$$\overbrace{L_0 - 1}^{-1} V_1 \overbrace{L_0 - 1}^{-1} V_2 \overbrace{L_0 - 1}^{-1} \cdot\cdot \overbrace{L_0 - 1}^{-1} V_m$$

$$= \underbrace{\sqrt{x_1}^{P^2} \sqrt{x_2}^{\overbrace{P - k_1}^{2}} \sqrt{x_3}^{\overbrace{P - k_1 - k_2}^{2}} \cdot\cdot \sqrt{x_m}^{\overbrace{P - k_1 - k_2 - \cdot\cdot - k_{m-1}}^{2}}} \text{⧗} \underbrace{x_1^L V_1 x_2^L V_2 x_3^L \cdot\cdot x_m^L V_m}$$

$$\text{LHS} = x_1^L V_1 x_2^L V_2 x_3^L \cdot\cdot x_m^L V_m = \underbrace{\sqrt{x_1}^{P^2} \text{⧗} x_1^L} \underbrace{k_1 \text{⧗} V_1} \underbrace{\sqrt{x_2}^{P^2} \text{⧗} x_2^L} \underbrace{k_2 \text{⧗} V_2} \underbrace{\sqrt{x_3}^{P^2} \text{⧗} x_3^L} \cdot\cdot \underbrace{\sqrt{x_m}^{P^2} \text{⧗} x_m^L} \underbrace{k_m \text{⧗} V_m}$$

$$= \underbrace{\sqrt{x_1}^{P^2} k_1 \sqrt{x_2}^{P^2} k_2 \sqrt{x_3}^{P^2} k_3 \cdot\cdot \sqrt{x_m}^{P^2} k_m} \text{⧗} \underbrace{x_1^L V_1 x_2^L V_2 x_3^L \cdot\cdot x_m^L V_m} = \text{RHS}$$

$$\text{Tr} \overbrace{L_0 - 1}^{-1} V_1 \overbrace{L_0 - 1}^{-1} V_2 \overbrace{L_0 - 1}^{-1} \cdot\cdot \overbrace{L_0 - 1}^{-1} V_m$$

$$= \text{Tr} \underbrace{\sqrt{x_1}^{P^2} \sqrt{x_2}^{\overbrace{P - k_1}^{2}} \sqrt{x_3}^{\overbrace{P - k_1 - k_2}^{2}} \cdot\cdot \sqrt{x_m}^{\overbrace{P - k_1 - k_2 - \cdot\cdot - k_{m-1}}^{2}}} \text{Tr} \underbrace{x_1^L V_1 x_2^L V_2 x_3^L \cdot\cdot x_m^L V_m}$$

$$\sum_{i}^{1|m} \overbrace{P - k_1 - \cdot\cdot - k_{i-1}}^{2} {}^{x_i}\not{c} = {}^{x_1 \cdot\cdot x_m}\not{c} \left(P - \sum_{i}^{1|m} k_i \frac{x_1 \cdot\cdot x_i \not{c}}{x_1 \cdot\cdot x_m \not{c}} \right)^2 - \sum_{i<j}^{1|m} k_i \cdot k_j \left({}^{x_1 \cdot\cdot x_j / x_1 \cdot\cdot x_i}\not{c} + \frac{x_1 \cdot\cdot x_j / x_1 \cdot\cdot x_i \not{c}^2}{x_1 \cdot\cdot x_m \not{c}} \right)$$

$$K_z \text{⧗} \underbrace{\exp\left(k_i^\mu \eta_{\mu\nu} X^\nu_{-\not{n}} w_i^n \right) \exp\left(-k_i^\mu \eta_{\mu\nu} X^\nu_{\not{n}} w_i^{-n} \right) y^n K_z}$$