

$$\hat{\Psi}(\underline{x}) = \sum_{\nu=1}^{\infty} \psi_{\nu}(\underline{x}) a_{\nu} \quad | \quad \hat{\Psi}^{\dagger}(\underline{x}) = \sum_{\mu=1}^{\infty} \psi_{\mu}^{*}(\underline{x}) a_{\mu}^{\dagger}$$

$$\begin{aligned} \hat{N} &= \sum_{\lambda=1}^{\infty} a_{\lambda}^{\dagger} a_{\lambda} = \sum_{\lambda=1}^{\infty} \int \psi_{\lambda}(\underline{x}) \hat{\Psi}^{\dagger}(\underline{x}) d\underline{z} \int \psi_{\lambda}^{*}(\underline{x}') \hat{\Psi}(\underline{x}') d\underline{z}' \\ &= \int \underbrace{\sum_{\lambda=1}^{\infty} \psi_{\lambda}(\underline{x}) \psi_{\lambda}^{*}(\underline{x}')}_{= \delta(\underline{x} - \underline{x}')} \hat{\Psi}^{\dagger}(\underline{x}) \hat{\Psi}(\underline{x}') d\underline{z} d\underline{z}' \\ &= \int \delta(\underline{x} - \underline{x}') \hat{\Psi}^{\dagger}(\underline{x}) \hat{\Psi}(\underline{x}') d\underline{z} d\underline{z}' = \int \hat{\Psi}^{\dagger}(\underline{x}) \hat{\Psi}(\underline{x}) d\underline{z} \end{aligned}$$

$$A_{\lambda\mu} = \int \psi_{\lambda}^{*}(\underline{x}) A(\underline{x}) \psi_{\mu}(\underline{x}) d\underline{z}$$