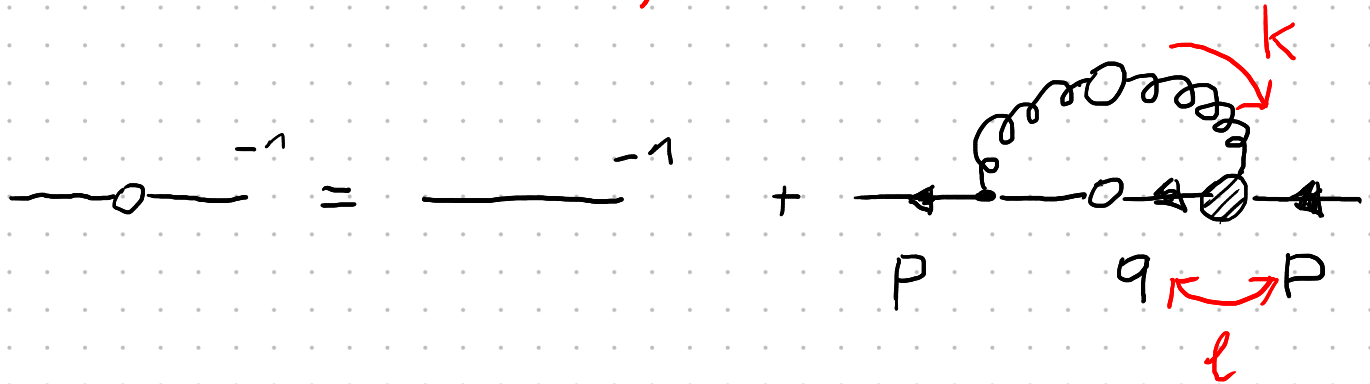


# Preliminary Work



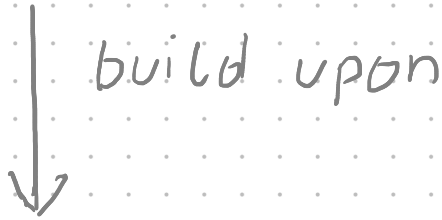
[Hadron Physics with functional methods; Project 1: Quark DSE]

on "The Quark Propagator  
for Timelike Momenta"

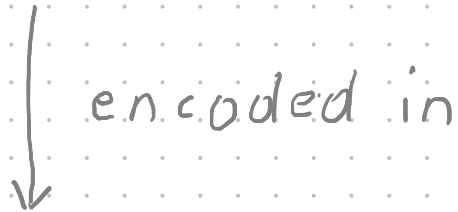
Felix Halbwedl

# Why Quark Propagators?

Hadron Properties (mass, lifetime, scattering form factor)



Quark Properties

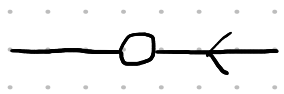


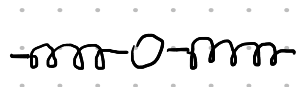
Quark Propagator

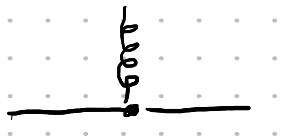
# Quark DSE



The diagram shows the Dyson-Schwinger equation for the quark propagator. On the left is a bare 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 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. The second term is a loop diagram representing a self-energy correction. It consists of a horizontal line with an open circle in the middle and an arrow pointing to the left, with a superscript  $-1$  above it. This line is connected to a shaded circle (representing a quark-gluon vertex) on the right. From this shaded circle, a gluon line (represented by a wavy line) goes up and then loops back down to the open circle on the left, forming a loop.

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

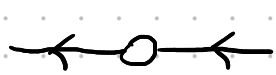
  $D^{\mu\nu}(k)$  ... dressed gluon propagator

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

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

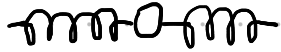
# Dressing Functions

dressing functions      tensor structures



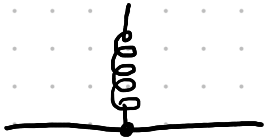
$$\sigma_v(p^2), \sigma_s(p^2)$$

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



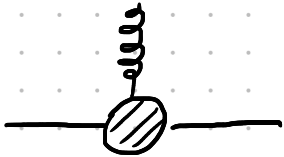
$$Z(k^2)$$

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



$$1$$

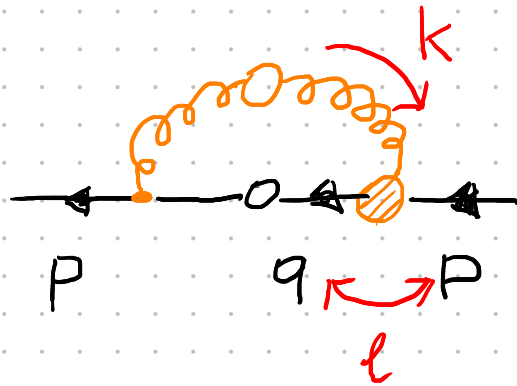
$$i\gamma^\mu$$



$$f(k^2)$$

$$i\gamma^\mu$$

# Marys-Tandy Model





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

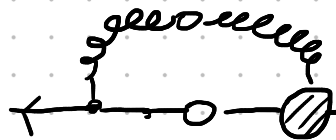
$$\alpha(k^2) \sim \underbrace{k^4 e^{-k^2}}_{k \ll} + \underbrace{(\ln(k^4))^{-1}}_{k \gg}$$

# Dressing Functions II

dressing functions tensor structures

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

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

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

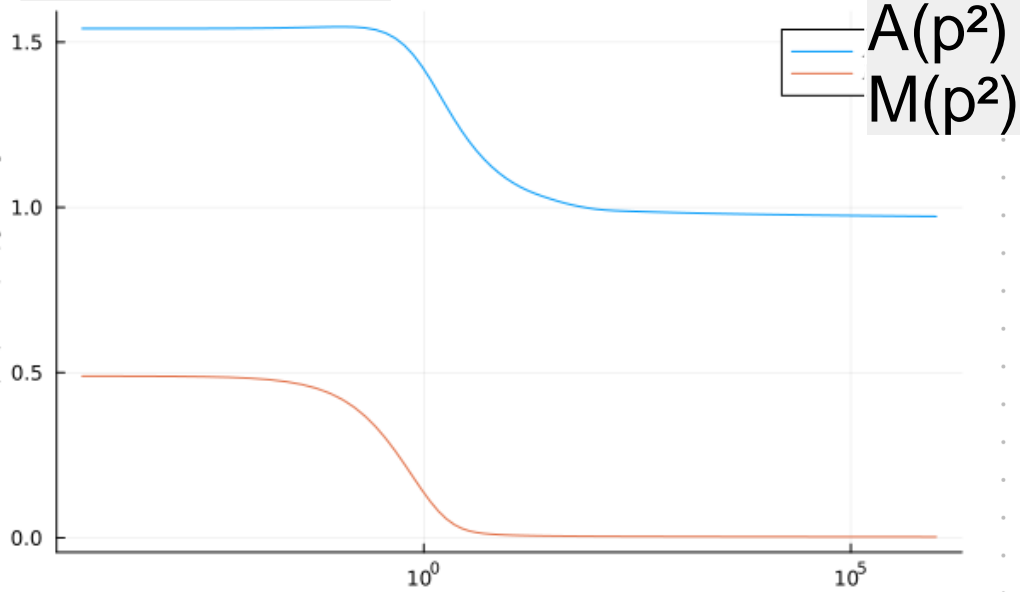


# Results

Wine tasting

Functions for  $u$  quark

Wine tasting



Wine tasting

Felix Halbwedl