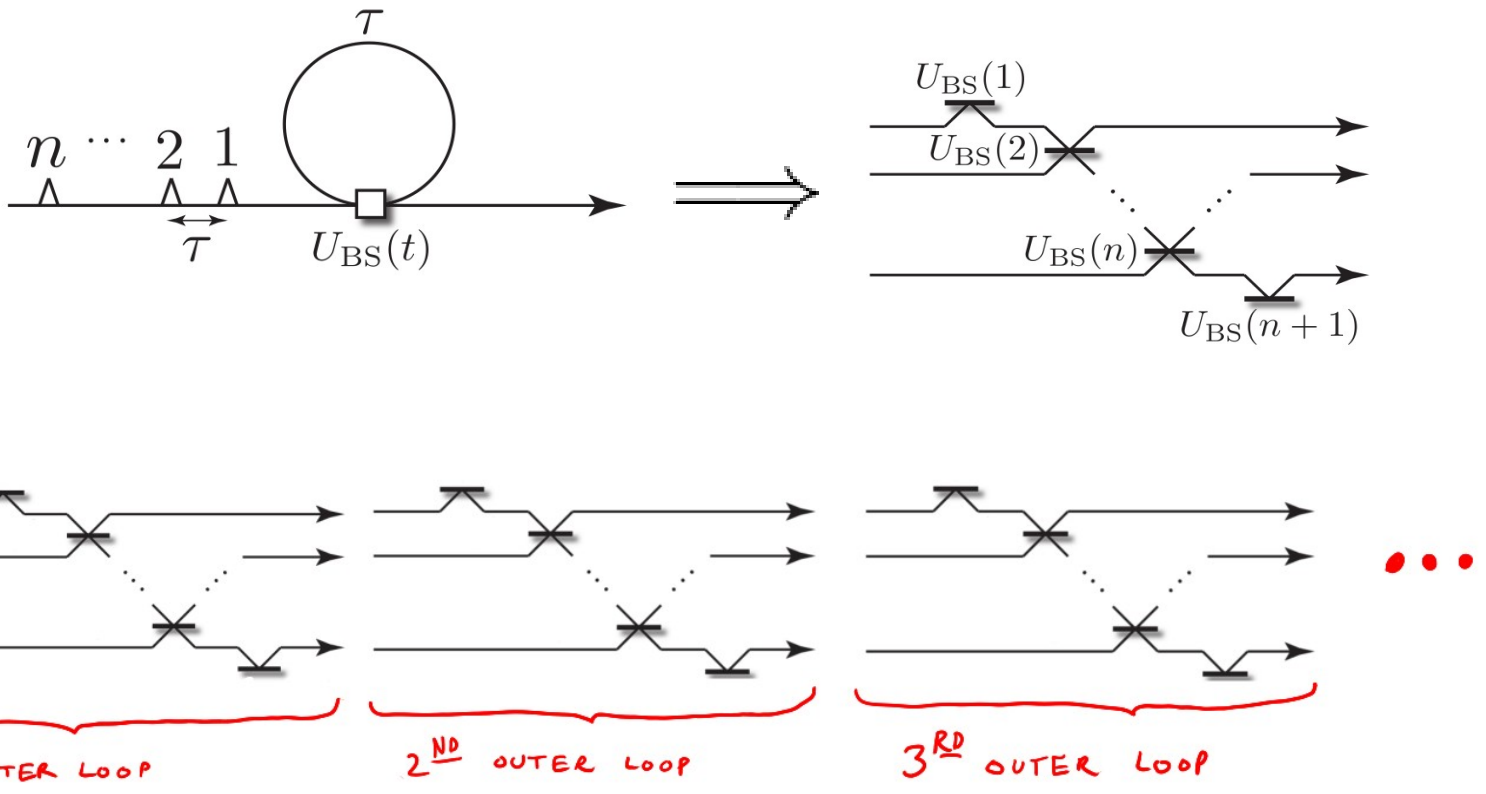
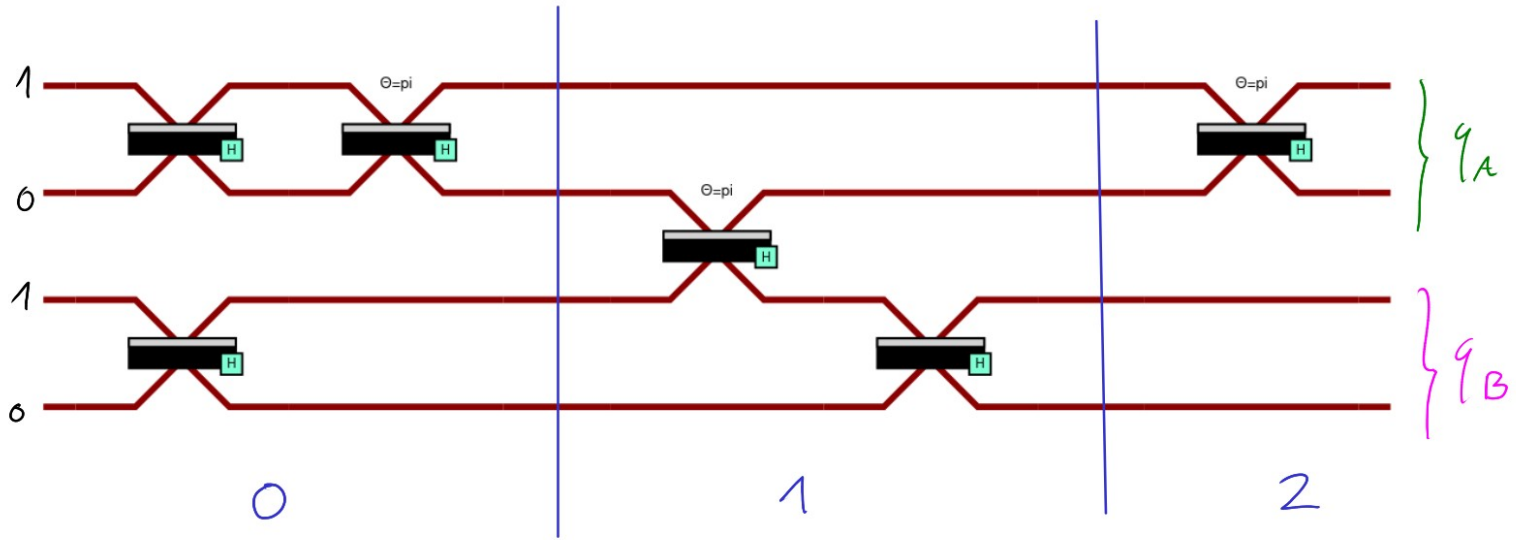
Graphs, trees and more...

in a photonic architecture!

What can we do with just the small loop? And with the outer one?



Generation in the computational basis.



$\frac{1}{2\sqrt{2}}\,|1010\rangle$

$\frac{1}{2\sqrt{2}}\,|1001\rangle$

$\frac{1}{2\sqrt{2}}\,|0110\rangle$

$-\frac{1}{2\sqrt{2}}\,|1010\rangle$

$\frac{1}{2\sqrt{2}}\,|0002\rangle$

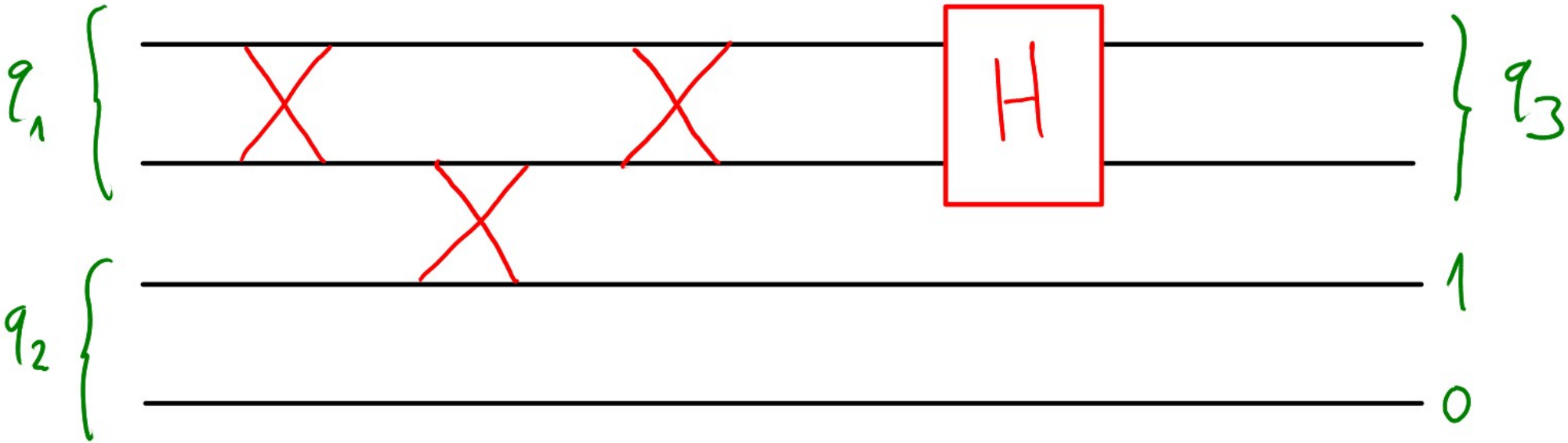
$\frac{1}{2\sqrt{2}}\,|0020\rangle$

$\frac{1}{2}\,|1100\rangle$

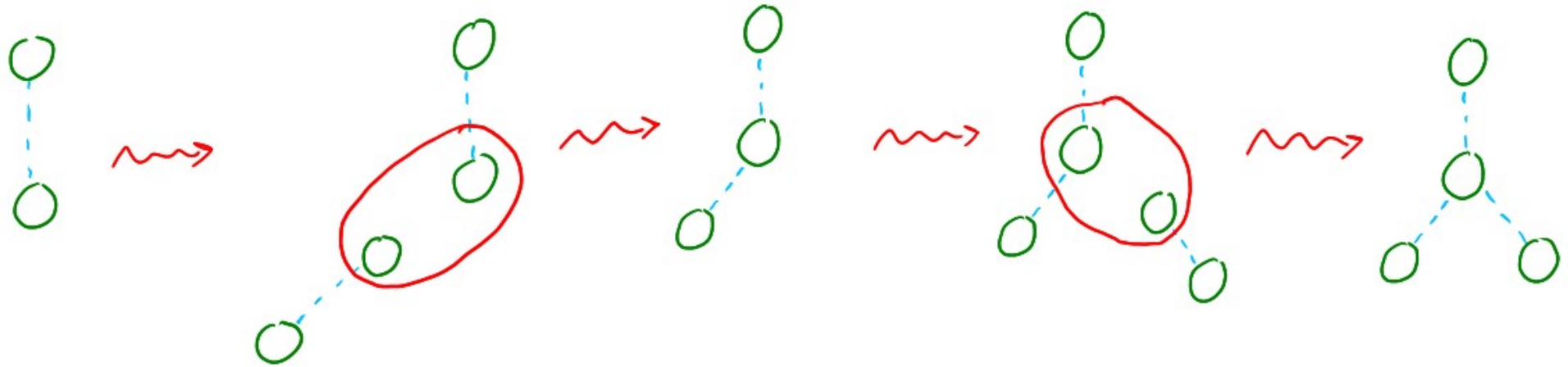
THROW AWAY

Just 4 time slots (instead of 8) and 2 outer loops (instead of 4)....

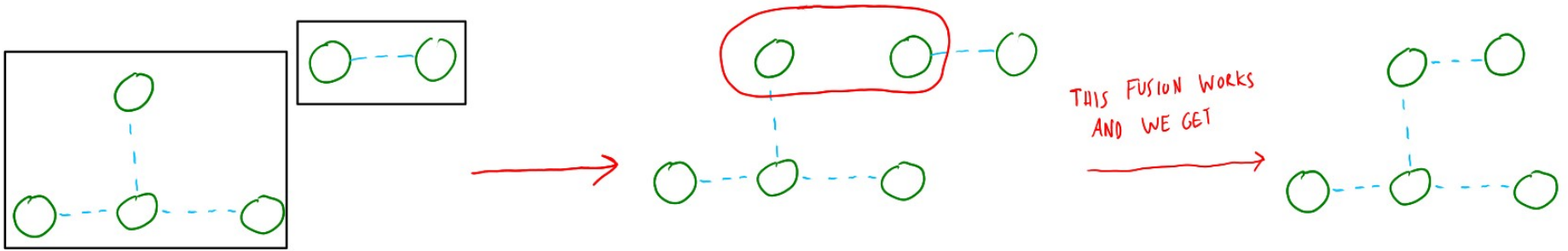
Gluing things together: Fusion

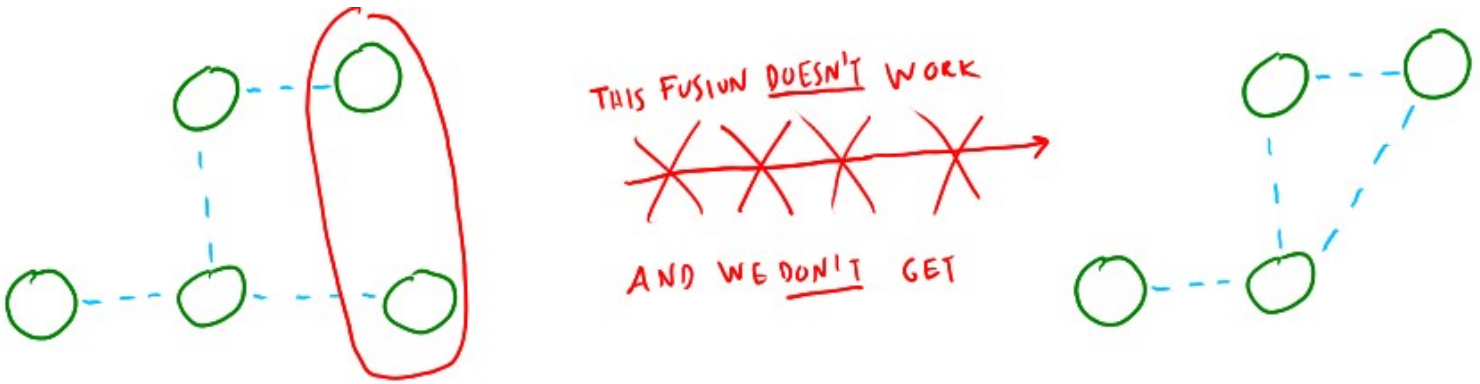


A simple example: three Bell pairs and two fusions.

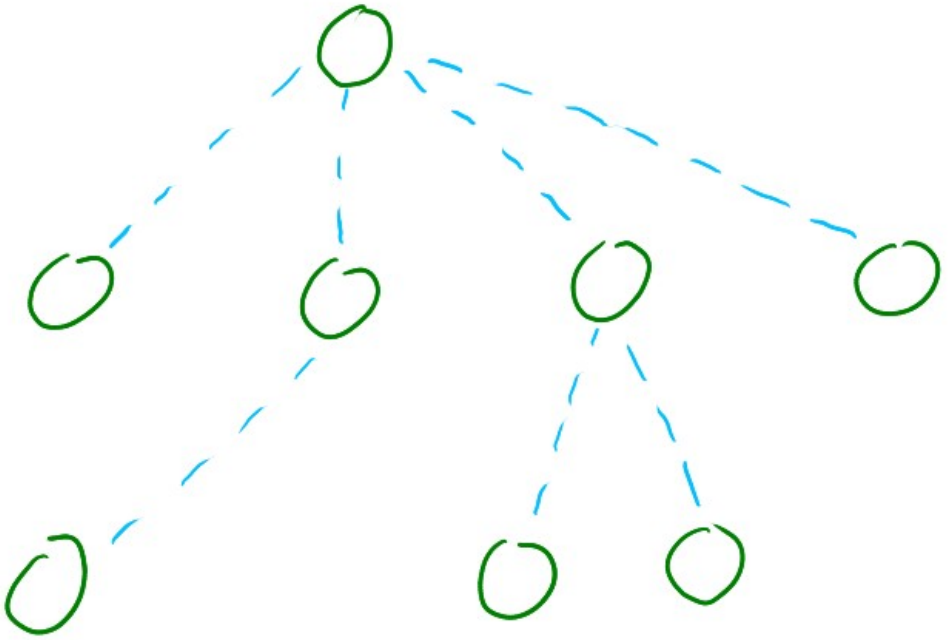


Theorem. Two states generated in the computational basis can always be fused together to get a new state in the computational basis.



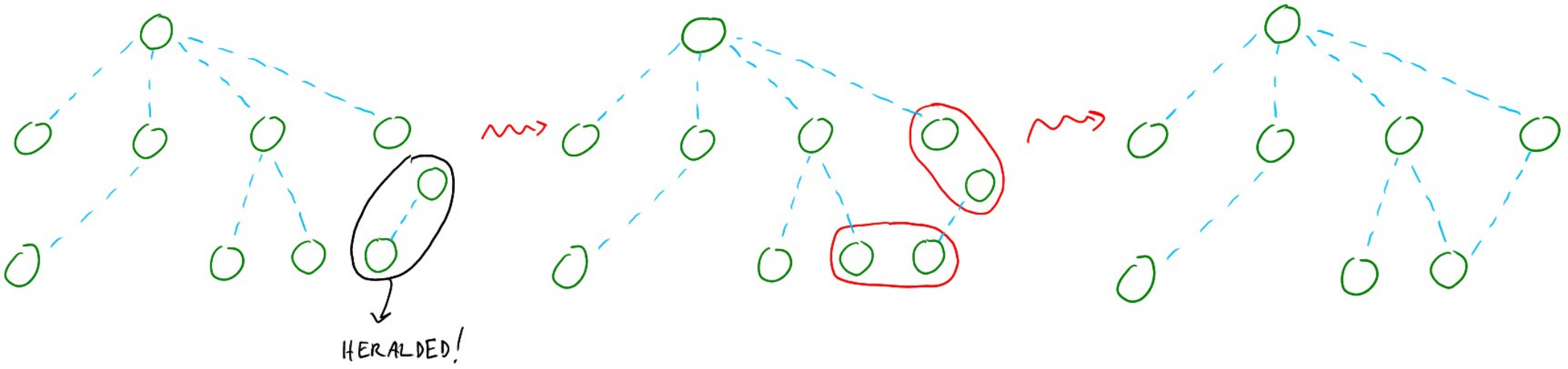


Easy corollary. We can build tree-like graph states with just Bell pairs in the computational basis and fusion.



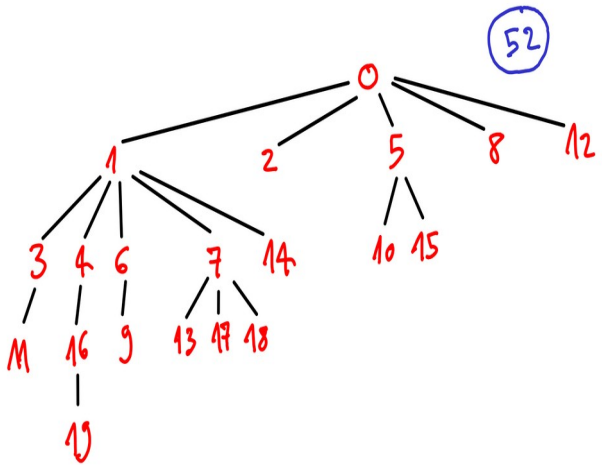
What if we want to add cycles to our graph state?

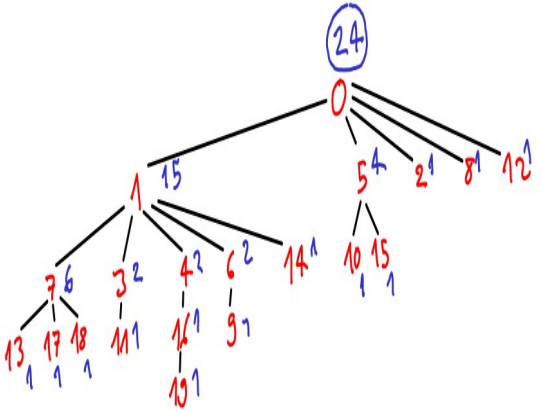
Result. To add an edge inside a graph state in the computational basis we can use an heralded pair and the following procedure:

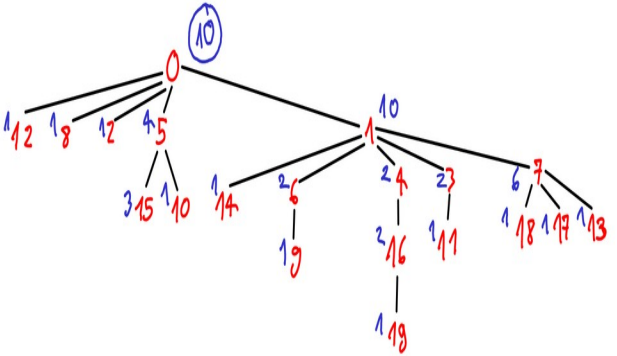


$52 \gg 24 \gg 10$

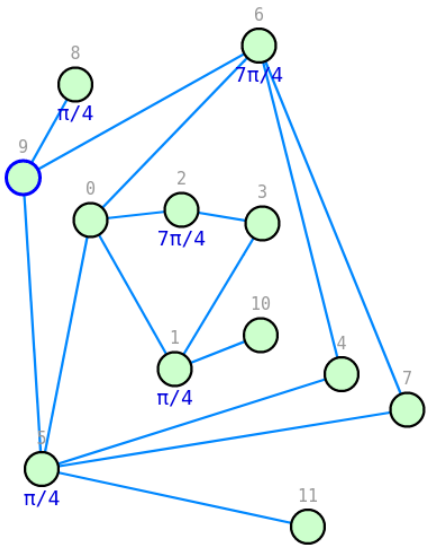
random worst DFS best DFS

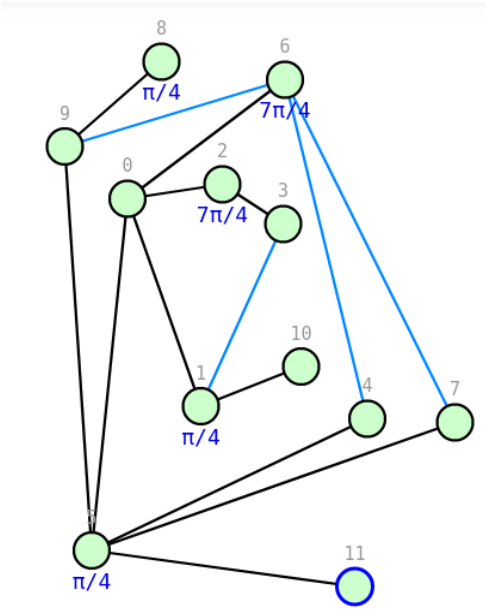


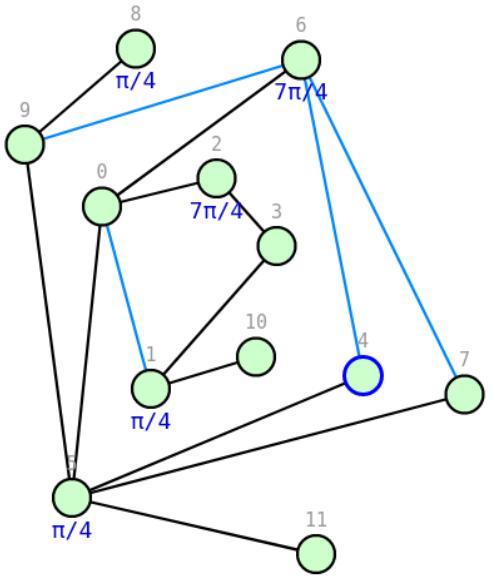




Tree extraction...







Future developments.

- ZX-optimization to get the smallest circuit;
- introducing the concepts of **gflow** and time cones in our MBQC gives us the possibility to have a variable number of inner loop.