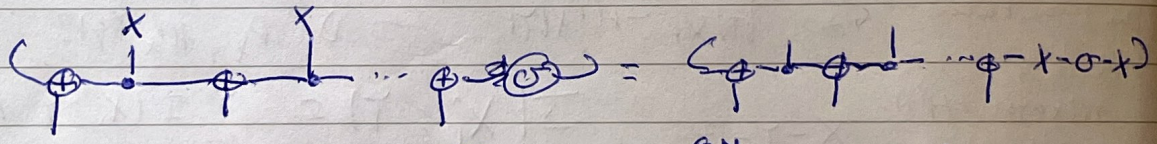




also

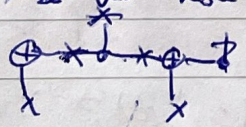


can see by these rules that



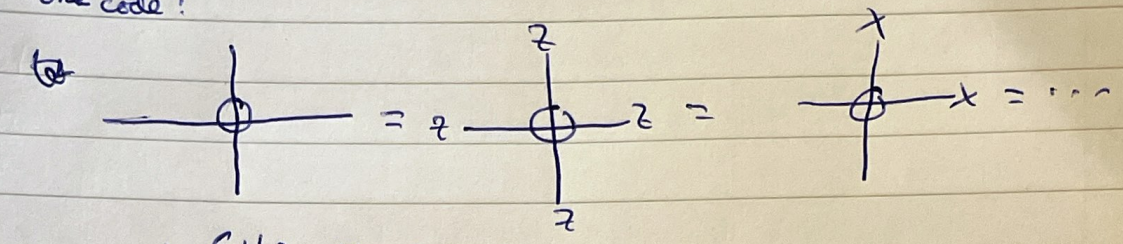
(is symmetric above & $X^{\otimes N}$, below is $Z^{\otimes N}$ (if $\sigma = I$)

also, see that single X on top pulls through to two adjacent X on bottom:

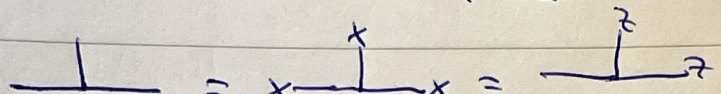


similarly two adjacent Z on top pull through to single Z on bottom.

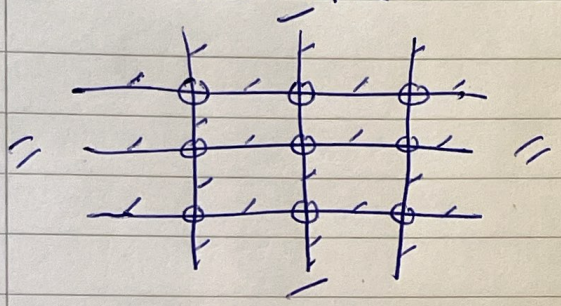
Toric code:

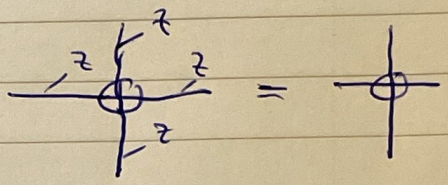


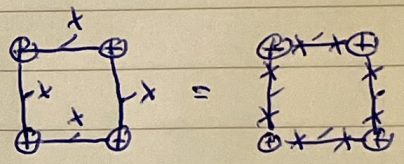
is GHZ state in X basis.



is GHZ state in Z basis.

Toric code state: $|\psi\rangle =$  identify // and /.

have 

and 

So $\bigotimes_{i\in v} Z_i |\psi\rangle = |\psi\rangle$ for vertex v

and $\bigotimes_{i\in p} X |\psi\rangle = |\psi\rangle$ for plaquette p.

$|\psi\rangle$ is PEPS with bond dimension 2.

So Hamiltonian is $H = -\sum_v \bigotimes_{i\in v} Z_i - \sum_p \bigotimes_{i\in p} X_i$.

$|\psi\rangle$ is GS of H as it is GS of each term.

Have $\prod_v \bigotimes_{i\in v} Z_i = I = \prod_p \bigotimes_{i\in p} X_i = I$.