

$$\begin{aligned}
\omega &= \overbrace{1 - \vartheta \vartheta^*}^{-1/2} \varrho \Rightarrow d\varrho = \overbrace{1 - \vartheta \vartheta^*} \omega \\
1 - \vartheta \vartheta^* - \varrho \varrho^* &= \overbrace{1 - \vartheta \vartheta^*}^{1/2} \overbrace{1 - \overbrace{1 - \vartheta \vartheta^*}^{-1/2} \overbrace{1 - \vartheta \vartheta^*}^{-1/2}} \overbrace{1 - \vartheta \vartheta^*}^{1/2} = \overbrace{1 - \vartheta \vartheta^*}^{1/2} \overbrace{1 - \omega \omega^*} \overbrace{1 - \vartheta \vartheta^*}^{1/2} \\
&= \overbrace{1 - \vartheta \vartheta^* - \varrho \varrho^*} = \overbrace{1 - \vartheta \vartheta^*} \overbrace{1 - \omega \omega^*} \\
\int_{d\zeta} \overbrace{1 - \zeta \zeta^*}^{\lambda} \zeta^{\mathbf{J}} &= \int_{d\vartheta} \int_{d\varrho} \overbrace{1 - \vartheta \vartheta^* - \varrho \varrho^*}^{\lambda} \vartheta|_{\varrho}^{\mathbf{J}} = \int_{d\vartheta} \overbrace{1 - \vartheta \vartheta^*}^{\lambda} \int_{d\omega} \overbrace{1 - \vartheta \vartheta^*}^{-1} \overbrace{1 - \omega \omega^*}^{\lambda} \overbrace{\vartheta|_{1 - \vartheta \vartheta^* \omega}^{1/2}}^{\mathbf{J}} \\
&= \int_{d\vartheta} \overbrace{1 - \vartheta \vartheta^*}^{\lambda-1} \int_{d\omega} \overbrace{1 - \omega \omega^*}^{\lambda} \vartheta|_{\frac{1 - \vartheta \vartheta^* \omega}{1/2}}^{\mathbf{J}} \\
\zeta_{\mu}^* \zeta_{\mu} &= \left(\overline{\varrho \cdots \varrho} \right) \vartheta_{\mathbf{x}}^* \vartheta_{\mathbf{x}} \left(\varrho \cdots \varrho \right) = \vartheta_{\mathbf{x}}^* \vartheta_{\mathbf{x}} \overline{\varrho \cdots \varrho} \varrho \cdots \varrho \\
\overline{\varrho \cdots \varrho} \varrho \cdots \varrho &= \overline{x_{i_1}^{j_1} \omega} \cdots \overline{x_{i_k}^{j_k} \omega} \overline{x_{j_1}^{i_1} \omega} \overline{x_{j_k}^{i_k} \omega} \\
&= x_{i_1}^1 \overline{\omega} \cdots x_{i_k}^k \overline{\omega} x_{j_1}^1 \omega \cdots x_{j_k}^k \omega = x_{i_1}^1 \cdots x_{i_k}^k x_{j_1}^1 x_{j_k}^k \overline{\omega} \cdots \overline{\omega} x_{j_1}^1 \omega \cdots x_{j_k}^k \omega \\
\frac{\Gamma_{\lambda-r+k+1}}{\Gamma_{\lambda+1}} \int_{d\omega} \overbrace{1 - \omega \omega^*}^{\lambda} \overline{\varrho \cdots \varrho} \varrho \cdots \varrho &= \frac{\Gamma_{\lambda-r+k+1}}{\Gamma_{\lambda+1}} x_{i_1}^1 \cdots x_{i_k}^k x_{j_1}^1 x_{j_k}^k \int_{d\omega} \overbrace{1 - \omega \omega^*}^{\lambda} x_{i_1}^1 \overline{\omega} \cdots x_{i_k}^k \overline{\omega} x_{j_1}^1 \omega \cdots x_{j_k}^k \omega \\
&= x_{i_1}^1 \cdots x_{i_k}^k x_{j_1}^1 x_{j_k}^k \varepsilon_{i_1 \cdots i_k}^{j_1 \cdots j_k} = x_{i_{\pi(1)}}^{\pi(1)} \cdots x_{i_{\pi(k)}}^{\pi(k)} x_{j_1}^1 x_{j_k}^k \varepsilon_{i_1 \cdots i_k}^{j_1 \cdots j_k} = x_{j_k}^k x_{j_1}^1 x_{i_{\pi(1)}}^{\pi(1)} \cdots x_{i_{\pi(k)}}^{\pi(k)} x_{j_1}^1 x_{j_k}^k \overline{1} \\
&= \sum_{\pi} -1 \prod_i x_{i_{j_i}}^{j_i} x^{\pi(i)} = \sum_{\pi} -1 \prod_i (x^2)^{\pi(i)} = \overbrace{x^2} = \overbrace{1 - \vartheta \vartheta^*} \\
\frac{\Gamma_{\lambda-r+k+1}}{\Gamma_{\lambda+1}} \int_{d\zeta} \overbrace{1 - \zeta \zeta^*}^{\lambda} \zeta_{\mu}^* \zeta_{\mu} &= \int_{d\vartheta} \overbrace{1 - \vartheta \vartheta^*}^{\lambda} \vartheta_{\mathbf{x}}^* \vartheta_{\mathbf{x}}
\end{aligned}$$