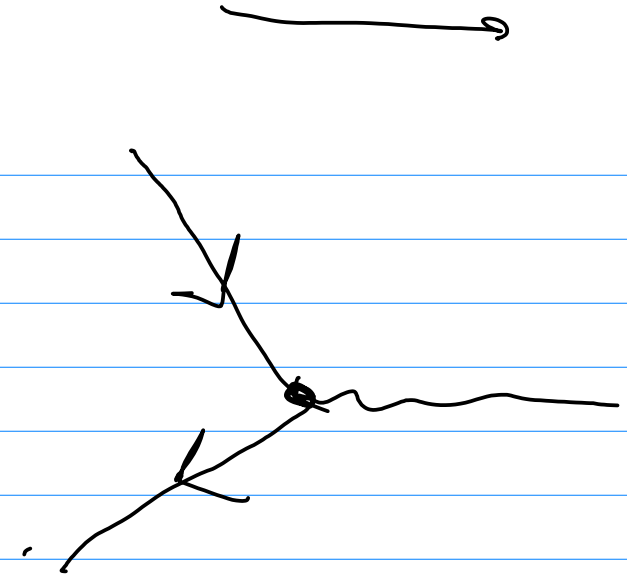

HEP CLASE 04 (20)
LA-CONCA 2022
JAL 2022/03/31

ELECTRODINAMICA

$$-\frac{1}{4} F_{\mu\nu} F^{\mu\nu} - A_\mu J^\mu \leftarrow$$

$$A \to \tilde{A} = A - \partial\chi$$

$$\tilde{F} = F$$

$$\tilde{A}_\mu J^\mu = (A_\mu - \partial_\mu \chi) J^\mu$$

$$= A_\mu J^\mu - \partial_\mu \chi J^\mu$$

$$= A_\mu J^\mu - \partial_\mu (\chi J^\mu) + \chi \underbrace{\partial_\mu J^\mu}_{0}$$

$$\partial_\mu A^\mu = 0$$

$$\tilde{A}^\mu = A^\mu - \partial^\mu \chi$$

$$\partial_\mu \tilde{A}^\mu = \partial_\mu A^\mu - \partial_\mu \partial^\mu \chi$$

$$= 0$$

$$= -\Box \chi = 0$$

$$\bar{\tilde{\psi}} \left(i \gamma^\mu \left(\partial_\mu + i q \tilde{A}_\mu \right) \right) \tilde{\psi}$$

$$\psi = e^{iq\chi} \psi$$

$$\bar{\psi} = e^{-iq\chi} \bar{\psi}$$

$$e^{-iq\chi} \bar{\psi} \left(i \gamma^\mu \left(\partial_\mu + i q \tilde{A} \right) \right) e^{iq\chi} \psi$$

$$e^{-iq\chi} \bar{\psi} i \gamma^\mu \partial_\mu \left(e^{iq\chi} \psi \right) +$$

$$+ e^{-iq\chi} \bar{\psi}\, i\gamma^\mu i q \hat{A}_\mu e^{+iq\chi} \psi$$

$$e^{-iq\chi} \bar{\psi}\, i\gamma^\mu \left(iq\partial_\mu \chi e^{iq\chi} \psi + \right.$$

$$\left. e^{iq\chi} \partial_\mu \psi \right) - \bar{\psi}\, \gamma^\mu q \hat{A}_\mu \psi$$

$$= \bar{\psi} \left(-\gamma^\mu q \partial_\mu \chi + i\gamma^\mu \partial_\mu - \gamma^\mu q \hat{A}_\mu \right)$$

$$= \bar{\psi} \left(-\gamma^\mu q \partial_\mu \chi + i\gamma^\mu \partial_\mu - q\gamma^\mu A_\mu \right.$$

$$\left. + q\gamma^\mu \partial_\mu \chi \right) \psi = i \bar{\psi}\, \gamma^\mu D_\mu \psi$$