

## HW5

$$H|0\rangle = \frac{1}{\sqrt{2}} \begin{pmatrix} 1 \\ 1 \end{pmatrix}$$

$$\rho = \frac{1}{2} \begin{pmatrix} 1 & 1 \\ 1 & 1 \end{pmatrix} = (1, 0, 0)$$

$$H|1\rangle = |-\rangle$$

$$\rho = \frac{1}{2} \begin{pmatrix} 1 & -1 \\ -1 & 1 \end{pmatrix}$$

Therefore it also rotate 90 degree through the  $Y$  axis.

Let's check an example at the  $Y$  axis.

$$\rho = \frac{1}{2} \begin{pmatrix} 1 & -i \\ i & 1 \end{pmatrix}$$

Apply  $H$  to it

$$H\rho H^* = \frac{1}{\sqrt{2}} \begin{pmatrix} 1 & 1 \\ 1 & -1 \end{pmatrix} \frac{1}{2} \begin{pmatrix} 1 & -i \\ i & 1 \end{pmatrix} \frac{1}{\sqrt{2}} \begin{pmatrix} 1 & 1 \\ 1 & -1 \end{pmatrix} = \frac{1}{4} \begin{pmatrix} 2 & 2i \\ -2i & 2 \end{pmatrix}$$

Therefore it doesn't do anything, so the conclusion makes sense.

Therefore it rotate 90 degrees clockwise through the  $Y$  axis to  $|0\rangle$ .