

$$\rho(a, w) = w \left| \psi(a) \right\rangle \left\langle \psi(a) \right| + (1 - w) \left| 00 \right\rangle \left\langle 00 \right|,$$

$$\left| \psi(a) \right\rangle = \sqrt{a} \left| 01 \right\rangle + \sqrt{1 - a} \left| 10 \right\rangle.$$