

N₂

$$\langle X_f | \hat{U}(T) T \left\{ \frac{(\hat{X}(t+T) - \hat{X}(t))^2}{T^2} \right\} | X_i \rangle$$

$$= \langle X_f | \hat{U}(T) \left\{ \hat{X}(t+T) \hat{X}(t+T) + \hat{X}(t) \hat{X}(t) - \right.$$

$$\left. 2 \hat{X}(t+T) \hat{X}(t) \right\} | X_i \rangle \equiv U_{fi} \left[\frac{X_{free}^2(t+T)}{T^2} \right]$$

$$\equiv U_{fi} \cdot \left[\frac{X_{free}^2(t+T)}{T^2} - \frac{i\hbar}{T^2} G(t+T, t+T) + \frac{X_{free}^2(t)}{T^2} \right.$$

$$\left. - \frac{i\hbar}{T} G(t, t) + \frac{2i\hbar}{T^2} G(t+T, t) - \frac{2X_{free}(t+T)X_{free}(t)}{T^2} \right]$$

$$= U_{fi} \cdot \left\{ F_{free} + \frac{i\hbar}{mT^2} \left[2(t+T-t)t - t(t-T) - (t+T)(t+T-t) \right. \right.$$

$$\left. t+T-T \right] \right\} = U_{fi} \cdot \left\{ F_{free} + \frac{i\hbar}{mT^2} \left[2t^2 + 2tT - 2Tt - t^2 + tT - t^2 - tT + tT - \right. \right.$$

$$\left. - tT - t^2 + tT \right] \right\} = U_{fi} \cdot \left\{ F_{free} + \frac{i\hbar}{mT^2} [2T - T^2] \right\} \equiv$$

$$\begin{aligned}
 \text{Free } F_{free} &= \frac{1}{T^2 T^2} \left[(t X_f + (T-t) X_i)^2 + ((t+T) X_f + (T-t-T) X_i)^2 - \right. \\
 &\quad \left. - (t X_f + (T-t) X_i) ((t+T) X_f + (T-t-T) X_i) \right] =
 \end{aligned}$$

$$\begin{aligned}
 &= \frac{1}{T^2 T^2} \left[(t^2 + Tt + T^2) X_f^2 + ((T-2t)T + 2t(T-T) - 2t^2) X_f X_i + \right. \\
 &\quad \left. + ((t-T)^2 + (t-T)T + T^2) X_i^2 \right]
 \end{aligned}$$

$$\Rightarrow U_{fi} \left\{ \frac{1}{T^2 T^2} \left[X_f^2 (t^2 + tT + T^2) + X_f X_i ((T-2t)T + 2t(T-T) - 2t^2) + X_i^2 \cdot \right. \right.$$

$$\left. \left. \cdot ((t-T)^2 + (t-T)T + T^2) \right] + \frac{i\hbar}{m T^2 T} [Tt - T^2] \right\}$$

$$U_{fi} = \langle X_f | \hat{U}(T) | X_i \rangle$$
