VR: $[a_\nu, a_\mu^+] = \delta_{\nu\mu} \mathbb{1}$

$$[\hat\psi(\underline{x}), \hat\psi^+(\underline{x}')] = \sum_{\nu,\mu} [\psi_\nu(\underline{x}) a_\nu, \psi_\mu^*(\underline{x}') a_\mu^+]$$

$$= \sum_{\nu,\mu} \psi_\nu(\underline{x}) \psi_\mu^*(\underline{x}') [a_\nu, a_\mu^+] = \sum_\nu \psi_\nu(\underline{x}) \psi_\nu^*(\underline{x}') = \delta(\underline{x}-\underline{x}')$$

Orthonormalität: $\langle \psi_\nu | \psi_\mu \rangle = \int \psi_\nu^*(\underline{x}) \psi_\mu(\underline{x}) d\tau = \delta_{\nu\mu}$

Vollständigkeit: $\sum_\nu \psi_\nu(\underline{x}) \psi_\nu^*(\underline{x}') = \delta(\underline{x}-\underline{x}')$

$\psi(\underline{x}) = \sum_\nu \psi_\nu(\underline{x}) c_\nu$ mit $c_\nu = \int \psi_\nu^*(\underline{x}') \psi(\underline{x}') d\tau'$

$$= \int \underbrace{\sum_\nu \psi_\nu(\underline{x}) \psi_\nu^*(\underline{x}')}_{\delta(\underline{x}-\underline{x}')} \psi(\underline{x}') d\tau' = \psi(\underline{x})$$

$$\hat N = \sum_{\lambda=1}^{\infty} a_\lambda^+ a_\lambda = \sum_{\lambda=1}^{\infty} \int d\tau \int d\tau' \, \psi_\lambda(x) \hat\psi^+(\underline{x}) \psi_\lambda^*(\underline{x}') \hat\psi(\underline{x}')$$

$\delta(\underline{x}-\underline{x}')$

$$= \int d\tau \, \hat\psi^+(\underline{x}) \hat\psi(\underline{x})$$

$$a_\lambda = \int \psi_\lambda^*(\underline{x}) \hat\psi(\underline{x}) d\tau$$