polarisation vectors

$$\varepsilon_+^\mu(p,q) = \frac{[p\,\sigma^\mu\, q\rangle}{\sqrt{2}\langle pq\rangle}$$

q is arbitrary ref vector $q^2 = 0$

$[p|$ spinor phase $+\frac{1}{2}$

$\frac{1}{\langle p|}$ spinor phase $+\frac{1}{2}$

overall spin $+1$

gauge choice:

light like axial gauge

$$\sum_{h=\pm} \varepsilon_h^\mu(p,q)\, \varepsilon_{-h}^\nu(p,q)$$

$$= -g^{\mu\nu} + \frac{p^\mu q^\nu + p^\nu q^\mu}{p\cdot q}$$

$$p^\mu \longrightarrow |p\rangle [p|$$

$$p^\mu = \frac{1}{2}\langle p|\bar{\sigma}^\mu|p]$$

$$(\bar{\sigma}\cdot p)_{\alpha\dot{\alpha}} = {}_\alpha|p\rangle[p|_{\dot{\alpha}}$$

$\times\ \sigma^{\dot{\alpha}\alpha\mu}$

$$\Rightarrow (\bar{\sigma}\cdot p)\sigma^{\mu\dot{\alpha}\alpha} = [p|\sigma^\mu|p\rangle$$

$$= 2p^\mu$$

$$(\bar{\sigma}\cdot p)\sigma^{\mu\dot{\alpha}\alpha} = \bar{\sigma}^\nu_{\alpha\dot{\alpha}} p_\nu \sigma^{\mu\dot{\alpha}\alpha}_\alpha$$

$$\not{p}\, u(p) \;\to\; \bar{u}(p)\, \not{p}$$

$$p_\mu \sigma^\mu |p\rangle \;\to\; \langle p| \bar{\sigma}^\mu p_\mu$$

$$p_\mu\, \sigma^{\mu\,\dot{\alpha}\alpha}\, {}_\alpha|p\rangle \;\to\; \langle p|^\alpha\, \bar{\sigma}^\mu_{\alpha\dot{\alpha}}\, p_\mu$$

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spinors @ mathematica

free mathematica package
for spinor-helicity.

$$\frac{1}{(2k\cdot p)^{\alpha}}$$

$F(s_1, \dots, s_n) \to$ n-1 ratios $\frac{s_1}{s_n}, \dots, \frac{s_{n-1}}{s_n}$

$$F(m^2, p^2) = \underline{(m^2)}^{\frac{d-4}{2}} \tilde{F}\left(\frac{p^2}{m^2}\right)$$

$$\frac{\partial}{\partial p^2} \sim \frac{\partial}{\partial m^2}$$

$F(s_1 \dots s_n)$ homogeneous

$$F(\lambda s_1, \dots, \lambda s_n) = \underline{\lambda}^{\alpha} F(s_1, \dots, s_n)$$

$$\left(s_1\frac{\partial}{\partial s_1}+s_2\frac{\partial}{\partial s_2}+\dots+s_n\frac{\partial}{\partial s_n}\right)F = \underline{\alpha F}$$

Euler Scaling Relation

@ 1 Loop

$$\int D^d k \; \underbrace{f(k)}_{} \qquad\qquad f(\lambda k) = \lambda^\alpha f(k)$$

$$\int D^d k \; f(\lambda k) = \lambda^\alpha \int D^d k \; f(k)$$

$$\Downarrow$$

$$k'_\mu = \lambda k_\mu$$

$$D^d k = \lambda^{-d} D^d k'$$

$$\lambda^{-d} \int D^d k' \, f(k') = \lambda^{\alpha} \int D^d k \, f(k)$$

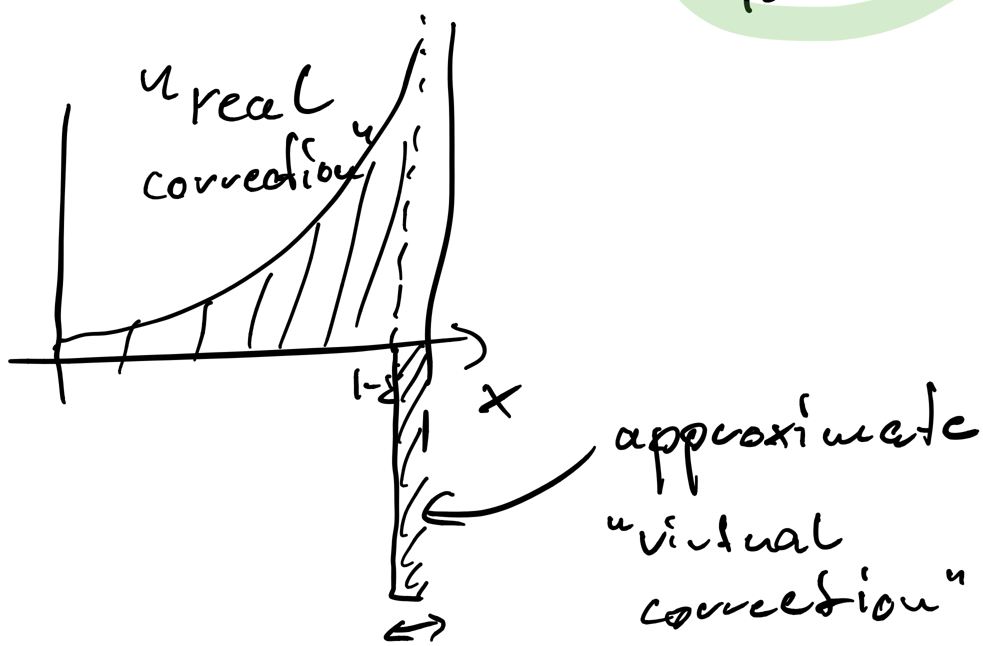
- $\alpha = -d$
- $\int D^d k \, f(k) = 0$!

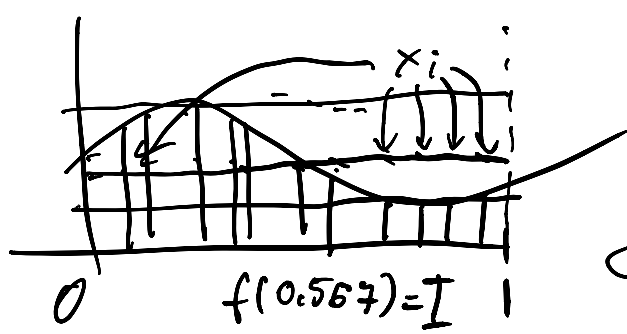
SCALELESS INTEGRALS IN DIM. REG. ARE ZERO!

$$\sum_{b=q,g} \int dx \, x \, \hat{P}_{ab}(x) = 0 \qquad P_{qq}(z) = C_F\left(\frac{2}{1-z} - (1+z)\right)$$

↑ unitarity

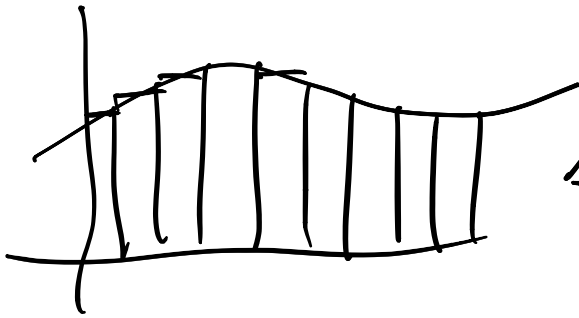
$$\hat{P}_{ab}(x) = \lim_{\varepsilon \to 0}\left[P_{ab}(x)\,\theta(1-\varepsilon-x) - \delta_{ab}\,\frac{\theta(x-1+\varepsilon)}{\varepsilon}\sum_{c=q,g}\int_0^{1-\varepsilon} dz\, z\, P_{ac}(z)\right]$$





$f(x_i)$

$$\sigma = \sqrt{\frac{\langle f^2\rangle - \langle f\rangle^2}{N-1}}$$



$$\frac{1}{\Delta x}\sum_{\text{bins}} f(\bar{x}_i)$$