

$$\int_{p_0}^p T_{ab} \xi_{\text{new}}^b dH^b = \int dA \int_{\lambda_0}^0 d\lambda (\lambda - \lambda_0) T_{\kappa\kappa} = \int dA \int_{\lambda_0}^0 d\lambda (-\lambda) T_{\kappa\kappa}$$