Title: Lecture - QFT I, PHYS 601

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Subject: Condensed Matter, Particle Physics, Quantum Fields and Strings

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LSZ

scalar $2 \to 2$

step 1 $\langle f|S|i\rangle = \langle \Omega|\, \underline{a_4(+\infty)\, a_3(+\infty)}\; \underline{a_1^\dagger(-\infty)\, a_2^\dagger(-\infty)}\, |\Omega\rangle$

$$a_1 \equiv a_{\vec{k}_1}$$

step 2

fermion particle-particle

$$b_1 \equiv b_{\vec{k}_1}^{s_1}$$

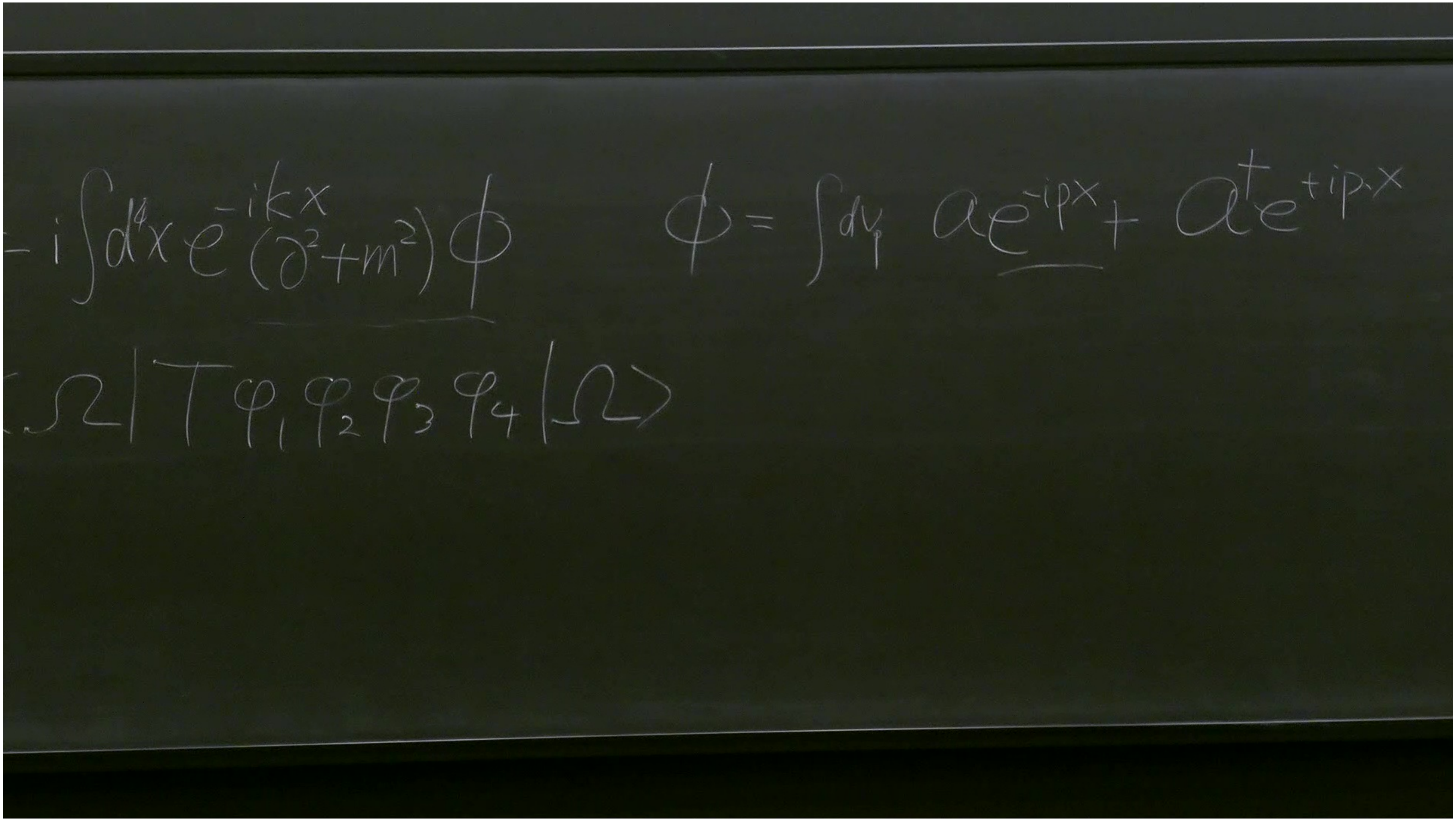
Step 1. $\langle \Omega | b_4(+\infty)\, b_3(+\infty)\, b_1^{\dagger}(-\infty)\, b_2^{\dagger}(-\infty) |\Omega\rangle$

$$|M|^2 \ni \sum_s u^s \bar{u}^s$$

step 2

$$a_1^\dagger(+\infty) - a_1^\dagger(-\infty) \equiv I_1^\dagger = \int_{-\infty}^{\infty} \partial_0 a_1(t) = -i\int d^4x\, e^{-ikx}(\partial^2+m^2)\phi$$

$$\langle f|S|i\rangle = \prod_{i=1}^{4} \int d^4x_i\, e^{-i\lambda_i k_i x_i}(\partial_i^2+m^2)\langle\Omega|T\varphi_1\varphi_2\varphi_3\varphi_4|\Omega\rangle$$


$-i\int d^4x\, e^{-ikx}(\partial^2+m^2)\phi$
$\phi = \int dV_p\, a e^{-ipx} + a^\dagger e^{+ip\cdot x}$
$\langle\Omega| T \varphi_1\varphi_2\varphi_3\varphi_4 |\Omega\rangle$

$$\prod \int d^4x_j \, e^{-ik_i x_i} \underline{(i\not{\partial} - m)}$$

$$\langle \Omega | T \, \psi \psi \bar{\psi} \bar{\psi} | \Omega \rangle$$

$$\prod \int d^4x_i \, (i \overleftarrow{\not{\partial}} + m) \, \underline{e^{-ik_i x'}}$$

$$\int_{-\infty}^{\infty} \partial_0 a_1(t) = -i\int d^4x\, e^{-ik\cdot x}(\partial^2+m^2)\phi \qquad \phi = \int d\tilde{p}\; a e^{-ip\cdot x} + a^\dagger e^{+ip\cdot x}$$

$$^{k_i x_i}(\partial_i^2+m^2)\boxed{\langle\Omega|T\varphi_1\varphi_2\varphi_3\varphi_4|\Omega\rangle}$$

$$= \frac{\langle 0|T\varphi_1\varphi_2\varphi_3\varphi_4 e^{i\mathcal{L}}|0\rangle}{\langle 0|e^{i\mathcal{L}}|0\rangle}$$

no change

$$\langle 0|\psi_1\psi_2\bar{\psi}_3\cdots|0\rangle$$

$$= -\langle 0|\psi_2\psi_1\bar{\psi}_3\cdots|0\rangle$$

$$= -\psi_1\bar{\psi}_3\langle 0|\psi_2\cdots|0\rangle$$

Aprium

$$\langle 0|\psi_1\bar{\psi}_2\psi_3\cdots\rangle$$

$$= -\langle 0|\psi_1\psi_3\bar{\psi}_2\cdots\rangle$$

plum