Title: Lecture - QFT I, PHYS 601

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Collection/Series: Quantum Field Theory I (Core), PHYS 601, October 7 - November 6, 2024

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

Date: October 25, 2024 - 9:00 AM

URL: https://pirsa.org/24100034

Interactions

Amuse-bouche of QED $\quad A_\mu \rightarrow A_\mu + \partial_\mu \alpha$

$\underbrace{\qquad\qquad\qquad}_{\text{gauge symmetry}}$

$F^{\mu\nu}F_{\mu\nu}$

$J^\mu = \bar{\Psi}\gamma^\mu\Psi$

$\mathcal{L}_{int} = \bar{\Psi}\gamma^\mu\Psi A_\mu$

$\bar{\Psi}\gamma^\mu\Psi A_\mu$

$$\bar{\psi}\gamma^\mu\psi A_\mu \rightarrow \bar{\psi}\gamma^\mu\psi A_\mu + \underline{\bar{\psi}\gamma^\mu\psi\,\partial_\mu\alpha} \longleftarrow \text{not invariant}$$

gauge the global symmetry (local)

$$\mathcal{L} = \bar{\psi}(i\gamma\!\!\!/ - m)\psi$$

$$\psi \xrightarrow{\partial_\mu} \left(\psi\, \frac{e^{-i\alpha(x)Q}}{\text{global}} \right)^{\text{gauge}}$$

$$\bar{\psi}i\gamma^\mu\partial_\mu\psi = \bar{\psi}\,e^{+i\alpha(x)Q}\,i\gamma^\mu e^{-i\alpha(x)Q}\,\partial_\mu\psi + \bar{\psi}i\gamma^\mu(-i(\partial_\mu\alpha)Q)\psi$$

$$Q\,\bar{\psi}\gamma^\mu\psi\,(\partial_\mu\alpha)$$

$$\mathcal{L} = \bar{\psi}(i\not{\partial} - m)\psi - Q\bar{\psi}A_\mu\gamma^\mu\psi$$

$$= \bar{\psi}(i\not{\partial} - Q\not{A})\psi - m\bar{\psi}\psi$$

$$\mathcal{L}_{QED} = \bar{\psi}(i\not{D} - m)\psi$$

$$D_\mu = \partial_\mu + iQA_\mu$$

apple: rotation symmetry –

: stem
: skin is smooth
: taste sweet or tart

$$\mathcal{L} = \bar{\psi}(i\slashed{\partial} - m)\psi - Q\bar{\psi}A_\mu \gamma^\mu \psi$$

$$= \bar{\psi}(i\slashed{\partial} - Q\slashed{A})\psi - m\bar{\psi}\psi$$

$$\mathcal{L}_{QED} = \bar{\psi}(i\slashed{D} - m)\psi$$

$$\underline{D_\mu = \partial_\mu + iQA_\mu}$$

apple: rotation symmetry -

    : stem

    : skin is smooth X $\longrightarrow$ pineapple

    : taste sweet or tart

detective

PU   4 C3RW YpF

Year 2024

Year 2023   CS Wu   discover cobalt

$$Co \rightarrow Ni + e^- + \bar{\nu}_e + 2\gamma$$

0.003k mirror

mirror
predicts

mystery: what kind of
interactions allow
parity violation.