Alice randomly chooses the Z basis (left) or the X basis (right) to store bits $x$ and $y$.

Karzig et al. [1] propose that islands of superconducting nanowires correspond to qubits. An “octon” island with 8 Majorana zero modes corresponds to 3 qubits.

Properties:
- Only can measure parity of any 2 MZMs
- The island has overall even parity
- Two operators commute if they intersect on even number of MZMs ($Z_1$ and $Z_3$), else anticommute

Suppose Bob wants bit $x$ (stored in top four MZMs)
He measures parity of bottom four MZMs in either X or Z basis, by measuring the 2 vertical operators or the 2 horizontal operators. If the bottom has even parity, he reads bit $x$ from the horizontal operator. If it has odd parity, he reads bit $x$ from the vertical operator.

Thus, he always obtains bit $x$ perfectly. But bit $y$ is lost if he chose the wrong basis to get parity of bottom.

$$P(\text{get } y) = \frac{3}{4}$$

Claim: Octon is imperfect OTM

$$P(\text{get } x) = 1 \quad P(\text{get } y) = \frac{3}{4}$$

OR

$$P(\text{get } x) = \frac{3}{4} \quad P(\text{get } y) = 1$$

Read bit from octon OTM

$$P(\text{get } y) = \frac{3}{4}$$

What about MZM faults?
We choose a CSS code and obtain two classical codes A and B from it.
- In top layer, code A corresponds to the X stabilizers and logical operator $X_A$.
- In bottom layer, code B corresponds to Z stabilizers and logical operator $Z_B$.
- All stabilizer equivalents of $X_A$ and $Z_B$ intersect.

Thus, we can store the two classical bits as the parity of logical operators $X_A$ and $Z_B$. Obtaining parity of one logical operator reduces probability of getting the other one.

One-time memory (OTM)

An ideal one-time memory stores two bits $x$ and $y$. Bob can choose to read either $x$ or $y$, but not both.

OTM

$x$, $y$

get $x$

OR

get $y$

NOT BOTH

Octon Majorana islands

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Properties:
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Octon cluster → Better OTM

A cluster of $k$ octons is equivalent to a nearly perfect OTM. One bit is given by XOR of the top bits of all $k$ octons, and the other bit is given by XOR of bottom bits of all $k$ octons. If we want to correctly output one bit (say $x$), the other bit $y$ can be read with probability

$$P(\text{get } y) = \frac{1}{2} + \frac{1}{2^k+1}$$

References
1. T. Karzig et al., PRB 95, 235305 (2017)
2. S. Goldwasser et al., Crypto 2008, 39