CAMPO FOTONICO

$$\mathcal{J}_\nu u(p) = \mathrm{TF}|_y \int d^4x\, d^4z\; e^{ik\cdot x}\, \vec{\Box}_x \langle 0| A_\nu(x)\, \phi(y,x)\, \psi_\gamma(y)\, \bar\psi_\rho(z) |0\rangle\; i\, \overleftarrow{\partial\!\!\!/}_z^{\rho\sigma} e^{-ip\cdot z}\, u_\sigma(p)$$

↳ $\phi = 1$

$$= \mathrm{TF}|_y \int d^4x\, d^4z\; e^{ik\cdot x}\, \vec{\Box}_x \langle 0| A_\nu(x)\, \psi_\gamma(y)\, \bar\psi_\rho(z) |0\rangle\; i\, \overleftarrow{\partial\!\!\!/}_z^{\rho\sigma} e^{-ip\cdot z}\, u_\sigma(p)$$

$$\mathrm{int} = -ie \int d^4t\; \bar\psi_\alpha(t)\, A_\mu(t)\, \gamma^\mu_{\alpha\beta}\, \psi_\beta(t)$$

$$= \mathrm{TF}|_y (-i) \int d^4x\, d^4z\, d^4t\; e^{ik\cdot x}\, \vec{\Box}_x \langle 0| A_\nu(x)\, \psi_\gamma(y)\, \bar\psi_\rho(z)\, \bar\psi_\alpha(t)\, A_\mu(t)\, \gamma^\mu_{\alpha\beta}\, \psi_\beta(t) |0\rangle\, (i)\, \overleftarrow{\partial\!\!\!/}_z^{\rho\sigma} e^{-ip\cdot z}\, u_\sigma(p)$$

$$= \mathrm{TF}|_y\, e \int d^4x\, d^4z\, d^4t\; e^{ik\cdot x}\, \vec{\Box}_x \langle A_\nu(x) A_\mu(t)\rangle \langle \psi_\gamma(y)\bar\psi_\alpha(t)\rangle\, \gamma^\mu_{\alpha\beta} \langle \psi_\beta(t)\bar\psi_\rho(z)\rangle\; \overleftarrow{\partial\!\!\!/}_z^{\rho\sigma} e^{-ip\cdot z}\, u_\sigma(p)$$

$$= \mathrm{TF}|_y\, e \int d^4x\, d^4z\, d^4t\; e^{ik\cdot x}\, \vec{\Box}_x \int d\tilde{k}_1 \left((-i)\frac{g_{\nu\mu}}{k_1^2}\, e^{-ik_1\cdot(x-t)}\right) \int d\tilde{k}_2 \left((i)\frac{\not k_2^{\gamma\alpha}}{k_2^2}\, e^{-ik_2\cdot(y-t)}\right)$$
$$\gamma^\mu_{\alpha\beta} \int d\tilde{k}_3 \left((i)\frac{\not k_3^{\beta\rho}}{k_3^2}\, e^{-ik_3\cdot(t-z)}\right) \overleftarrow{\partial\!\!\!/}_z^{\rho\sigma} e^{-ip\cdot z}\, u_\sigma(p)$$

$$= \mathrm{TF}|_y\, (i)\, g_{\nu\mu} \int d^4x\, d^4z\, d^4t\; d\tilde{k}_1\, d\tilde{k}_2\, d\tilde{k}_3\; e^{-ix\cdot(k_1-k)}\, e^{-ik_2\cdot y}\, e^{-iz\cdot(p-k_3)}\, e^{-it\cdot(k_3-k_2-k_1)}$$
$$\left\{(-)\frac{\not k_2^{\gamma\alpha}}{k_2^2}\, \gamma^\mu_{\alpha\beta}\, (i)\, \delta^\sigma_\beta\right\} u_\sigma(p)$$

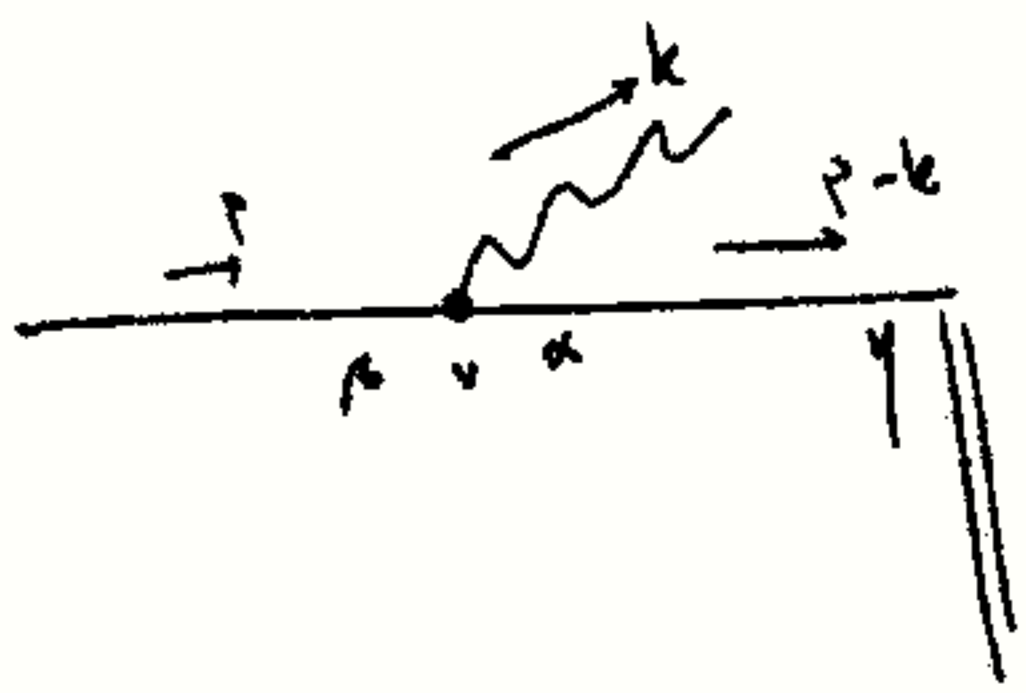
$k_1 = k$
$k_3 = p$

$$= \mathrm{TF}|_y\, e\, g_{\nu\mu} \int d^4t\, d\tilde{k}_2\; e^{-ik_2\cdot y}\, e^{-it\cdot(p-k-k_2)} \left\{\frac{\not k_2^{\gamma\alpha}}{k_2^2}\, \gamma^\mu_{\alpha\beta}\right\} u_\beta(p)$$

$k_2 = p-k$

$$= \mathrm{TF}|_y\, e\, g_{\nu\mu}\; e^{-i(p-k)\cdot y} \left\{\frac{(\not p-\not k)^{\gamma\alpha}}{(p-k)^2}\, \gamma^\mu_{\alpha\beta}\right\} u_\beta(p)$$

$$= \mathrm{TF}|_y\, e\; e^{-i(p-k)\cdot y}\, \frac{(\not p-\not k)^{\gamma\alpha}}{(p-k)^2}\, \gamma_\nu^{\alpha\beta}\, u_\beta(p)$$



Controllo diagrammatico:

$$i\,\frac{(\not p-\not k)}{(p-k)^2}\,(-ie\gamma_\nu)\, u(p) = e\,\frac{(\not p-\not k)}{(p-k)^2}\,\gamma_\nu\, u(p)$$