

$$\begin{aligned} \exp \left[S_P^\mu [U_{\mathbf{x}}, U_{\mathbf{x}}^\dagger] \right] &= \int DU_k D\bar{\psi} D\psi \exp \left[S_L [e^{N_t \mu} U_{\mathbf{x}}, e^{-N_t \mu} U_{\mathbf{x}}^\dagger, U_i(x), \psi, \bar{\psi}] \right] \\ &= \sum_D c_D N^{-p_D} \left(\frac{\beta}{2N^2} \right)^{p'_D} h^{p''_D} P_D [e^{N_t \mu} U_{\mathbf{x}}, e^{-N_t \mu} U_{\mathbf{x}}^\dagger] \end{aligned}$$