

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


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


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