

# Scattering in Relativistic Quantum Field Theories by Prof. Dingyu Shao

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The vacuum state of a field theory with interaction is given by

$$|\Omega\rangle = \lim_{T \rightarrow \infty(1-i\epsilon)} (e^{-iE_0(t-(-T))} \langle \Omega|0\rangle)^{-1} U(t_0, -T) |0\rangle. \quad (1)$$

Suppose  $x^0 > y^0 > t_0$ , we have

$$\langle \Omega | \mathcal{T}[\phi(x)\phi(y)] | \Omega \rangle$$

$$\langle \Omega | \mathcal{T}[\phi(x)\phi(y)] | \Omega \rangle = \lim_{T \rightarrow \infty(1-i\epsilon)} \frac{\langle 0 | \mathcal{T} \phi_I(x) \phi_I(y) \exp\left(-i \int_{-T}^T dt H_I(t)\right) | 0 \rangle}{\langle 0 | \mathcal{T} \exp\left(-i \int_{-T}^T dt H_I(t)\right) | 0 \rangle} \quad (2)$$