(b)

$|100\rangle$ $|010\rangle$ $|001\rangle$

BS_M

BS_N

D_3

Transmission channel

D_1 D_3 D_2

After first BS_M:

$$|100\rangle \xrightarrow{\text{BS}_M} \cos(\theta_M)|100\rangle + \sin(\theta_M)|010\rangle$$

goes through previous device

Bob permits photons:

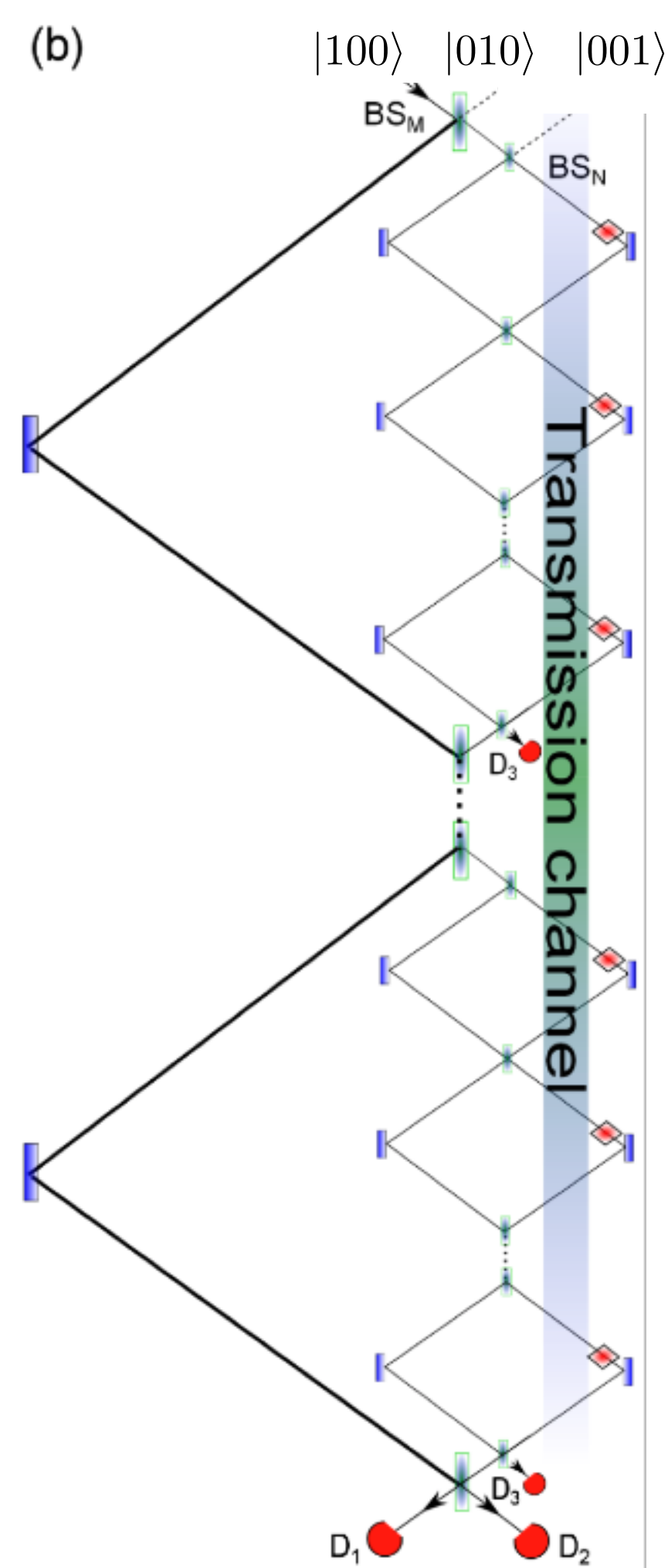Previously, hit the right detector (D_2). Here, that is D_3. Input to second BS_M:

$$\cos(\theta_M)|100\rangle + \sin(\theta_M)|001\rangle$$

blocked by D_3 (Quantum Zeno Effect!)

After Mth BS_M:

$$\cos^{M-1}(\theta_M)(\cos(\theta_M)|100\rangle + \sin(\theta_M)|010\rangle)$$

$$\approx |100\rangle \quad \boxed{D_1}$$

(b) $|100\rangle$ $|010\rangle$ $|001\rangle$

BS_M
BS_N
D_3
Transmission channel
D_3
D_1 D_2

This is communication:

If Bob blocks photons, D_2 clicks.

If Bob permits photons, D_1 clicks.

Bob can transfer information to Alice.