Vacuum in the front form of QFT

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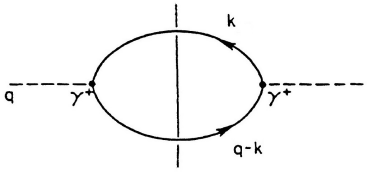
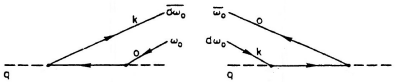
Summary: vacuum → cutoff → counterterms → gluon mass → hadrons

SVZ QCD sum rules
on the light front
SDG, PRD 38,3277 (1988)

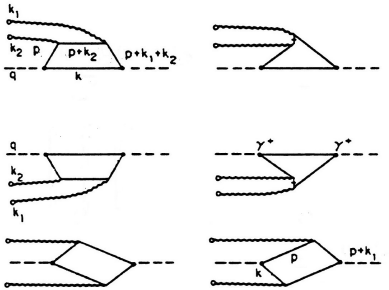
$$\psi_t = \psi + \omega, \quad A_t = A + a$$



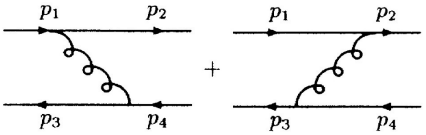


$$a^\mu = \tfrac{1}{2} x_\rho (f_0^{\rho\mu} + \bar{\eta}^\mu f_0^{+\rho} + \bar{\eta}^\rho f_0^{+\mu}) + O(x^2)$$

$$\omega = \omega_0 + x_p d^\rho \omega_0 + O(x^2)$$



counterterms
Wilson et al.
PRD49,6720(1994)



$$p_g^+ > \epsilon$$

SRG

$$4g^2 T^a_{\alpha_3\alpha_1} T^a_{\alpha_4\alpha_2} \delta_{s_1 s_3} \delta_{s_2 s_4} \frac{2m^2}{\epsilon} \frac{(p_{1\perp} - p_{3\perp})^2}{[(p_{1\perp} - p_{3\perp})^2 + m^2][(p_{1\perp} - p_{3\perp})^2 + m_G^2]} \delta(p_1^+ - p_3^+)$$

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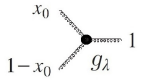
M. Gómez-Rocha, SDG
PRD 92, 065005 (2015)

RGPEP

$$q_t = \mathcal{U}_t\, q_0\, \mathcal{U}_t^\dagger$$

$$H_t' = [\mathcal{G}_t, H_t]$$

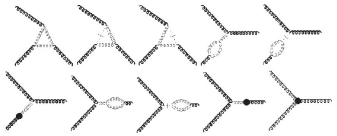


$$t = \lambda^{-4} \quad g_\lambda = g_0 - \frac{g_0^3}{48\pi^2} N_c [11 + h(x_0)] \ln \frac{\lambda}{\lambda_0}$$

$$r_\delta(x) = x/(x+\delta) \qquad h(x_0) = 12\left[3 + \frac{1 - x_0 - x_0^2}{(1-x_0)(1-2x_0)} \ln x_0 + \frac{(1-x_0)^2 - x_0}{x_0(1-2x_0)} \ln(1-x_0)\right]$$

$$r_\delta(x) = \theta(x-\delta) \qquad h(x_0) = 12 \ln \min(x_0, 1-x_0)$$

$$r_\delta(x) = x^\delta \theta(x-\epsilon) \qquad h(x_0) = 0$$



vacuum condensate → in-hadron condensate → effective Fock space (RGPEP) → mass ansatz

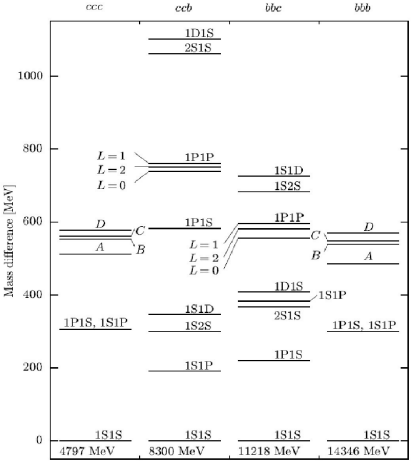
K. Serafin et al.
arXiv:1805.03436
PL B773, 172 (2017)

RGPEP

gluon mass

$$\begin{bmatrix} H_{t0} + g^2 H_{t2} & g H_{t1} \\ g H_{t1} & H_{t0} + g^2 H_{t2} \end{bmatrix} \begin{bmatrix} |3Q_t\, G_t\rangle \\ |3Q_t\rangle \end{bmatrix} = E \begin{bmatrix} |3Q_t\, G_t\rangle \\ |3Q_t\rangle \end{bmatrix}$$

$$\begin{bmatrix} H_{t0} + \mu_t^2 & g H_{t1} \\ g H_{t1} & H_{t0} + g^2 H_{t2} \end{bmatrix} \begin{bmatrix} |3Q_t\, G_t\rangle \\ |3Q_t\rangle \end{bmatrix} = E \begin{bmatrix} |3Q_t\, G_t\rangle \\ |3Q_t\rangle \end{bmatrix}$$



Literature guide to vacuum in the RGPEP

SDG, PRD **38**, 3277 (1988) - SVZ vacuum in LF QCD
K. G. Wilson *et al.*, PRD **49**, 6720 (1994) - LF vacuum and counterterms in QCD
SDG, K. G. Wilson, PRD **57**, 3558 (1998) - bound states from as. free Hamiltonians
SDG, PRD **63**, 116006 (2001) - effective dynamics of gluons in the RGPEP
SDG, T. Masłowski, PRD **65**, 065011 (2002) - eff. Poincaré algebra in the RGPEP
SDG, APPB **42**, 1933 (2011) - the RGPEP vacuum condensate → hadron condensate
SDG, APPB **43**, 1843 (2012) - new non-perturbative formulation of the RGPEP
SDG, PRD **87**, 125032 (2013) - fermion mass mixing without vacuum in the RGPEP
M. Gómez-Rocha, SDG, PRD **92**, 065005 (2015) - as. freedom with the new RGPEP
SDG, M. Gómez-Rocha, J. More, K. Serafin, PLB **773**, 172 (2017) - condensate → mass
K. Serafin, M. Gómez-Rocha, J. More, SDG, arXiv:1805.03436 - gluon mass → baryons

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