非局所場理論について
(素粒子基礎理論討論会，第二回
5月26日(水), 1954)

1. 非局所場における内部自由度の制限と相互作用
2. ~~Non-linear~~ 非線型性と非局所性.
3. 時空の量子化.

1. 内部自由度の制限が，相互作用の無い考え方の結果か：
一つの場だけ考えた時に(又は linear な non-local field eq. を考えた時に)
色々な mass state が出てくる.
~~[illegible]~~ 幾つかの場との相互作用(又は他の場との相互作用)のある場合には，classical field eq. の解の性格が全く変わる.

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DATE
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1, 非局所場の理論

W. D. Schulz
On the Interaction of Non-local and Local Fields
(Doctor Thesis, Columbia University, 1954.)

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2. 非線形理論との関係

Zur Quantisierung nichtlinearer Gleichungen
(Göttinger Nachrichten 11a (1953), 111)
W. Heisenberg

$$\langle 0 | T\, q(t_1)\, q(t_2)\, \varphi(t_3) | \Phi \rangle = \tau(t_1 t_2, t_3)$$

$$\ddot{q} = -\omega_0^2 q - \lambda q^3$$

$$\frac{d^2}{dt_1^2} \tau_{00}(t_1 t_2 |) = -\omega_0^2 \tau_{00}(t_1 t_2 |) - \lambda \tau_{00}(t_1 t_1 t_1 t_2 |) - i \frac{\hbar}{m} \delta(t_1 - t_2)$$

$\frac{1}{2}\Delta_F$: $\langle 0 | T q(t_1) q(t_2) | 0 \rangle$

$\frac{1}{2}\Delta_1$: $\langle 0 | \frac{q(t_1)q(t_2) + q(t_2)q(t_1)}{2} | 0 \rangle$

$i\Delta$: $\langle 0 | q(t_1)q(t_2) - q(t_2)q(t_1) | 0 \rangle$

$$L = l^{-4} \sqrt{1 + l^4 \left[\sum_\nu \left(\frac{\partial \varphi}{\partial x_\nu}\right)^2 + \kappa^2 \varphi^2\right]}$$

$s = t^2 - r^2$

$\kappa = 0$: $$\varphi = \frac{1}{2l^2} \int_0^s \frac{ds}{\sqrt{s(1+bs^3)}}$$

(Heisenberg, ZS. f. Phys. 133 (1952), 65.

$s \to 0$ $\quad \varphi \to \sqrt{s}$

$$\gamma_\mu \frac{\partial \psi}{\partial x_\mu} = l^2 \mathfrak{J}(\psi \psi^\dagger \psi)$$

$$l^{-2} \gamma_\mu^{(r)} \frac{\partial}{\partial x_\mu^{(r)}} \tau = \mathfrak{J}\left[\frac{1}{2} S_F(x_1 - y_1) \tau(x_2 \cdots x_m x_r | y_2 \cdots y_n x_r)\right]$$

$$+ \cdots$$

$$+ \delta(x_r - y_r) \tau(x_1 \cdots x_{r-1} x_{r+1} \cdots x_m | y_2 \cdots y_n)$$

$$+ \cdots$$

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$$S_1(x-y) = \langle 0 | -\psi(x)\psi^\dagger(y) + \psi^\dagger(y)\psi(x) | 0 \rangle$$

$$S_1(r,t) = \frac{1}{\pi}\int_{-\infty}^{\infty} \frac{dt'}{t'} S(r, t-t')$$

Schwinger
Pauli-Villars Rev. Mod. Phys. 21 (1949), 434

$$\chi_\alpha(x,x') = e^{-i(a_\nu\psi_\nu^\dagger + \tilde{a}_\nu\psi_\nu)}\psi_\alpha(x)\, e^{+i(a_\nu\psi_\nu^\dagger + \tilde{a}_\nu\psi_\nu)}$$

$$\gamma_\mu \frac{\partial \chi_\alpha}{\partial x_\mu} = l^2 J(\psi\psi^\dagger\psi)$$

χ_α : nichtanalytisch auf dem Lichtkegel

$$\chi_\alpha = \chi_\alpha^0(x,x') + C_\alpha(x-x')$$

q-fn

$$\gamma_\mu \frac{\partial C}{\partial x_\mu} = l^2 J(CC^\dagger C) + \kappa(s)\cdot C$$

$$S_{\alpha\nu}(x-x') = \lim_{a_\nu \to 0} \frac{\partial C_\alpha(x-x')}{\partial a_\nu}$$

$C_\alpha(x-x') \to -a_\nu S_{\alpha\nu}^{l.Th}(x-x')$ für große s

$\propto s^{-\frac{1}{4}}$ für $s \to 0$

(unendlich schnell oszilliert)

$$S_1(x-x') = \frac{\kappa^2}{4\pi}\gamma_\mu\frac{\partial}{\partial x_\mu}\mathrm{Im}\Big[\frac{H_1^{(1)}(\kappa\sqrt{s})}{\kappa\sqrt{s}} + \frac{2i}{\pi\kappa^2 s} - \frac{i}{\pi}\lg\frac{\gamma\kappa\sqrt{s}}{2}\Big] - \frac{\kappa^2}{4\pi}\mathrm{Im}\Big[\frac{H_1^{(1)}(\kappa\sqrt{s})}{\kappa\sqrt{s}} + \frac{2i}{\pi\kappa^2 s}\Big]$$

for $s \lessgtr 0$