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1、四次元的化

i) Non-local な場の取扱い.
Non-local, local の間にどこに本質的な違いがあるか.

ii) special Relativity を拡張しない場合の理論としてどういう formulation.

A.

$$\phi(x) = C(x) + \int G(x-y)C^{+}(y)$$

$$[\phi(x), \phi(x')] = \int G(x'-y')[C(x), C^{+}(y')]$$

$$+ \int G(x-y)[C^{+}(y), C(x')]$$

$$= G(x'-x) \mp G(x-x')$$

$$\psi_\alpha(x) = a_\alpha(x) + \int F_{\alpha\beta}(x-y) b^{+}_\beta(y)$$

$$\psi^{+}_{\alpha}(x) = b_\alpha(x) + \int F_{\alpha\beta}(x-y) a^{+}_\beta(y)$$

$$\{\psi_\alpha(x), \psi^{+}_\gamma(x')\} = \int F_{\gamma\delta}(x'-y')\{a_\alpha(x), a^{+}_{\delta}(y')\}$$

$$+ \int F_{\alpha\beta}(x-y)\{b^{+}_\beta(y), b_\gamma(x')\}$$

$$= F_{\gamma\alpha}(x'-x) + F_{\alpha\gamma}(x-x')$$

$$\mathcal{K}(x)\phi(x) = \mathcal{K}(x)C(x) + C^{+}(x)$$

$$\mathcal{D}_{\alpha\beta}(x)\psi_\beta(x) = \mathcal{D}_{\alpha\beta}(x)a_\beta(x) + b^{+}_\alpha(x)$$

(i) $G(x)$: even fn ならば $\phi(x)$ はすべて commutative

$$\phi^{+}(x) = C^{+}(x) + \int G(x-y)C(y)$$

$$[\phi(x), \phi^{+}(x')] = \delta(x-x')$$

$$+ \iint G(x-y)G(x'-y')[C^{+}(y), C(y')]$$

$$= \delta(x-x') - \int G(x-y)G(x'-y)$$

B. $$\phi(x) = \frac{C(x)+C^{+}(x)}{2} + i\int K(x-y)\frac{C(x)-C^{+}(x)}{2}$$

$$[\phi(x),\phi(x')] = \frac{1}{4}\{\underbrace{[C(x),C^{+}(x')]}_{\delta(x-x')} + \underbrace{[C^{+}(x),C(x')]}_{-\delta(x-x')}\}$$

$$+ i\int K(x'-y')\frac{1}{4}\{\delta(x-y')+\delta(x-y')\}$$

$$+ i\int K(x-y)\frac{1}{4}\{\delta(x'-y)+\delta(x'-y)\}$$

$$+0$$

$$= \frac{1}{2}i\{K(x'-x) - K(x-x')\}$$

C.

$$\int F(x-y)\varphi(y)\,dy = 0$$

$$F(x) = \int f(k)e^{ikx}\,dk$$

$$\iint e^{ikx} e^{-iky} f(k)\varphi(y)\,dy\,dk$$

$$\varphi(y) = \int C(k')e^{ik'y}\,dk'$$

$$\iint e^{ikx} C(k')f(k)\,e^{i(k'-k)y}\,dy\,dk$$

$$= \int e^{ikx} C(k)f(k)\,dk$$

$$f(k)C(k) = 0$$

$$f(k) = f(k_n k_n)$$

$$f(\kappa_n^2) = 0 \quad n = 1, 2, \ldots$$

$$\mathfrak{F}(x)\Omega = \int F(x-y)\varphi(y)dy \cdot \Omega = 0$$

$$\chi(x) = \int K(x-y)\varphi^{+}(y)dy$$

$$[\mathfrak{F}(x), \chi(x')] = [\int F(x-y)\varphi(y)dy, \chi(x')] = 0$$

$$F(x-y)K(x'-y'$$