



$\hat{U} \hat{U}^\dagger \hat{\rho} \hat{U} \hat{U}^\dagger = \hat{\rho}$:
 1. $\hat{U}^\dagger \hat{\rho} \hat{U} \hat{U}^\dagger \hat{U} \hat{U}^\dagger = \hat{U}^\dagger \hat{\rho} \hat{U}$
 2. $\hat{\rho} \hat{U} \hat{U}^\dagger \hat{\rho} \hat{U} \hat{U}^\dagger = \hat{\rho}$