

$$\hat{U} \hat{U}^\dagger \hat{\rho} \hat{\rho}^\dagger: \hat{\rho} \hat{\rho}^\dagger \hat{\rho} \pm \hat{U}^\dagger \hat{\rho}^2 \hat{\rho} \hat{\rho} \pm \hat{U} \hat{U}^\dagger \hat{\rho} \pm$$