

list of errors  $\{b_j\}_j$  list of pauli words  $\{a_j\}_j$

set of errors undetectable iff  $\sum_j (a_j b_j) = 0 \mod 2\pi$

Now assume  $a_j = \frac{2\pi k_j}{r}$

list of errors labelled  $\{b_j\}_j$  undetectable iff  $\forall k \in \mathbb{Z}$

$\sum_j a_j b_j = 0 \mod 2\pi$

$\Leftrightarrow \sum_j (k_j b_j) = 0 \mod 2\pi$

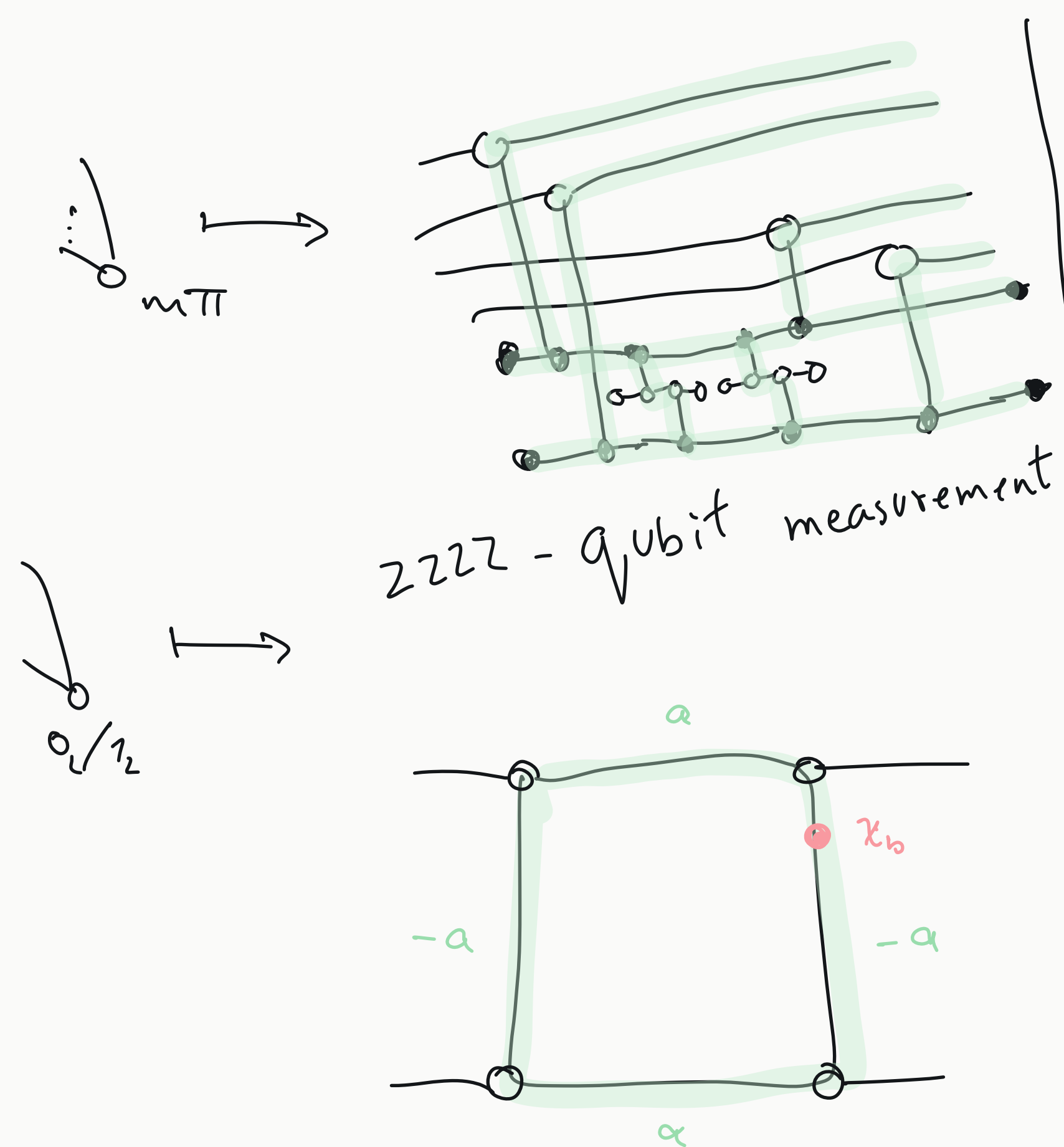
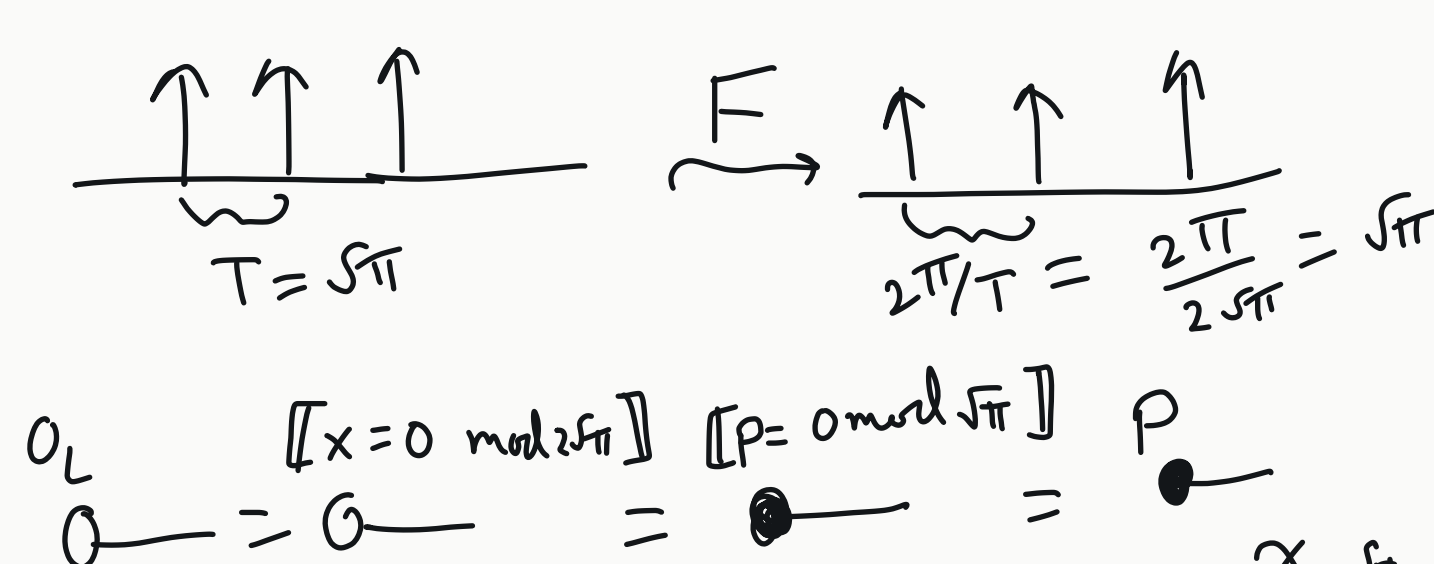
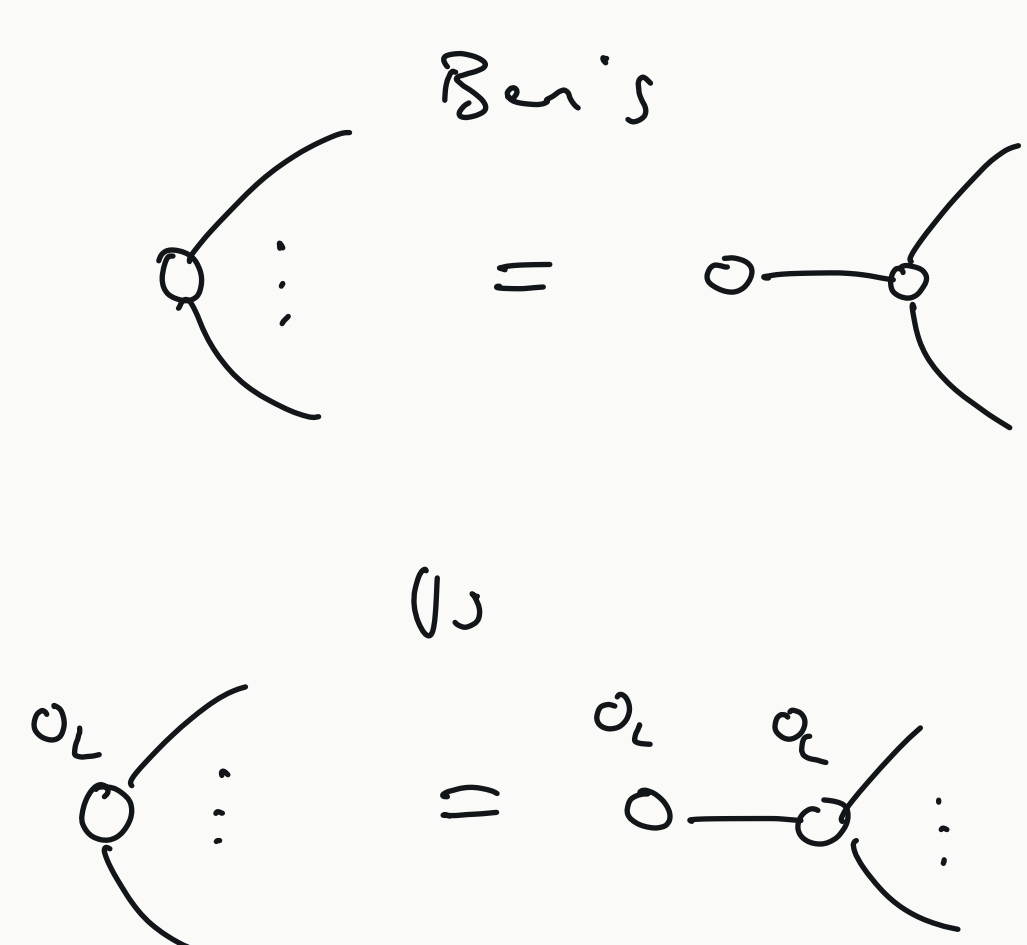
$\Leftrightarrow \sum_j b_j = 2\pi n \quad n \in \mathbb{Z}$

$\Leftrightarrow \sum_j b_j = 2\pi \frac{n}{r}$

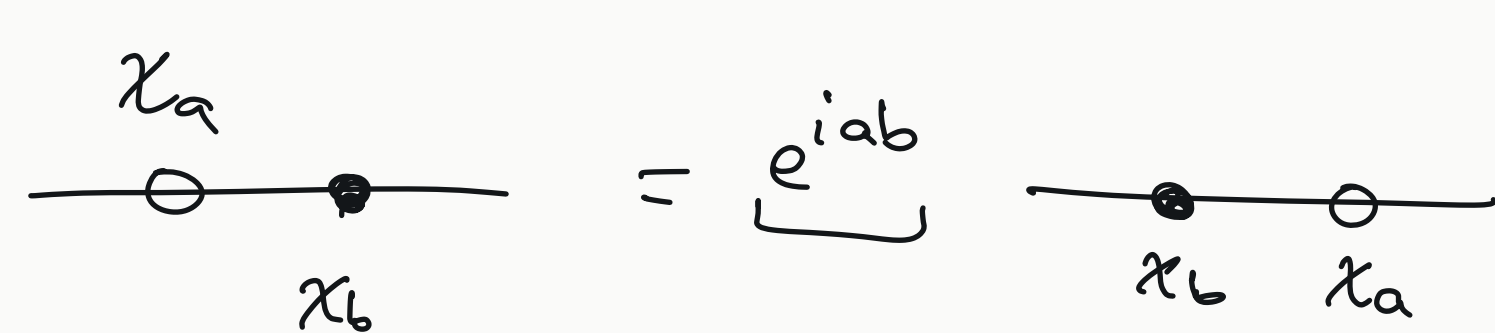
$\Leftrightarrow \sum_j b_j = 2\pi n \quad n \in \mathbb{Z}$

$(\sum_j b_j \mod 2\pi) \mod 2\pi = 0$

$-b_j \mod 2\pi = 2\pi - b_j \neq b_j$



detectable if  $a$  and  $b$  not commute  
i.e.  $ab \neq 2\pi \mathbb{Z}$



$2\sqrt{\pi}, \sqrt{\pi}$

$$a = \sum_j a_j$$

$$\chi_a(x) = e^{i\theta x}$$

$$ax = 2\pi k \Rightarrow a = \left(\frac{2\pi}{r}\right)^k$$

$$a \in \frac{2\pi}{r} \mathbb{Z}$$

period of twist  $\frac{2\pi}{a}$

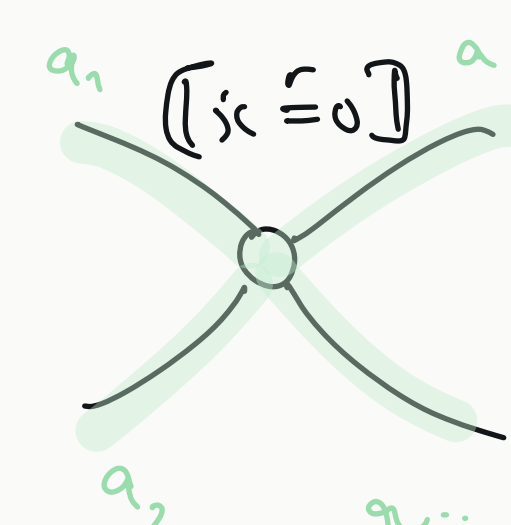
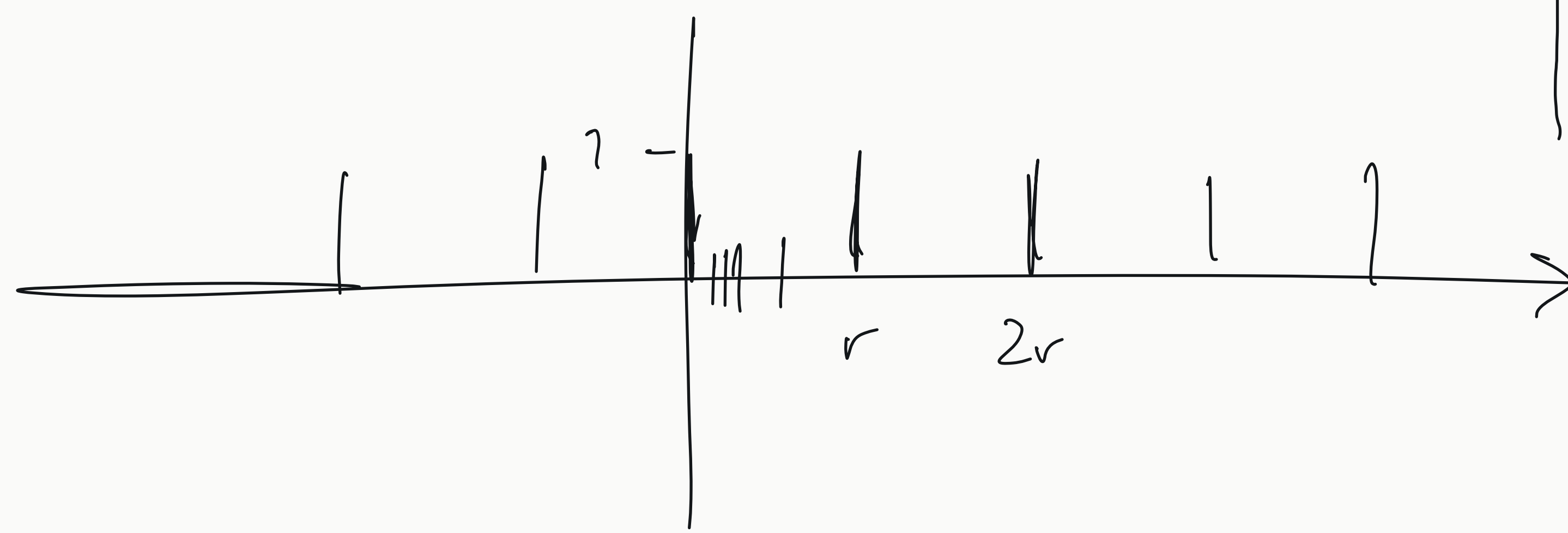
want this  $= \frac{r}{n}, n \in \mathbb{Z}$

$$\frac{2\pi}{a} = \frac{r}{n}$$

$$\Leftrightarrow 2\pi n = ar$$

$$\Leftrightarrow \frac{2\pi n}{r} = a$$

$$\Leftrightarrow a \in \frac{2\pi}{r} \mathbb{Z}$$



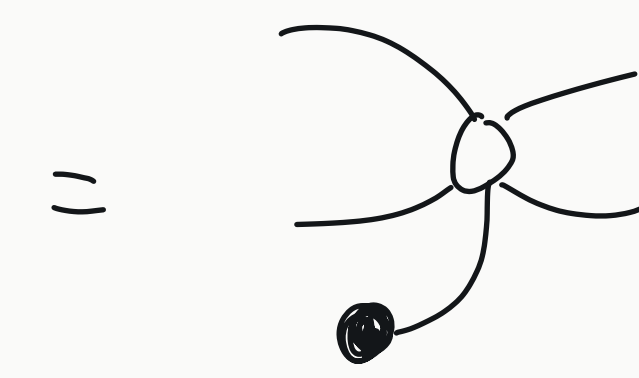
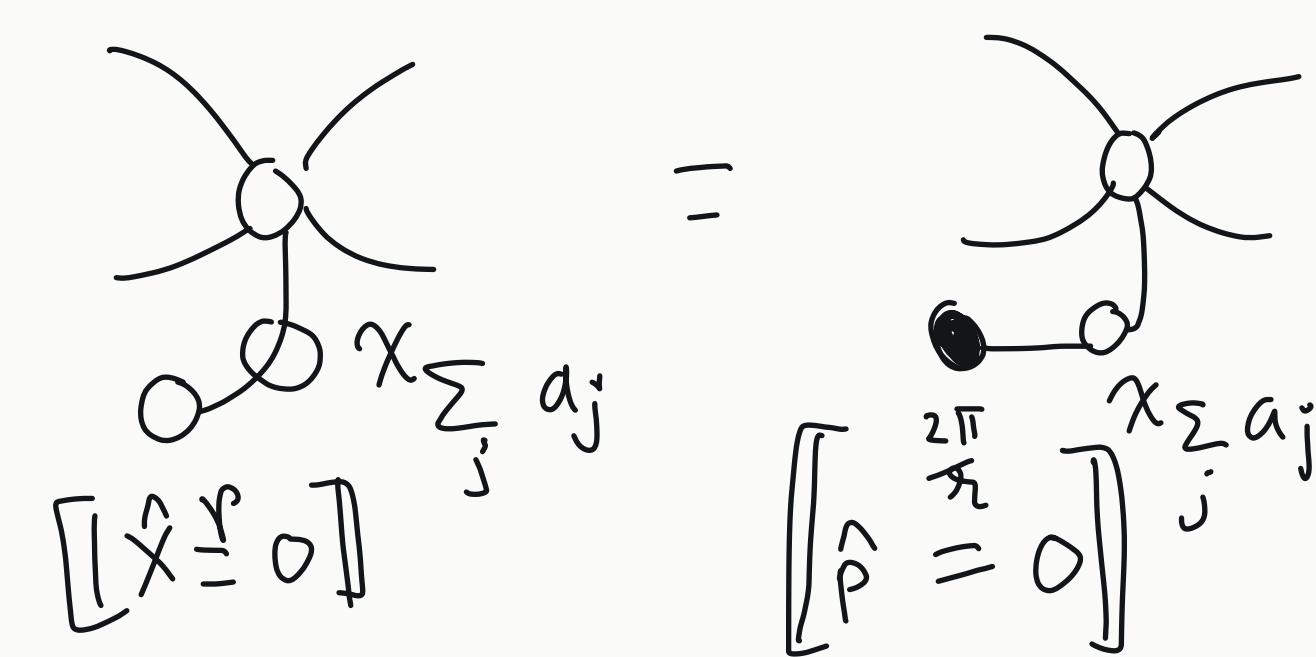
valid iff  $\sum_j a_j \in \frac{2\pi}{r} \mathbb{Z}$  or  $\frac{1}{r} \mathbb{Z}$

valid iff  $r(\sum_j a_j) = 0 \mod 1$

$r(\sum_j a_j) = n \quad n \in \mathbb{Z}$

i.e.  $\sum_j a_j = \frac{n}{r}$

$$[x = 0]$$



$$[p - \sum_j a_j = 0 \mod \frac{2\pi}{r}]$$

$$\Rightarrow \sum_j a_j = 0 \mod \frac{2\pi}{r}$$

$$\Rightarrow \sum_j a_j \in \frac{2\pi}{r} \mathbb{Z}$$