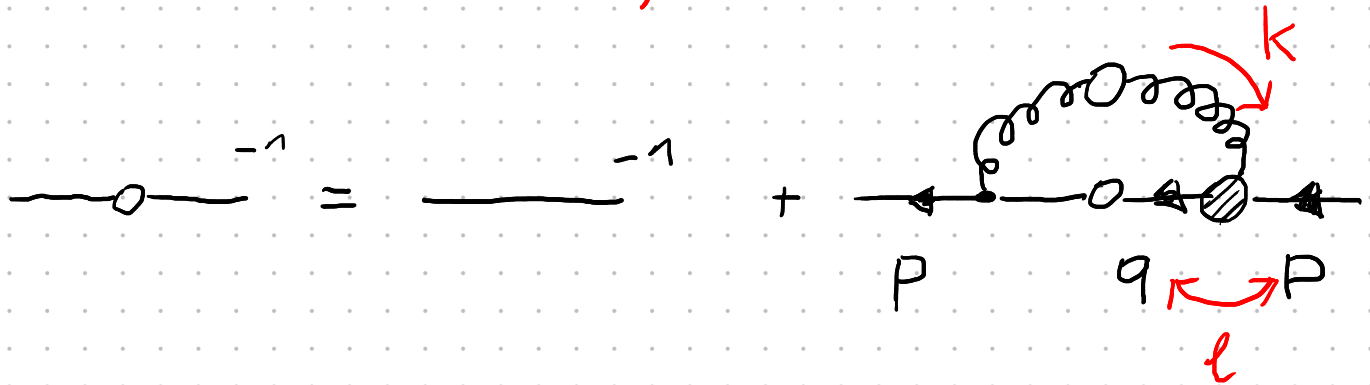


Preliminary Work



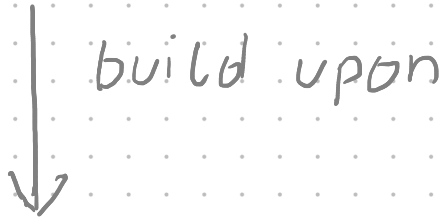
[Hadron Physics with functional methods; Project 1: Quark DSE]

on "The Quark Propagator
for Timelike Momenta"

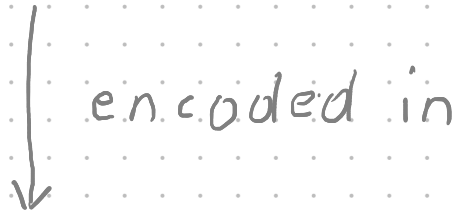
Felix Halbwedl

Why Quark Propagators?

Hadron Properties (mass, lifetime, scattering form factor)

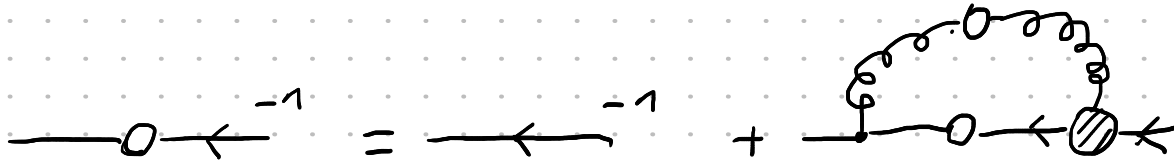


Quark Properties



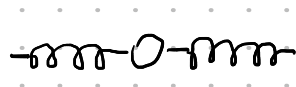
Quark Propagator

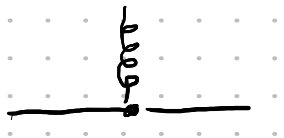
Quark DSE



The diagram shows the Dyson-Schwinger equation for the quark propagator. On the left is a dressed quark propagator, represented by a horizontal line with an open circle in the middle and an arrow pointing to the left, with a superscript -1 above it. This is equal to the sum of two terms. The first term is a bare quark propagator, represented by a horizontal line with an arrow pointing to the left and a superscript -1 above it. The second term is a loop diagram where a horizontal line with an arrow pointing to the left enters a shaded circle vertex from the right. From this vertex, a gluon line (represented by a curly line) goes up and then forms a loop with another shaded circle vertex. From this second vertex, a gluon line goes down and back to the first shaded circle vertex. The line then continues to the left from the first shaded circle vertex.

 $S(q)$... dressed quark propagator

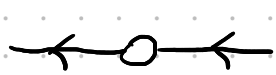
 $D^{\mu\nu}(k)$... dressed gluon propagator

 $gZ_1 i\gamma^\mu$... tree-level quark-gluon vertex

 $g\Gamma^\mu(l, k)$... full quark-gluon vertex

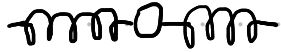
Dressing Functions

dressing functions tensor structures



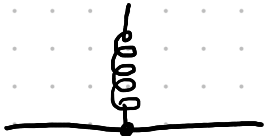
$$\sigma_v(p^2), \sigma_s(p^2)$$

$$-i\not{p}, \mathbb{1}$$



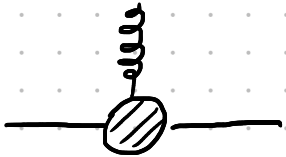
$$Z(k^2)$$

$$T_k^{\mu\nu}$$



$$1$$

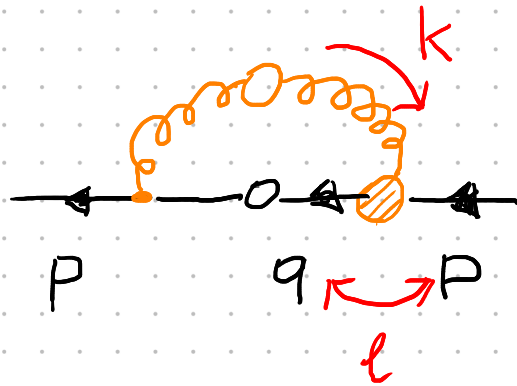
$$i\gamma^\mu$$



$$f(k^2)$$

$$i\gamma^\mu$$

Marys-Tandy Model





$$\begin{aligned} Z(k^2) &\rightarrow \alpha(k^2) \\ f(k^2) &\rightarrow \alpha(k^2) \end{aligned}$$

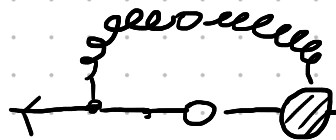
$$\alpha(k^2) \sim \underbrace{k^4 e^{-k^2}}_{k \ll} + \underbrace{(\ln(k^4))^{-1}}_{k \gg}$$

Dressing Functions II

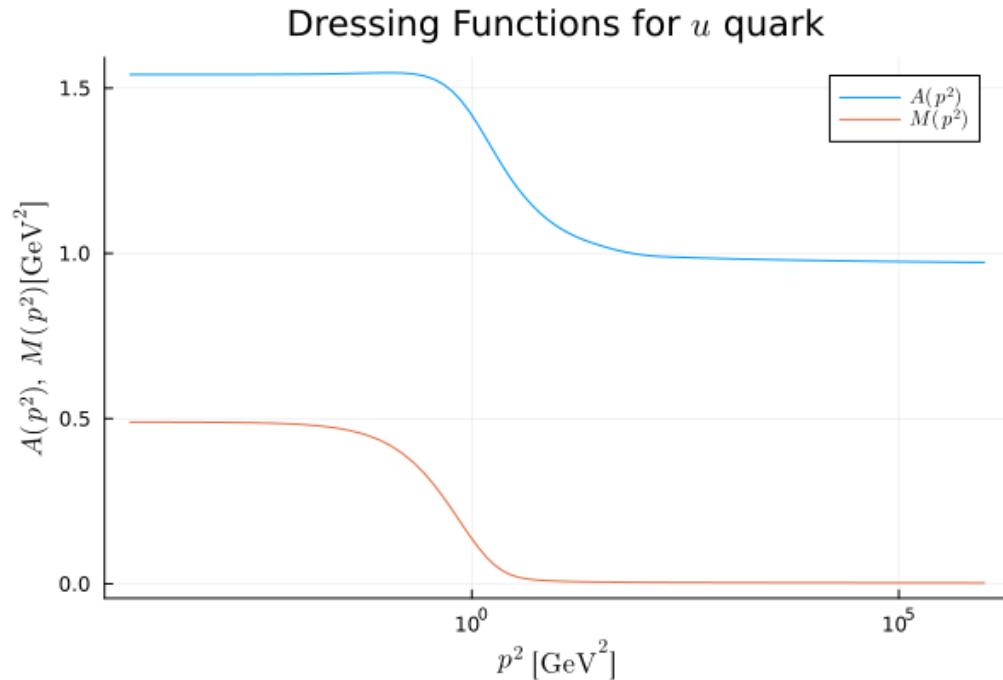
dressing functions tensor structures

 $1, m$ $i\not{p}, \mathbb{1}$

 $A(p^2), A(p^2)M(p^2)$ $i\not{p}, \mathbb{1}$

 $\Sigma_a(p^2), \Sigma_m(p^2)$ $i\not{p}, \mathbb{1}$

Results



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