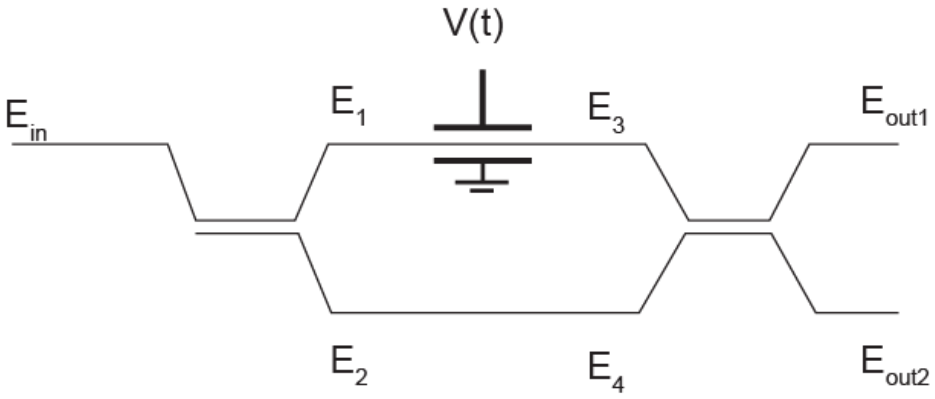
Getting the transmittance of the MZI:



$$\begin{bmatrix} E_{out1} \\ E_{out2} \end{bmatrix} = \frac{1}{\sqrt{2}} \begin{bmatrix} 1 & i \\ i & 1 \end{bmatrix} \begin{bmatrix} E_3 \\ E_4 \end{bmatrix};$$

$$\begin{bmatrix} E_3 \\ E_4 \end{bmatrix} = \begin{bmatrix} \exp\left[i\left(\phi_1 - \pi \frac{V}{V_\pi} \right) \right] & 0 \\ 0 & \exp\left[i(\phi_2) \right] \end{bmatrix} \begin{bmatrix} E_1 \\ E_2 \end{bmatrix};$$

$$\begin{bmatrix} E_1 \\ E_2 \end{bmatrix} = \frac{1}{\sqrt{2}} \begin{bmatrix} 1 & i \\ i & 1 \end{bmatrix} \begin{bmatrix} E_{in} \\ 0 \end{bmatrix}$$

We get:

$$\begin{bmatrix} E_{out1} \\ E_{out2} \end{bmatrix} = \frac{1}{2} \begin{bmatrix} 1 & i \\ i & 1 \end{bmatrix} \begin{bmatrix} \exp\left[i\left(\phi_1 - \pi \frac{V}{V_\pi} \right) \right] & 0 \\ 0 & \exp\left[i(\phi_2) \right] \end{bmatrix} \begin{bmatrix} 1 & i \\ i & 1 \end{bmatrix} \begin{bmatrix} E_{in} \\ 0 \end{bmatrix}$$

$$\begin{bmatrix} E_{out1} \\ E_{out2} \end{bmatrix} = \frac{1}{2} \begin{bmatrix} 1 & i \\ i & 1 \end{bmatrix} \begin{bmatrix} \exp\left[i\left(\phi_1 - \pi \frac{V}{V_\pi} \right) \right] & 0 \\ 0 & \exp\left[i(\phi_2) \right] \end{bmatrix} \begin{bmatrix} E_{in} \\ iE_{in} \end{bmatrix}$$

$$\begin{bmatrix} E_{out1} \\ E_{out2} \end{bmatrix} = \frac{1}{2}\begin{bmatrix} 1 & i \\ i & 1 \end{bmatrix}\begin{bmatrix} E_{in}\exp\left[i\left(\phi_1 - \pi\frac{V}{V_\pi}\right)\right] \\ iE_{in}\exp\left[i\left(\phi_2\right)\right] \end{bmatrix} = \frac{1}{2}\begin{bmatrix} E_{in}\exp\left[i\left(\phi_1 - \pi\frac{V}{V_\pi}\right)\right] - E_{in}\exp\left[i\left(\phi_2\right)\right] \\ iE_{in}\exp\left[i\left(\phi_1 - \pi\frac{V}{V_\pi}\right)\right] + iE_{in}\exp\left[i\left(\phi_2\right)\right] \end{bmatrix}$$

The output is given by Eout2:

$$E_{out2} = \frac{i}{2}E_{in}\left[\exp\left[i\left(\phi_1 - \pi\frac{V}{V_\pi}\right)\right] + \exp\left[i\left(\phi_2\right)\right]\right]$$

$$E_{out2} = \frac{i}{2}E_{in}\exp\left[\frac{i}{2}\left(\phi_1 - \pi\frac{V}{V_\pi} + \phi_2\right)\right]\left[\exp\left[\frac{i}{2}\left(\phi_1 - \pi\frac{V}{V_\pi} - \phi_2\right)\right] + \exp\left[-\frac{i}{2}\left(\phi_1 - \pi\frac{V}{V_\pi} - \phi_2\right)\right]\right]$$

$$E_{out2} = iE_{in}\exp\left[\frac{i}{2}\left(\phi_1 - \pi\frac{V}{V_\pi} + \phi_2\right)\right]\cos\left[\frac{1}{2}\left(\phi_1 - \pi\frac{V}{V_\pi} - \phi_2\right)\right]$$

The output field has a phase given by $\left[\frac{1}{2}\left(\phi_1 - \pi\frac{V}{V_\pi} + \phi_2\right)\right]$, it depends on V(t)! The light will be chirped.

The output power is given by:

$$P_{out} = \left|E_{out2}\right|^2 = \left|E_{in}\right|^2\cos^2\left[\frac{1}{2}\left(\phi_1 - \pi\frac{V}{V_\pi} - \phi_2\right)\right]$$

$$P_{out} = \left|E_{out2}\right|^2 = P_{in}\cos^2\left[\frac{\Delta\phi}{2}\right] \quad \text{with } \Delta\phi = \left(\phi_1 - \pi\frac{V}{V_\pi} - \phi_2\right)$$