



Mo Tu We Th Fr Sa Su

Memo No.

Date / /

3.5 The Continuum Limit

Continuous Case, $[\alpha_{\vec{p}}, \alpha_{\vec{q}}^+] = \delta^{(3)}(\vec{p} - \vec{q})$

$$\hat{A} = \int d^3 p F_p \alpha_{\vec{p}}^+ \alpha_{\vec{p}}$$

$$\alpha_{\vec{p}} \alpha_{\vec{p}'}^+, \quad \alpha_{\vec{p}} \alpha_{\vec{p}'}^+ - \alpha_{\vec{p}'}^+ \alpha_{\vec{p}} = \delta^{(3)}(\vec{p} - \vec{p}')$$

$$\alpha_{\vec{p}} \alpha_{\vec{p}'}^+ = \delta^{(3)}(\vec{p} - \vec{p}') + \alpha_{\vec{p}'}^+ \alpha_{\vec{p}}$$

$$\langle \vec{p}, \vec{p}' \rangle = \delta^{(3)}(\vec{p} - \vec{p}').$$

$$\langle x \rangle = \int d^3 q \phi^* q(x) |q\rangle$$

$$= \int d^3 q |q\rangle \langle q| x \rangle$$

$$= \int d^3 q \phi^* q(x) |q\rangle$$

$$\rightarrow \langle x | p \rangle = \int d^3 q x(q) \langle q | p \rangle$$

$$= \int d^3 q \phi(q) \delta^{(3)}(\vec{q} - \vec{p})$$

$$= \phi_p(x).$$



Mo Tu We Th Fr Sa Su

Memo No. _____

Date / /

$$\langle p' q' | q p \rangle = \langle 0 | \alpha_p^\dagger \alpha_q^\dagger \alpha_q \alpha_p | 0 \rangle$$

$$\langle p' q' | q p \rangle = \langle 0 | \alpha_p^\dagger \alpha_q^\dagger \alpha_q^\dagger \alpha_p^\dagger | 0 \rangle$$

$$= \cancel{\langle 0 | \alpha_p^\dagger \alpha_q^\dagger \alpha_q^\dagger \alpha_p^\dagger | 0 \rangle}$$

$$= \langle 0 | \alpha_p^\dagger (\delta^{(3)}(q' - q) \pm \alpha_q^\dagger \alpha_q^\dagger) \alpha_p^\dagger | 0 \rangle.$$

⊗

$$= \langle 0 | \alpha_p^\dagger \delta^{(3)}(q' - q) \alpha_p^\dagger | 0 \rangle \pm \langle 0 | \alpha_p^\dagger \alpha_q^\dagger \alpha_q^\dagger \alpha_p^\dagger | 0 \rangle$$

$$= \langle 0 | \delta^{(3)}(q' - q) (\delta^{(3)}(p' - p) \pm \alpha_p^\dagger \alpha_p^\dagger) | 0 \rangle$$

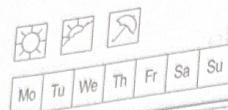
$$\pm \langle 0 | \alpha_p^\dagger \alpha_q^\dagger (\delta^{(3)}(q' - p) \pm \alpha_q^\dagger \alpha_q^\dagger) | 0 \rangle$$

$$= \delta^{(3)}(q' - q) \delta^{(3)}(p' - p) \pm \langle 0 | \delta^{(3)}(q' - p) (\delta^{(3)}(p' - q) \pm \dots) | 0 \rangle$$

$$= \delta^{(3)}(q' - q) \delta^{(3)}(p' - p) \pm \delta^{(3)}(q' - p) \delta^{(3)}(p' - q).$$

$$\langle x y \rangle = \cancel{\int d^3 p' d^3 q' \phi(p')}$$

Memo No.
Date



$$\langle xy | pq \rangle = \frac{1}{\sqrt{2\pi}} \int d^3p d^3q \phi_p(x) \phi_q(y) \langle pq | pq \rangle$$
$$= \frac{1}{\sqrt{2}} [\phi_p(x) \phi_q(y) + \phi_q(x) \phi_p(y)]$$

which is expected.