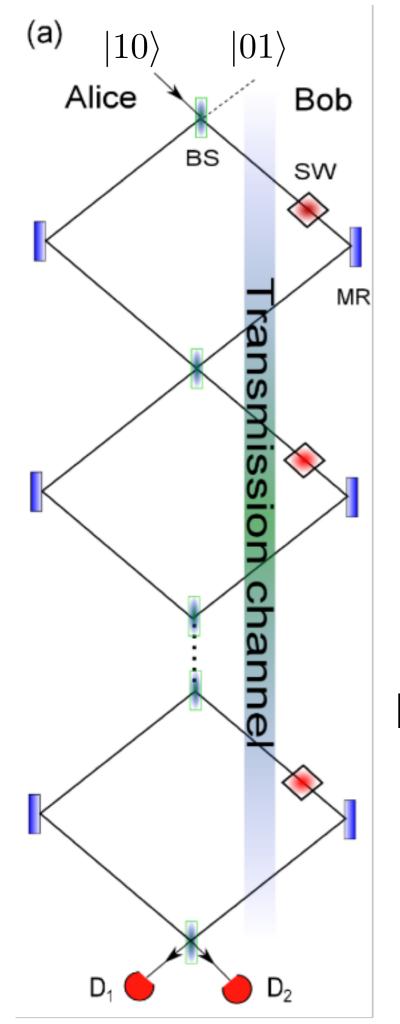


$$\hat{BS} \doteq \begin{pmatrix} \cos(\theta) & \sin(\theta) \\ -\sin(\theta) & \cos(\theta) \end{pmatrix}$$

$$\{\left|10\right\rangle,\left|01\right\rangle\}$$
 basis 
$$\theta=\frac{\pi}{2N} \text{ (property of beam splitter)}$$

## **Bob permits photons:**

$$\hat{BS}^{N} |10\rangle = \begin{pmatrix} \cos(\pi/2) & \sin(\pi/2) \\ -\sin(\pi/2) & \cos(\pi/2) \end{pmatrix} |10\rangle$$
$$= |01\rangle \qquad \boxed{D_2}$$



$$\hat{BS} \doteq \begin{pmatrix} \cos(\theta) & \sin(\theta) \\ -\sin(\theta) & \cos(\theta) \end{pmatrix}$$

 $\{|10\rangle\,,|01\rangle\}$  basis  $\theta=\frac{\pi}{2N}$  (property of beam splitter)

## **Bob permits photons:**

$$\hat{BS}^{N} |10\rangle = \begin{pmatrix} \cos(\pi/2) & \sin(\pi/2) \\ -\sin(\pi/2) & \cos(\pi/2) \end{pmatrix} |10\rangle$$
$$= |01\rangle \qquad \boxed{D_2}$$

## **Bob blocks photons:**

$$|10\rangle \xrightarrow{\mathrm{BS}} \cos(\theta) |10\rangle + \sin(\theta) |01\rangle$$

$$\hat{\mathrm{BS}}_{|}^{N} |10\rangle = \cos^{N-1}(\theta) (\cos(\theta) |10\rangle + \sin(\theta) |01\rangle)$$

$$\approx |10\rangle$$

$$D_{1}$$